Comments received on Public Draft Third National Climate Assessment

The National Climate Assessment and Development Advisory Committee (NCADAC) released a draft report in January 2013 for a 90-day public comment period. During the public comment period, commenters provided input via a web-based system. A panel of the National Academies also reviewed the report and published a consensus review, as well as an appendix of individual comments that are included here. In total, 4161 comments were received during the review period.

Author teams considered each comment, provided responses, and revised the report. A set of 41 independent Review Editors evaluated the responses to comments to confirm that the authors had read and considered all review comments and provided adequate written responses.

All commenter identities were hidden from the authors, NCADAC members, Review Editors, and staff throughout the review and revision process to ensure anonymous review. All commenters consented that their names would be published with their comments when the report was final.

This file includes the comments received during the 90-day public comment period and responses. NOTE: the full report underwent several rounds of review after these responses were complete, and changes may have been made that are not reflected here.

First Name	Last Name	Comment received on Public Draft Third NCA during Public Comment Period, January 14-April 12, 2013	Chapter	Figure/ Table Number	Start Page	Start Line	Response
Gail	Zawacki	Chapter 7, Forestry.It is astonishing that there are only two references to the damage done to forests by air pollution, and none to nitrogen overfertilization or acid rain, since these are the major threats to forest health. Tropospheric ozone is well-known to be toxic to plants, and the background level is inexorably rising. Forests are in decline globally. Localized drought from climate change and species-specific pathogen attacks from insects, disease and fungus cannot account for the accelerating rate of tree death across species and habitats everywhere in the world. Controlled fumigation experiments and hundreds of published research papers have demonstrated that plants whose immunities are weakened from ozone are more susceptible to opportunistic insect, disease and fungus. Likewise, is is equally well understood by the scientific community that plants - whether annual crops or native trees - under current ambient concentrations of ozone must allocate energy to repair damage to foliage, thus robbing root systems of nutrients, making vegetation more vulnerable to drought and wind-throw.This Chapter is doubly egregious because it makes two other ludicrous propositions. One is that climate change can be ameliorated through reforestation. New trees aren't going to grow if the US doesn't lead the world in a radical reduction of emissions of precurosors to ozone by drastic measures such as rationing fuel, if need be. And yet Chapter 7 also endorses the burning of "biomass", which, aside from its association with the obscenity of clear cutting timber, will only ADD to the emission of ozone precursors.With foresters endorsing the logging and burning of trees it's no wonder air pollution is downplayed in this analysis, which is so flawed as to be disingenuous.References:blog: http://witsendnj.blogspot.com/book (free download): http://www.deadtrees-dyingforests.com/pillage-plunder-pollute-llc/	7. Forestry				We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information to include.
Joe	Lalonde	Our planet is in constant changes and no repeating pattern exists. From planetary slowdown to distance differences to the sun and also the suns differing strengths, this planet has always been in change. Many areas were not covered by scientists of the past due to the lack of technological advances. This made understanding our planet very difficult along with the bias of the day of government and religious involvement. The mechanical component of planetary study is sorely lacking to be explored. The vast velocity differences along with planetary tilting angle of the sun's energy has NOT been covered. Many difference of regions and even hemispheres have distinct differences by movement of weather that does NOT cross the equatorial region.	Introduction: Letter to the American People				The cycles the commentor refers to generally occur on 100,000 year time frames…the changes we are observing are happening within decades; Milankovich theory can't explain current trends; We have proxy data going back 100 MY that give us the context within which we are evaluating the changes we are seeing. We have added more information on the accumulating evidence and increased certainty that the only explanation for the warming observed now is human activities.
Joe	Lalonde	There is a vast distance of data numbers which should be vastly lower due to the current model scientists are using.The past NEVER recorded how many hours of temperature differences... Low temperatures are sometimes sporadic at night when society mostly sleeps. The anomaly temperatures do NOT tell how long in the 24 hour period that the anomaly temperature was occurring. This would indicate the whole 24 hours to be of anomaly and not possibly a few hours. Yet still all of	1. Executive Summary				Thanks for your comment. There are multiple sources of proxy climate records that allow analysis of past temperatures.

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		the 24 hours is used in graphs for a single day. What happened to the hours of temperatures that were not an anomaly in that day?					
Sandra	Lewis	This is a lovely writ about yesterday's news. We sounded the alarms for major cuts AsSoonAsPossible. Lacks urgency	Introduction: Letter to the American People		1		We appreciate your concern but this is a scientific assessment, not a policy document.
James	Luscher	"Source:" is left blank (omitted).	Appendix: The Science of Climate Change		1156	5	Source added to the text.
Tom	Barron	Chapter #2 of the report includes notes regarding how confident the authors are regarding each of their findings. For example, see page 72 of the draft.I think that it would be helpful for these confidence indicators for each finding to also appear in the executive summary (pages 8 - 10).	1. Executive Summary				The intent of the Executive Summary is to give a high level view of the authors' findings. It is difficult to include such fine-grained information in a summary.
Randy	Bryan	Based on many conversation with friends and colleagues, I find a remarkable lack of education on Climate Change and its Human causes. After a brief read of the Executive Summary, I find that the Subjects of Climate Change and Human causes are handled inadequately. Especially in the Summary, I would recommend a discrete discussion with charts that show how we know the US/Earth is warming. And a separate discussion with evidence that shows how we know it is human caused. This second point is key and is the least understood by many in the public. All the discussions and proposals that follow presume agreement with the premise that we have Climate Change and that it is Human caused. But, I contend you have failed to show a convincing case for the 2 key elements, and that makes all that follows "ring" hollow. Please make the case more clearly, so I have an educational document that I can send to those who are open to further education. Thank you.	1. Executive Summary				An additional paragraph and some graphic has been added to the Executive Summary to emphasize the evidence underlying these conclusions.
James	Luscher	The labeling on the upper/lower graphs in figure 34 is confusing. After some thought, it appears that the "green" and "blue" lines represent the SAME scenario - although they have different lables (which seem to conflict ! - i.e. "80% LESS EMISSIONS" <=> "STABLE CONCENTRATION" (identical scenario?) seen to conflict with labeling: "STABLE EMISSIONS" <=> "INCREASING CONCENTRATION".It seems to me (my interpretation of what is being said) that the claim is that an 80% reduction in emissions result in stable concentration, but the switching of labels between graphs (for the same scenario?) make this uncertain.Equally confusing is the two separate lines labeled "INCREASING CONCENTRATION" (obvious from the slope!) - which I would guess differ by	Appendix: NCA Climate Science - Addressing Commonly Asked Question	34	1114		The green and blue lines refer to two very different scenarios: one where emissions stablize (and concentrations continue to increase), and one where emissions are reduced (and concentrations stabilize). We recognize this is a difficult concept and have attempted to clarify these differences further in the figure

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		scenario - but without a COLOR KEY for the lines require one to make a subjective judgement on what is represented.	s from A to Z				caption.
Tricia	Knoll	Thank you for doing this important scientific work. Many of us are anxious -- not just for the final report -- but for the broadest possible distribution of the information: engaging the media, guiding policy with important legislative actions to curb climate change. We're anxious too because many of us fear it may even be too late for people to engage in this, but I am both grateful for your work and urging you to do your best to see that mainstream media pick it up.	Introduction: Letter to the American People				Thank you for your comment; the final version of this report will be released electronically, which should facilitate greater access to the findings.
Neal	Dorst	This figure was created to prejudice the reader to assume a close relationship between two independent variables that may not exist. The limits of the vertical axes were selected to make the two values appear to track each other. The time limit of the horizontal axis was also selected to emphasize this seeming relationship. However, a long time axis would not have supported this, so the limits of the graph seem to have been selected to influence the reader to make an unsupported assumption. Also there is no mention that the datasets used were not homogenous across the time scale. Obviously, the network of temperature observations has changed and expanded considerably over the 130+ years of this plot. Also actual CO2 measurements from Mauna Loa are only available since 1955, so some sort of proxy must've been used for earlier values, but this is not disclosed to the reader. The exact same data could be replotted using different axes and the reader would not discern any relationship between CO2 and Global Temperature. Why were these values chosen except to lead the reader to assume what has not been proven?	2. Our Changing Climate	2.2	31		We have added a section on attribution to this section of the chapter, which demonstrates the clear relationship of the temperature changes with greenhouse gases over the last 50 years. This provides the basis for the figure. Versions of this figure have been shown many times before in other publications; it does provide a useful message relative to the attribution studies. Only by distorting the role of CO2 in climate by showing it as a relative percentage of the atmosphere would this message be lost.
Neal	Dorst	Granted the Kossin study only covered the period 1984 onwards, but this leads to misleading conclusions about the graph of Atlantic hurricane activity. The mid1980s were a well know period of reduced Atlantic tropical cyclone activity. Starting the graph at that point and ending in a period of enhanced tropical activity naturally results in a sharp upward trend. Nowhere in the caption nor the body of the report is it made clear that this increase in PDI or major hurricane numbers is mostly due to multi-decadal changes that have very little to do with long-term global climate change. The Kossin paper includes similar graphs of many basins around the world many of which show either a negative or null trend over this period. Since we are discussing Global climate change, why not address the lack of increase Global tropical cyclone activity?	2. Our Changing Climate	2.23	61		The assessment is not making any claims that there is a detectable human influence on tropical cyclones. The graphs focus on the Atlantic and NE Pacific basin as those are basins most germane to the US National Climate Assessment. The data from about 1980 on are regarded as best quality for intensity, with data from about 1970 on also probably more reliable than that back to 1950. Since no claim is being made as to a detection of an anthropogenic signal, we see no reason to change the figure along the lines suggested by the reviewer.
Neal	Dorst	Again the reader is being pushed to a conclusion by the choice of variable used. By using a percentage change for each category the reduction in overall number of tropical cyclones is de-emphasized while the relatively small numbers of Cat 4 &5 hurricanes is amplified. Why weren't absolute numbers used instead of per centages? Because the reader would then see the reduced total numbers versus a minor	2. Our Changing Climate	2.24	62		Category 4-5 hurricanes are much more important for hurricane damage potential than tropical storms. The decision to use a plot which

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		increase in major storms.					emphasizes the behavior of the more intense (and important for impacts) storms was deliberate and entirely appropriate.
George	Hart	This report and the sustained assessment process that is being developed represent steps forward in advancing our understanding of that challenge and its far-reaching implications for our nation and the world. COMMENT: The sentence makes no sense. Suggest: This report and the sustained assessment process that is being developed represents steps forward in advancing our understanding and its far-reaching implications for our nation and the world.	Introduction: Letter to the American People		2	1	Thank you for the suggestion. The text referencing the sustained assessment has been removed from the Letter.
Neal	Dorst	The opening sentences of this section do not clearly state that the sea temperature changes which influence Atlantic hurricane activity the most are part of a periodic, multi-decadal fluctuation is ocean temperature which is independent of any global climate change. The reader is misled into concluding that the increase in Atlantic hurricane activity from the 1970s is due to such climate change and not to a well-known oscillation which had its nadir in that period. There is no reference to the earlier active period in the Atlantic (1930s-1960s) which were as active as the present (adjusting for under-reporting in the pre-satellite era.) This would've undermined the Reports emphasis on blaming all changes on long-term climate. Also this section attempts to lightly skip over the fact that Global tropical cyclone activity shows no upward trend. If we are discussing a Global climate change, this ought to be addressed.	2. Our Changing Climate		59	17	The Hurricane KM has been revised substantially, and now includes statements that explicitly acknowledge natural variations and the Atlantic Multidecadal Oscillation as possible factors in an attribution issue that is an active area of research.Our goal here was to focus on the observed changes since the 1970s. We have shored up the text to be more clear and emphatic about attribution. Questions about previous periods of high activity in the Atlantic, data quality, and the fidelity of century-scale trends have been addressed a number of times in a number of reports, including the AR5 now in progress. To address these again here would serve little purpose. Instead we have chosen to focus on the highly active research topics related to the relative contributions of natural internal and external forcing on the observed tropical Atlantic climate variability. This brings in discussions of regional aerosol forcing as well as the ideas of local vs. remote SST changes. These topics are highly relevant for assessing past and projected changes in Atlantic TCs, and this is where we are focusing. Additional references and discussion of active research areas have been added.

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Oliver	Manuel	Comment on entire Chapter 29: Establish a scientific basis for identifying anthropologic global warming (AGW) by first inserting at the top of the current list of Research GoalsResearch Goal 0: Address literally hundreds of experimental data and observations [1-5 and references] that show Earth's heat source is and has been manically changing and evolving since birthing the entire solar system five billion years (5 Gyr) ago.This foundation is required to establish a scientific basis for AGW.With kind regards, Oliver K. Manuel Former NASA Principal Investigator for Apollo1. Peter Toth, "Is the Sun a pulsar?" Nature 270, 159-160 (1977): http://www.nature.com/nature/journal/v270/n5633/abs/270159a0.html2. Nigel Calder, The Manic Sun: Weather Theories Confounded (1997): http://www.amazon.com/Manic-Sun-Weather-Theories-Confounded/dp/18990441163. O. Manuel, C. Bolon, M. Zhong and P. Jangam, "The Sun's origin, composition and source of energy," 32nd Lunar & Planetary Science Conference, paper 1041 (March 2001): http://www.omatumr.com/lpsc.prn.pdf4. Curt Suplee, "The Sun: Living with a stormy star," National Geographic Magazine (July 2004): http://ngm.nationalgeographic.com/ngm/0407/feature1/index.html5. Oliver K. Manuel and Alberto Boretti, "Yes, the Sun a pulsar," Nature (submitted 12 Dec 2012): http://dl.dropbox.com/u/10640850/Yes_the_Sun_is_a_pulsar.pdf	29. Research Agenda for Climate Change Science				Thank you for the suggestion, but this comment is inconsistent with the author team's thorough assessment of the science. Additional text on the attribution of climate change to human activities has been added to the Climate Science chapter.
George	Hart	Along much of the coast in the Northwest, tectonic uplift reduces apparent sea level rise below the currently observed global average, though a major earthquake in the subduction zone, expected within the next few hundred years, would immediately reverse centuries of uplift and increase relative sea level about 40 inches or more (Atwater and Yamaguchi 1991; NRC 2012). COMMENT: Stating that something would means it will happen and I am afraid that is pure speculation on the authors part. I would suggest using the word could or should as there are too many unknown factors to be that definitive.	21. Northwest		726	24	'Would' is accurate. We clarified the supporting evidence for this statement, and the text was revised slightly in response to another comment (comment 7586). The recent NAS report (2012) pointed out that the land is rising along the Washington and Oregon coasts likely because interseismic strain is building in the Cascadia Subduction Zone and would abruptly subside during a great (magnitude greater than 8) earthquake. The last great earthquake in the region occurred in 1700, causing a sudden rise in relative sea level of up to 2 m due to subsidence (Atwater et al., 2005).
Andrew	McDonnell	The chapter should also note the effect of accelerated glacial melt on ocean chemistry. Low alkalinity melt waters have the potential to accelerate ocean acidification, particularly in the northern Gulf of Alaska.	22. Alaska and the Arctic				After consideration of this point, we still feel the existing text is clear and accurate since the chapter makes this point: "the latter resulting from the large fresh water input from melting sea ice (Yamamoto-Kawai et al. 2009)

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							and large rivers". The topic is also mentioned in Chapter 2.
Donald	Graham	"Same" changes - "Some" changes	1. Executive Summary		13	3	Change has been made.
Miriam	Noetzel	Willing to volunteer my services in problem-solving in the New York City area.	16. Northeast				This comment does not seem to raise any question or suggest any revision.
Landow	Bryant	The climate statements in your Executive Summary of unusual temperatures, storms, sea rise is not borne out when real world data is used. For example, The UK Met Office has just admitted that all their Anthropogenic Global Warming (AGW) predictions were wrong. Despite the rise in CO2 Global temperatures have not risen for 16 years. This alone should put the AGW theory into the dust bin of history and negates the main theory behind the AGW theory: A rise in CO2 makes the Temperatures rise as well. For 16 years temperatures have not risen despite the rise in CO2.Moreover, Joe Bastardi shows how observed temperatures over the last 30 years have been BELOW all 38 model projections put out by a variety of “climate institutes.” The consensus of the models has been revealed as being DEAD WRONG. Bold blue dots represent the observed trend: (Chart not shown here go to Joe Bastardi link to see twitter.com/BigJoeBastardi photo/1)Observed temperature trend over the last 30 years now below all 38 model projections. Chart source: Joe Bastardi, twitter.com/BigJoeBastardi photo/	1. Executive Summary				Ongoing variability in the climate system is not the same thing as long-term trends. This issue is addressed directly in the climate science chapter and the Commonly Asked Questions appendix, and there is a new section of the Context and Background section of the Introduction on this topic.
Landow	Bryant	Anthropogenic Global Warming (AGW) is not the problem. The problem is the great harm wrong headed Government policies will do to stop a bogus problem that cannot be stopped even if human kind all went back to the Stone Age when life was short and brutal. An excerpt from a speech by Richard Courtney:AGW does not pose a global crisis but the policy does, because it threatens constraint of fossil fuels and that constraint would kill millions – probably billions – of people.There’s no evidence for man-made global warming; none, not any of any kind.The existence of global warming is not evidence of anthropogenic global warming because warming of the Earth doesn’t prove human’s warmed it. At issue is whether humans are or are not affecting changes to the Earth’s temperature that have always happened naturally.The AGW-hypothesis says increased greenhouse gases – notably carbon dioxide – in the air raise global temperature, and anthropogenic emissions of carbon dioxide are increasing the carbon dioxide in the air to overwhelm the natural climate system.But empirical evidence says the hypothesis is wrong.1. The anthropogenic emissions and global temperature do not correlate.2. Change to atmospheric carbon dioxide concentration follows change to global temperature at all time scales.3. Recent rise in global temperature has not been induced by rise in atmospheric carbon dioxide concentrations.Global temperature fell from 1940 to 1970, rose to 1 998, and has fallen since. That’s 40 years of cooling and 28 years of warming. Global temperature is now similar to that of 1990. But atmospheric carbon dioxide concentration has increased at a near constant rate and by more than 30% since 1940. It has increased by 8% since 1990.4. Rise in global temperature has not been induced by anthropogenic emissions of carbon dioxide.Over 80% of the emissions have been since 1940 and the emissions have been increasing at a compound rate. But since 1940 there have been 40 years of cooling with only 28 years of warming. There’s been no significant warming since 1995, and global temperature has fallen since the high it had 10 years ago.5. The pattern of atmospheric warming	1. Executive Summary				The evidence for climate change is included in the climate science chapter and in the associated appendices.

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		predicted by the AGW hypothesis is absent.The hypothesis predicts most warming of the air at altitude in the tropics. Measurements from weather balloons and from satellites both show cooling at altitude in the tropics.So, the normal rules of science say the AGW-hypothesis is completely refuted.Nothing the hypothesis predicts is observed, and the opposite of some of its predictions are observed.But some people promote the hypothesis. They've several reasons (personal financial gain, protection of their career histories and futures, political opportunism, and…). But support of science cannot be one such motive because science denies the hypothesis. So, additional scientific information cannot displace the AGW-hypothesis and cannot silence its advocates. And those advocates are not scientists despite some of them claiming they are.Advocates promote AGW using three kinds of pseudo-science.They use `argument from ignorance'. This isn't new. In the Middle Ages experts said, "We don't know what causes crops to fail: it must be witches: we must eliminate them." Now, experts say, "We don't know what causes global climate change: it must be emissions from human activity: we must eliminate them." Of course, they phrase it differently saying they can't match historical climate change with known climate mechanisms unless an anthropogenic effect is included. But evidence for this "anthropogenic effect" is no more than the evidence for witches.Advocates rely on not-validated computer models.No model's predictions should be trusted unless the model has demonstrated forecasting skill. But climate models have not existed for 20, 50 or 100 years, so they cannot have demonstrated forecasting skill.Simply, the climate models' predictions of the future have the same demonstrated reliability as the casting of chicken bones to predict the future.Advocates use the Precutionary Principle saying we should stop greenhouse gas emissions in case the AGW hypothesis is right. But that turns the Principle on its head.Stopping the emissions would reduce fossil fuel usage with resulting economic damage. This would be worse than the `oil crisis' of the 1970s because the reduction would be greater, would be permanent, and energy use has increased since then. The economic disruption would be world-wide. Major effects would be in the developed world because it has the largest economies. Worst effects would be on the world's poorest peoples: people near starvation are starved by it.The precautionary principle says we should not accept the risks of certain economic disruption in attempt to control the world's climate on the basis of assumptions that have no supporting evidence and merely because they've been described using computer games.So, global warming is not a global crisis but the unfounded fear of global warming is. It threatens a constraint of fossil fuel use that would kill millions – probably billions – of people.					
Landow	Bryant	All the statements in your report do not match real world data. For example: Arctic ice record low caused by a rare Autumn Cyclone and only lasted for a month or two.Polar bears are increasing according to observers on the ground.The top meter of permafrost contains little gas, and in Siberia, permafrost areas are growing.Marine life, including corals, thrive with more CO2, and the pH of water varies around 8.2 by +/- 0.3. It hasn't been neutral (7.0), let alone acidic, in 600 million years.Are the authors of your report intentionally deceiving the public? If so they should be fired and people hired who are dedicated to truth not environmental politics.	1. Executive Summary				The authors have based their conclusions on the work of thousands of experts and decades of observations.
Donald	Graham	Scenarios ;A SynopsisLimits to Growth, The 30-Year UpdateDonella Meadows, Jorgen Randers, Dennis Meadows* 2004The signs are everywhere around us:• Sea level has risen 10-20 cm since 1900. Most non-polar glaciers are retreating, and the extent and thickness of Arctic sea ice is decreasing in summer.• In 1998 more than 45 percent of the globe's people had to live on incomes averaging $2 a day or less. Meanwhile, the richest onefifth of the world's population has 85 percent of the global GNP. And the	1. Executive Summary		18	6	Thank you for your comment; this material has been considered, but the authors believe the current language of this section is appropriate.

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		gap between rich and poor, is widening.• In 2002, the Food and Agriculture Organization of the UN estimated that 75 percent of the world's oceanic fisheries were fished at or beyond capacity. The North Atlantic cod fishery, fished sustainably for hundreds of years, has collapsed, and the species may have been pushed to biological extinction.• The first global assessment of soil loss, based on studies of hundreds of experts, found that 38 percent, or nearly 1.4 billion acres, of currently used agricultural land has been degraded.• Fifty-four nations experienced declines in per capita GDP for more than a decade during the period 1990-2001.These are symptoms of a world in overshoot, where we are drawing on the world's resources faster than they can be restored, and we are releasing wastes and pollutants faster than the Earth can absorb them or render them harmless. They are leading us toward global environmental and economic collapse —but there may still be time to address these problems and soften their impact.We've been warned before. More than 30 years ago, a book called The Limits to Growth created an international sensation. Commissioned by the Club of Rome, an international group of businessmen, statesmen, and scientists, The Limits to Growth was compiled by a team of experts from the U.S. and several foreign countries. Using system dynamics theory and a computer model called "World3," the book presented and analyzed 12 scenarios that showed different possible patterns —and environmental outcomes— of world development over two centuries from 1900 to 2100.The World3 scenarios showed how population growth and natural resource use interacted to impose limits to industrial growth, a novel and even controversial idea at the time. In 1972, however, the world's population and economy were still comfortably within the planet's carrying capacity. The team found that there was still room to grow safely while we could examine longer-term options.In 1992, this was no longer true. On the 20th anniversary of the publication of Limits to Growth, the team updated Limits in a book called Beyond the Limits. Already in the 1990s there was compelling evidence that humanity was moving deeper into unsustainable territory. Beyond the Limits argued that in many areas we had "overshot" our limits, or expanded our demands on the planet's resources and sinks beyond what could be sustained over time.1 The main challenge identified in Beyond the Limits was how to move the world back into sustainable territory.1. To overshoot means to go too far, to grow so large so quickly that limits are exceeded. When an overshoot occurs, it induces stresses that begin to slow and stop growth. The three causes of overshoot are always the same, at any scale from personal to planetary. First, there is growth, acceleration, rapid change. Second, there is some form of limit or barrier, beyond which the moving system may not safely go. Third, there is a delay or mistake in the perceptions and the responses that try to keep the system within its limits. The delays can arise from inattention, faulty data, a false theory about how the system responds, deliberate efforts to mislead, or from momentum that prevents the system from being stopped quickly.The 30-Year UpdateNow in a new study, Limits to Growth: The 30-Year Update, the authors have produced a comprehensive update to the original Limits, in which they conclude that humanity is dangerously in a state of overshoot.While the past 30 years has shown some progress, including new technologies, new institutions, and a new awareness of environmental problems, the authors are far more pessimistic than they were in 1972. Humanity has squandered the opportunity to correct our current course over the last 30 years, they conclude, and much must change if the world is to avoid the serious consequences of overshoot in the 21st century.Ecological Footprint versus Carrying Capacity(Click image to enlarge)This graph shows the number of Earths required to provide the resources used by humanity and to absorb their emissions for each year since 1960. This human demand is compared with the available supply: our one planet Earth. Human demand exceeds nature's supply from the 1980s onward, over-shooting it by some 20 percent in 1999. (Source: M. Wackernagel et al.)When The Limits to Growth was first published in 1972, most economists, along with many industrialists,					

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		politicians, and Third World advocates raised their voices in outrage at the suggestion that population growth and material consumption need to be reduced by deliberate means. Over the years, Limits was attacked by many who didn't understand or misrepresented its assertions, dismissing it as Malthusian hyperbole. But nothing that has happened in the last 30 years has invalidated the book's warnings.On the contrary, as noted energy economist Matthew Simmons recently wrote, "The most amazing aspect of the book is how accurate many of the basic trend extrapolations ... still are some 30 years later." For example, the gap between rich and poor has only grown wider in the past three decades. Thirty years ago, it seemed unimaginable that humanity could expand its numbers and economy enough to alter the Earth's natural systems. But experience with the global climate system and the stratospheric ozone layer have proved them wrong.All the environmental and economic problems discussed in Limits to Growth have been treated at length before. There are hundreds of books on deforestation, global climate change, dwindling oil supplies, and species extinction. Since The Limits to Growth was first published 30 years ago, these problems have been the focus of conferences, scientific research, and media scrutiny.What makes Limits to Growth: The 30-Year Update unique, however, is that it presents the underlying economic structure that leads to these problems. Moreover, Limits is a valuable reference and compilation of data. The authors include 80 tables and graphs that give a comprehensive, coherent view of many problems. The book will undoubtedly be used as a text in many courses at the college level, as its two earlier versions have been.World 3The World3 computer model is complex, but its basic structure is not difficult to understand. It is based in system dynamics —a method for studying the world that deals with understanding how complex systems change over time. Internal feedback loops within the structure of the system influence the entire system behavior.World3 keeps track of stocks such as population, industrial capital, persistent pollution, and cultivated lands. In the model, those stocks change through flows such as births and deaths; investment and depreciation; pollution generation and pollution assimilation; land erosion, land development, and land removed for urban and industrial uses.The model accounts for positive and negative feedback loops that can radically affect the outcome of various scenarios. It also develops nonlinear relationships. For example, as more land is made arable, what's left is drier, or steeper, or has thinner soils. The cost of coping with these problems dramatically raises the cost of developing the land —a nonlinear relationship.Feedback loops and nonlinear relationships make the World3 dynamically complex, but the model is still a simplification of reality. World3 does not distinguish among different geographic parts of the world, nor does it represent separately the rich and poor. It keeps track of only two aggregate pollutants, which move through and affect the environment in ways that are typical of the hundreds of pollutants the economy actually emits. It omits the causes and consequences of violence. And there is no military capital or corruption explicitly represented in World3. Incorporating those many distinctions, however, would not necessarily make the model better. And it would make it very much harder to comprehend.This probably makes the World3 highly optimistic. It has no military sector to drain capital and resources from the productive economy. It has no wars to kill people, destroy capital, waste lands, or generate pollution. It has no ethnic strife, no corruption, no floods, earthquakes, nuclear accidents, or AIDS epidemics. The model represents the uppermost possibilities for the "real" world.Readers who want to reproduce the World 3 scenarios of the book can do so themselves, because the authors have prepared interactive World 3 CDs. To order disks, please see back of title page. [See below]The authors developed World3 to understand the broad sweep of the future —the possible behavior patterns, through which the human economy will interact with the carrying capacity of the planet over the coming century.World3's core question is, How may the expanding global population and materials economy interact with and adapt to the earth's limited carrying capacity over the coming decade? The					

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		model does not make predictions, but rather is a tool to understand the broad sweeps and the behavioral tendencies of the system.Technology MarketsThe most common criticisms of the original World3 model were that it underestimated the power of technology and that it did not represent adequately the adaptive resilience of the free market. Impressive —and even sufficient— technological advance is conceivable, but only as a consequence of determined societal decisions and willingness to follow up such decisions with action and money.Technological advance and the market are reflected in the model in many ways. The authors assume in World3 that markets function to allocate limited investment capital among competing needs, essentially without delay. Some technical improvements are built into the model, such as birth control, resource substitution, and the green revolution in agriculture. But even with the most effective technologies and the greatest economic resilience that seems possible, if those are the only changes, the model tends to generate scenarios of collapse.One reason technology and markets are unlikely to prevent overshoot and collapse is that technology and markets are merely tools to serve goals of society as a whole. If society's implicit goals are to exploit nature, enrich the elites, and ignore the long term, then society will develop technologies and markets that destroy the environment, widen the gap between rich and poor, and optimize for short-term gain. In short, society develops technologies and markets that hasten a collapse instead of preventing it.The second reason for the vulnerability of technology is that adjustment mechanisms have costs. The costs of technology and the market are reckoned in resources, energy, money, labor, and capital.The Driving Force: Exponential GrowthFor more than a century, the world has been experiencing exponential growth in a number of areas, including population and industrial production. Positive feedback loops can reinforce and sustain exponential growth. In 1650, the world's population had a doubling time of 240 years. By 1900, the doubling time was 100 years. When The Limits to Growth was published in 1972, there were under 4 billion people in the world. Today, there are more than 6 billion, and in 2000 we added the equivalent of nine New York cities.Doubling times: A quantity growing according to a pure exponential growth equation doubles in a constant time period. There is a simple relationship between the rate of growth in percentage terms and the time it will take a quantity to double. Growth Rate (% per year) Approximate Doubling Times (years) 0.1 720 0.5 144 1.0 72 2.0 36 3.0 24 4.0 18					

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		5.0 14 6.0 12 7.0 10 10.0 7Another area of exponential growth has been the world economy. From 1930 to 2000, the money value of world industrial output grew by a factor of 14 —an average doubling time of 19 years. If population had been constant over that period, the material standard of living would have grown by a factor of 14 as well. Because of population growth, however, the average per capita output increased by only a factor of five."Moreover, in the current system, economic growth generally occurs in the already rich countries and flows disproportionately to the richest people within those countries. Thus, according to the United Nations Development Program, the 20 percent of the world's people who lived in the wealthiest nations had 30 times the per capita income of the 20 percent who lived in the poorest nations. By 1995 the average income ratio between the richest and poorest 20 percent had increased from 30:1 to 82:1."Only eight percent of the world's people own a car. Hundreds of millions of people live in inadequate houses or have no shelter at all —much less refrigerators or television sets. Social arrangements common in many cultures systematically reward the privileged, and it is easier for rich populations to save, invest, and multiply their capital."The Limits"Limits to growth include both the material and energy that are extracted from the Earth, and the capacity of the planet to absorb the pollutants that are generated as those materials and energy are used. Streams of material and energy flow from the planetary sources through the economic system to the planetary sinks where wastes and pollutants end up. There are limits, however, to the rates at which sources can produce these materials and energy without harm to people, the economy, or the earth's processes of regeneration and regulation."Resources can be renewable, like agricultural soils, or nonrenewable, like the world's oil resources. Both have their limits. The most obvious limit on food production is land. Millions of acres of cultivated land are being degraded by processes such as soil erosion and salinization, while the cultivated area remains roughly constant. Higher yields have compensated somewhat for this loss, but yields cannot be expected to increase indefinitely. Per capita grain production peaked in 1985 and has been trending down slowly ever since. Exponential growth has moved the world from land abundance to land scarcity. Within the last 35 years, the limits, especially of areas with the best soils, have been approached."Another limit to food production is water. In many countries, both developing and developed, current water use is often not sustainable. In an increasing number of the world's watersheds, limits have already been reached. In the U.S. the Midwestern Ogallala aquifer in Kansas is overdrawn by 12 cubic kilometers each year. Its depletion has so far caused 2.46 million acres of farmland to be taken out of cultivation. In an increasing number of the world's watersheds, limits have already, indisputably, been exceeded. In some of the poorest and richest economies, per capita water withdrawals are going down because of environmental problems, rising costs, or scarcity."Another renewable resource is forests, which moderate climate, control floods, and harbor species, from rattan vines to dyes and sources of medicine. But today, only one-fifth of the planet's original forest cover remains in large tracts of undisturbed natural forests. Although forest cover in temperate areas is stable, tropical forest area is plummeting."From 1990 to 2000, the FAO reports that more than 370 million acres of forest cover —an area the size of Mexico— was converted to other uses. At the same time that forests decline, demand for forest products is growing. If-the loss of 49 million acres per year, typical in the 1990s, continues to increase at 2 percent per year, the unprotected forest will be gone					

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		before the end of the century."Nonrenewable Resources"A prime example of a nonrenewable resource is fossil fuels, whose limits should be obvious, although many people, including distinguished economists, are in denial over this elementary fact. More than 80 percent of year 2000 commercial energy use comes from nonrenewable fossil fuels —oil, natural gas, and coal. The underground stocks of fossil fuels are going continuously and inexorably down. Between 1970 and 2000, even though billions of barrels of oil and trillions of cubic feet of natural gas were burned, the ratio of known reserves to production actually rose, due to the discovery of new reserves and reappraisal of old ones."Nonetheless the stock of reserves is finite and nonrenewable. Moreover, fossil fuels use is limited by the planet's capacity to absorb their byproducts after burning, such as the greenhouse gas carbon dioxide. Fossil fuels may be limited by both supply and sinks. Peak gas production will certainly occur in the next 50 years; the peak for oil production will occur much sooner, probably within the next decade. Energy efficiency and renewables offer the best prospect for a sustainable future."Flows of Physical Capital in the Economy of World3"It is important to distinguish between money and the real things money stands for. This figure shows how the economy is represented in World3. The emphasis is on the physical economy, the real things to which the earth's limits apply, not the monetary economy, which is a social invention not constrained by the physical laws of the planet."Industrial capital refers here to actual hardware —the machines and factories that produce manufactures products."The production and allocation of industrial output are central to the behavior of the simulated economy in World3. The amount of industrial capital determines how much industrial output can be produced each year. This output is allocated among five sectors in a way that depends on the goals and needs of the population. Some industrial capital is consumed; some goes to the resource sector to secure raw materials. Some goes to agriculture to develop land and raise land yield. Some is invested in social services, and the rest is invested in industry to offset depreciation and raise the industrial capital stock further."Materials are another finite resource. If population rises, and if those people are to have housing, health services, education, cars, refrigerators, and televisions, they will need steel, concrete, copper, aluminum, plastic, and many other materials."But if an eventual nine billion people on earth all consumed materials at the rate of the average American, world steel production would need to rise by a factor of five, copper by a factor of eight, and aluminum by a factor of nine. From source to sink, the processing, fabricating, handling, and use of materials leaves a trail of pollution.Such materials flows are neither possible nor necessary. Fortunately, growth in materials consumption has slowed, and the prospects for further slowing are good. The possibilities for recycling, greater efficiency, increased product lifetime, and source reduction in the world of materials are exciting. On a global scale, however, they have not yet reduced the vast materials flow through the economy. At best, they have slowed its rate of growth."Another fundamental limit to growth is sinks —the capacity of the planet to absorb the pollution and waste resulting from human economic activity. The most intractable wastes are nuclear wastes, hazardous wastes (like human synthesized chemicals), and greenhouse gases. They are chemically the hardest to sequester or detoxify, and economically and politically the most difficult to regulate."Current atmospheric concentrations of carbon dioxide and methane are far higher than they have been in 160,000 years. It may take decades for the consequences of climate change to be revealed in melting ice, rising seas, changing currents, greater storms, shifting rainfall, and migrating insects, birds or mammals. It is also plausible that climate may change rapidly."The Scenarios"Using the World3 computer model, Limits to Growth: The 30-Year Update presents 10 different scenarios for the future, through the year 2100. In each scenario a few numbers are changed to test different estimates of "real world" parameters, or to incorporate optimistic predictions about the development of technology, or to see what happens if the world chooses different policies, ethics, or goals. Most of the					

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		scenarios presented in Limits result in overshoot and collapse —through depletion of resources, food shortages, industrial decline, or some combination of these or other factors."Under the "business as usual scenario," world society proceeds in a traditional manner without major deviation from the policies pursued during most of the 20th century. In this scenario, society proceeds as long as possible without major policy change. Population rises to more than seven billion by 2030. But a few decades into the 21st century, growth of the economy stops and reverses abruptly."As natural resources become harder to obtain, capital is diverted to extracting more of them. This leaves less capital for investment in industrial output. The result is industrial decline, which forces declines in the service and agricultural sectors. About the year 2030, population peaks and begins to decrease as the death rate is driven upward by lack of food and health services."					
Landow	Bryant	For 16 years now a rise in CO2 had not caused a rise in Global temperatures per the UK Met. Ergo reducing CO2 will have no impact on the climate. Bruce of Newcastle January 13, 2013 at 8:02 am · Reply This is a very encouraging event, especially when you read the New Scientist write up:So what are these natural cycles? Mostly they involve the movement of heat between the atmosphere and the oceans. The oceans are the sleeping giant of climate change. They act as a huge heat sink: 90 per cent of the heat generated by accumulating greenhouse gases is absorbed by the oceans. How fast this happens is variable, depending on ocean currents and other fluctuations.Scientists have known for a long time that in El Niño years, when warm water spreads out across the equatorial Pacific, heat leaves the ocean for the atmosphere. But there are also longer-term cycles. The biggest cycles are known as the Pacific Decadal Oscillation and the Atlantic Multidecadal Oscillation. Recently, both have been causing the oceans to absorb more heat, shutting off atmospheric warming.So the UK Met Office has either noticed or been forced to consider the PDO and AMO!Which is interesting since this fluctuation is easy to see in their very own HadCRUT dataset, corresponding to 1/3rd of the temperature increase between 1900 and 2000.Which obviously drops CO2 climate sensitivity by a third if taken into account.Now add that NASA GSFC has also come out this week with the acknowledgement that solar effects have a larger impact on temperature than they hitherto had expected and we have the next domino to drop.Solar output, TSI + UV + magnetic influence, overall correlates to about 1/2 the temperature rise last century.Which if added to the ocean cyclic component drops climate sensitivity to 1/6th or less of the IPCC's estimate. Which is consistent with Lindzen, Spencer and other empirical measurements of 2XCO2.Friends, we only need two things now: Hadley and NASA to compare notes, and them both to actually use realistic values in their models, and the CAGW religion will be consigned to the dustbin.Report this 140	1. Executive Summary				Additional material on the intersection of variability and climate change has been added to the introduction in the Context and Background section.
Patrick	Campbell	Values are all presented as exact numbers with no uncertainty bands, so that, for example, temperature rise of 1.7 F may actually be 1.7 F(± 0.4 F) with the actual error band shown. We need a feel for the uncertainty of the reported observations.	2. Our Changing Climate				Uncertainties in the observational time series and associated trends are presented in the Appendix on Climate Science, in three figures under Supplemental Message 2. One figure shows the uncertainty through a

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							comparison of temperatures. A second figure contains similar depictions for other variables. The third figure shows the uncertainties in the forcing terms. We have put this information in the Appendix rather than in the Our Changing Climate chapter because the trends dominate the uncertainty in the observational time series shown here, so the first-order messages pertain to trends. We also added a special box on Uncertainty to the chapter. This new box appears in Key Message 5. The uncertainty described therein pertains mainly to model projections and is based largely on the extent to which different models agree.
George	Bond	There is a simple plan to unite all peoples on earth - plant trees. Admittedly, this will not solve the problem we are facing, but it gives everyone an opportunity to actually do something that actually helps. This plan crosses all language and religious lines. Good luck in your efforts. George Bond Suffield, CT USA					We greatly appreciate your positive comment.
George	Bond	There is a simple plan to unite all peoples on earth - plant trees. Admittedly this does not solve the problem we are facing, but it does give everyone something to do to help. This plan crosses all language and religious barriers. Good luck in your work. George Bond Suffield, CT					We greatly appreciate your positive comment.

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		USA					
Rob	Wilson	There needs to be some discussion regarding ground absorption of water in regards to existing ground water content, i.e. downpour on hard dry ground is more destructive and leads to less water entering aquifer than a four day light rain.	2. Our Changing Climate		47	14	Thank you for the suggestion, but we do not go into those details in this chapter.
Rob	Wilson	Is there any discussion or research on sources of the precipitation? For instance, lake effect snow/rain and tropical rain in the northeast versus rain from pacific/artic sources.	2. Our Changing Climate		42	9	Mechanisms of change are briefly discussed but space limitations prohibit detailed discussions of the source of available moisture for precipitation.
Lee	Davis	Your page times out and has 'eaten' over 90 minutes of my work. I've made carefully written comments upon what I have read so far. And those comments just 'vanished' while I contemplated what to say next.Please encourage people to word process their comments first before cut and pasting them into this comment box. Please put that on the web site.	Introduction: Letter to the American People				A warning regarding the "time-out" function was inserted into the website in several places.
Rick	Knight	It would be helpful to expand this bullet point to not only reflect the failure of current efforts to meet the B1 scenario, but also to characterize which of the other higher-emission scenarios would most closely be anticipated with continuation of current policies. This would help emphasize the extent of policy change that is needed to meet the B1 scenario.	27. Mitigation		955	37	This analysis would require consideration of the entire international regime, which while interesting, is beyond the scope of the chapter.
Landow	Bryant	When ocean levels have risen only 3mm/year (showing little or no trend of extreme rises in ocean levels) it is difficult to believe the claim in the report that future trends will be "worse than we thought". Nothing in the report supports this claim in any credible way. This makes the authors of the report sound like they are just another end of the world dooms day death cult.	24. Oceans and Marine Resources				This comment is inconsistent with the current state of the science on this topic. Chapter 2 (Changing Climate) details a recent doubling of the rate of rise, and discusses the likelihood of far higher increases leading to potentially 6.6ft rise by 2100.
Ken	Jones	The tenor of the whole piece seems quite calm actually, and the examples in the first paragraph somewhat benign. Clearly there are more dramatic, far-reaching effects. Just the fact that here in California continued rise of the ocean level perhaps an inch could easily soon cause the mass flooding of the Central Valley growing region with salt water as it once was seems kind of a disaster of epic proportions and the cost of doing something about it quite major. Acidification of the ocean and species loss. How about the droughts and major fires sweeping across multiple states this last year. We are in 2013 now so references to 2012 might be useful as this was the hottest year on record by a long shot.	Introduction: Letter to the American People				Thanks for your comments, the authors have worked hard to provide a measured responses taking all of the evidence into account. A reference to heat in 2012 has been inserted.
Lance	Wallace	The period with no significant warming listed refers only to 1998-2007, but in fact it is now from about 1996-2012, or 16 years. This longer period makes the statement about not measured in years but in decades wrong, since indeed we are approaching decades with no warming.	2. Our Changing Climate		28	41	The text has been revised to incorporate additional explanation of why the recent slowdown in the increase in air temperature is consistent with the author team's thorough assessment of the science.

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Ed	Fore	When are Utilties going to start conserving? Coal-fired boilers are only 30% efficient, with the condenser using 30%, over 30% of BTU's go to atmosphere. With coal at 16M BTU/ton, that is a lot of heat loss per hour. The units I worked on use over 350 tons/HR.This could be corrected but there are only DEMAND-SIDE incentives in place. The SUPPLY-SIDE has recommendations with no teeth and no incentives. Insulating for this 30% heat loss could also reduce other pollutants. All heavy industry could use a cattle prod Ed Fore.. Member.... IBEW # 160 RTD; ASTM C-16: Nat'l Inst Blgd Sci; Nat'l Assoc Corrosion Engr: Author -EPRI High Temp Insul; business owner Foremost Products	29. Research Agenda for Climate Change Science				Thank you for your comment, however policy issues are beyond the defined scope of the National Climate Assessment, a scientific document that provides the basis for decision making, but does not address policy.
Ed	Fore	With coal at 16 MBTU/ton, how much coal is burned in the US/World per hour? Electric generation is only 30% efficient, so the rest of the BTU's go to atmosphere. Smelters put 100% to atmoshpere. Where are all these BTU"s going? And no one says diddly about this side of the equation!	4. Energy Supply and Use				Our chapter focuses on climate impacts on energy production and supply. It is beyond the scope of this chapter to assess sources of emissions and efficiencies of energy production. The International Energy Association (www.iea.org) is a good source for discussion of these issues.
Sandra	Lewis	This lacks data. Find water main breaks and melting asphalt and the cost of repair. Asphalt melts and must be added as a vulnerability	11. Urban Systems, Infrastructure, and Vulnerability		422		We chose examples with broad-based impacts to illustrate the connections, rather than locally-specific examples such as water-main breaks and melting asphalt.
Sandra	Lewis	Well written, nice choice on the opening sentiment	11. Urban Systems, Infrastructure, and Vulnerability		442		Thanks.
Sandra	Lewis	Bingo! This is exactly right. Might be browns gas stealing H, in the atmosphere. Just a thought... This should be the first chapter. I am glad this gas emphasis is being explored	4. Energy Supply and Use		519	33	Thank you for the accolade.

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Sandra	Lewis	Lacking a ton of data include mass deaths mainly fowl. that have occurred in the last 5 ...yes. Due to climate change.	4. Energy Supply and Use		296	20	The physical impacts of climate change on species are beyond the scope of this chapter. Chapter 8 addresses Ecosystems, Biodiversity and Ecosystem Services.
Sandra	Lewis	Lacking data include mass deaths mainly fowl. that have occurred in the last 5 ...yes. Due to climate change.	4. Energy Supply and Use		296	20	The physical impacts of climate change on species are beyond the scope of this chapter. Chapter 8 addresses Ecosystems, Biodiversity and Ecosystem Services.
Zackary	Cutner	I would submit that the directness of the draft language not be reduced by any degree. Readers of this report who are Climate Change Sceptics need as much of a dose of reality as is possible to deliver.					Thank you for your comment.
Philip	Hansten	“Prediction is very difficult. Especially if it’s about the future.” Niels Bohr was right… rediction is indeed difficult, particularly in complex systems such as climate change, or how combinations of chemicals will react in a particular human body. After spending the past 50 years trying to predict outcomes in people taking interacting drugs, I think the principles involved are almost identical to those that could be profitably used in dealing with the risk of climate change. (I am a professor emeritus at the University of Washington, and some of the comments below were published in my blog on The Ernest Becker Foundation.)1. Prediction of Magnitude. Suppose you are on colchicine for gout, and you start clarithromycin for a sinus infection. Clarithromycin can produce colchicine toxicity, which in turn can cause fatal bone marrow suppression. Some people have less serious reactions, but we cannot determine ahead of time how bad it will be in any given person; there are too many variables. Climatologists have the same dilemma; they know that the CO2 buildup is risking catastrophe, but they cannot make precise predictions of timing and magnitude; again… too many variables. Precise prediction of outcomes, however, is not required for a rational assessment of risk.2. Tipping Point. There is another similarity. Once serious colchicine toxicity begins, it is difficult to stop. Colchicine can inhibit its own elimination by the kidneys, and dialysis doesn’t work. So by the time a serious reaction is detected, it is often too late. Climatologists tell us a similar story; we may get to a point where mutually reinforcing effects are set into motion, and no amount of remedial action will stop the inexorable march to disaster.3. Threshold for Action. There is scientific consensus among experts regarding both climate change and colchicine. Some refuse to accept the science, usually because they don’t understand it or they benefit from their denial. But it is not a matter of whether the specific predictions of climatologists will prove true 30 years from now… rather, the question is whether global warming presents a non-trivial risk of catastrophe. The threshold for taking action when dealing with complex problems that can potentially lead to disastrous outcomes often occurs long before definitive scientific data are available. One can always say, “the jury is still out” to justify inaction; look at the delaying tactics of Big Tobacco after the health risks of cigarettes became clear. But in science, the jury is always still out, so the question is not about juries… the question is whether or not the data suggest we should take vigorous action.But despite all the similarities, there is one striking difference between colchicine and climate change; ignoring a colchicine-clarithromycin drug interaction puts one person at risk of death; ignoring climate change could be fatal to billions.	1. Executive Summary				Your point about the critical interactions in the climate system is very well taken, as well as the references to complexity.
William	Fraser	Fort Myers, Florida, is incorrectly spelled as Fort Meyers in this sentence:"Three of these (Palm Coast, FL, Cape Coral-Fort Meyers, FL, and Myrtle Beach area, SC) are along the coast and vulnerable to sea	17. Southeas		583	29	The text has been revised to incorporate this suggestion.

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		level rise and storm surge."For city name verification: City Government: http://www.cityftmyers.com/ Google Maps: http://goo.gl/zoR8E	t and Caribbean				
Ben	Beard	Regarding Figure 9.8: Changes in Tick Habitat references Ogden et al. 2008. The reprinted figure is actually from Brownstein et al. 2005 and not from Ogden et al. 2008.	9. Human Health	9.8	345		Citation has been changed.
Oliver	Manuel	Writers of the "Introduction: Letter to the American People" need to watch and privately contemplate the following video on the source of energy that controls a volume of space large enough to contain ten billion, billion (10^19) Earths:That is 10,000,000,000,000,000,000 Earths http://informthepundits.wordpress.com/2013/01/15/fabulous-solar-activity-video/With kind regards, Oliver K. Manuel Former NASA Principal Investigator for Apollo	Introduction: Letter to the American People				Thank you for your suggestion.
Karl	Whitehead	Any discussion of sea level change must include the effects of plate techtonics. [see http://curry.eas.gatech.edu/Courses/6140/ency/Chapter10/Ency_Oceans/Sea_Level_Variations.pdf] The data used by this report to confirm sea level rise uses measurements from 290 tidal gages around the world. The data table also records that in the last 100 years, all continents have been rising except North America, while North America has been falling. This has more to do with sea level change than a 1 or 2 degree rise in temperature. The movement of the continents has been causing the sea level to rise for the last 15,000 years. There is no possible way to stop this change, so mankind must be preparing for it.	24. Oceans and Marine Resources				Due to the size of the topic, and the page limit for the chapter, we focused on broad trends rather than delving too deeply or providing such a level of specificity. It is true the tectonics affects SLR, but is a smaller effect and on a much longer timescale than other factors under consideration in our report - these include warming, melting of glaciers and ice sheets, glacial rebound around North America and ocean currents - which as dicussed in detail in Chapter 2.
John	Stampfl	Refer to figure 21.7. In this area, Northwest, Montana. Insect damage seems to be more serious than depicted on Figure 7.1.May be just a matter of scale between the two figures.	7. Forestry	7.1	265		Due to the size of the sector and the page limit for the chapter, we focused on broad trends rather than delving too deeply or providing such a level of specificity. The text has been revised to add the dates over which the disturbance index was estimated (2005-2009) and given the dynamic nature of disturbance in the west, the dates associated with the index contributes to the nature of the disturbance assessment. Figure 2.17 in

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							Vose et al. focuses on the likelihood of future warming and vulnerability and the text in the disturbance section supports the conclusion of the graphic that western forests are highly vulnerability to loss of carbon.
John	Stampfl	I didn't see much discussion of the problems faced by the Sacramento-San Joaquin Rivers Delta. Much of the Delta area is below the level of the Rivers during runoff periods. The tide levels affect the river levels. It seems at a minimum levees need to be raised and strengthened.	25. Coastal Zone Development and Ecosystems				We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to add during revisions. Given the limited additions possible, we could not elaborate on the Delta, but mention it once in the text. Moreover, Figure 25.4 (Panel d) contains a mention of adaptation activities in San Francisco Bay.
Anthony	Westerling	"Recent policies that allow some wildfires to burn naturally have increased burned area back to the levels seen before the strict fire controls."This sentence is highly controversial, not supported by the peer-reviewed literature, can be shown empirically to be highly questionable, and directly contradicts the main findings on wildfire reported in chapter 20. It implies that the observed increase in wildfire in the region is merely a rebound in fire due solely to a change in fire suppression policy. It is simply not possible to credibly attribute changes in fire to this one policy variable in the presence of simultaneous changes in climate and other factors. Furthermore, the general increasing trend in forest burned area predates effective changes in fire suppression policy. Also, burned area can be shown to have increased in Forest Service forests before Park Service forests, despite the fact that policies were implemented by Park Service units long before any changes were applied to forest service lands. This sentence is overly broad, unsubstantiated by any peer-reviewed literature, empirically suspect, and contradicts the rest of the text on wildfire. It will engender very strong public criticism from scientists such as myself.	20. Southwest		695	5	Thank you for your comment. The section has been modified to accommodate your suggestion.
Anthony	Westerling	Prescribed burning, mechanical thinning, and retention of large trees can help forest ecosystems adapt to climate change (Finney et al. 2005; Stevens et al. 2008; Swetnam et al. 2009).While this is true for some forest types in the region, it is not generally true for all forest types. This sentence should be strongly qualified.Fire suppression has not had significant qualitative impacts on fire regimes in forests where the natural pre-suppression fire rotation was substantially longer than the historical period of effective fire suppression. Furthermore, it is questionable whether fire suppression is effective under the climatic conditions that foster large fires in infrequent, high-severity fire regimes. Introducing prescribed fire and thinning in such systems would be an unnatural disturbance. Empirical evidence that such measures would actually enhance adaptation in those forest types is needed.	20. Southwest		695	29	Thank you for your comment. We have modified the sentence to reflect that the outlined actions do not help all forest ecosystems adapt to climate change.
Anthony	Westerling	"Models project a doubling of burned area in the southern Rockies, (Litschert et al. 2012) and up to 74% more fires in California (Westerling et al. 2012)."This is incorrect. Westerling et al (2012) find increases in burned area of up to 74%, not fire frequency. Note also that the 74% refers to California as	20. Southwest		695	23	Thank you for your comment. The text has been revised to incorporate this suggestion.

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		a whole, whereas the increase in burned area in Sierra Nevada forests is found to exceed 100% in a large area of those forests across a wide range of climate scenarios.					
William	Lanahan	I was wondering if everyone on the committee was of the same opinion. What kind of a scientific paper is written without peer review? Every paper I've seen has a Pro and Con opinion. After all there are thousands and thousands of scientists that do not agree with the conclusions expressed here. The least you could do is allow a dissenting opinion for a fair and balanced view. Has anyone looked into how much the remedies will raise taxes? If so those figures should be revealed to the taxpayers.					The transparent process leading to this report is documented on our website and has included numerous avenues for the public to engage. In addition to a three-month public comment period, an expert panel of the National Academies also provided peer review of the report and published their review publicly. Finally, policy issues are beyond the defined scope of the National Climate Assessment, a scientific document that provides the basis for decision making, but does not address policy.
Paul	Schoenhagen	This is a very interesting and important topic. Are there any specific recommendation for healthcare systems how to increase preparedness/adaptation?	9. Human Health				More information on preparedness and adaptation can be found in Ch.28 on Adaptation of the National Climate Assessment report; along with several references cited in this chapter: (1) National Research Council. America's Climate Choices: Adapting to the Impacts of Climate Change . Washington, DC: The National Academies Press, 2010. (2) Hess JJ, McDowell JZ, Luber G. 2012. Integrating cilmate change adaptation into public health practice: using adaptive management to increase adaptive capacity and build resilience. Environ Health Perspect 120:171-179. (3) Bedsworth L. 2009. Preparing for cilmate change: a perspective from local public health officers in California. Environ Health Perspect 117:617-623.
Daniel	Botkin	Comments on The Executive Summary's first page. Statements from the report are in quotes. My comments follow.The executive summary is a political statement, not a scientific statement. If is filled with misstatements contradicted by well-established and well-known scientific papers. Quotes from the document are in quotes. My comments follow."Climate change is already affecting the American people." Climate change has always affected people and all life on Earth, so it isn't new to say it is "already affecting the American people". This is	Introduction: Letter to the American People				After a careful review of all of the existing literature and documentation, the authors are comfortable that their conclusions are robust. The fact that there are long-term trends does not mean that shorter-term variability will not result in year-to-year and even

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		just a political statement. "Certain types of weather events have become more frequent and/or intense, including heat waves, heavy downpours, and, in some regions, floods and droughts." It is inappropriate to use short-term changes in weather as an indication one way or another about persistent climate change. Steve Schneider, one of the top climate change climatologist, with whom I worked in the 1980s, made clear that you should never use short-term weather changes as proof about climate change. "Sea level is rising," The sea level has been rising since the end of the last ice age, 12,500 years ago. To the lay reader this will come across as if it were a new event caused by human actions. This long-term rate has been characterized as about a foot a century. The question has been weather this has accelerated during the late 20th century. "glaciers and arctic sea ice are melting." This is an overstatement. The scientific literature is quite clear that in some places sea ice is decreasing, in others it is increasing. See "Mahoney, Andrew R., John R. Bockstoce, Daniel B. Botkin, Hajo Eicken, and Robert A. Nisbet. 2011, “Sea Ice Distribution in the Bering and Chukchi Seas: Information from Historical Whaleships' Logbooks and Journals,” Arctic. 64, (4): 465 – 477.""These changes are part of the pattern of global climate change, which is primarily driven by human activity." It remains unclear that this is driven by human activity.					decadal fluctuations. More detail on the relationship between trends and variability has been included in the revised Context and Background section of the Executive Summary of the report. We have added more information on the accumulating evidence and increased certainty that the only explanation for the warming observed now is human activities.
Don	Steinke	Hello from Vancouver Washington,The coal industry is planning to ship 36 miles of coal trains per day from Federal Lands in the Powder River Basin to ports in Oregon and Washington for shipment to Asia. The terminals are already in the permitting process. The Army Corps of Engineers is the lead agency. Despite urging from the Seattle Office of EPA to expand the scope of the EIS, the Army Corps of Engineers seems reluctant to expand the scope beyond the actual terminal site. The PowerPastCoal organization has turned out 8000 protesters to the scoping hearings.Everything about these proposed exports is contrary to everything the Obama Administration and you believe, and yet this is mostly within the president’s authority to stop. 1. The coal is coming from Federal Lands 2. We are selling the coal to Peabody and associates for $1.00 per ton. (I believe the price is determined by auction.) 3. The president is the chief commanding officer for the Army Corps of Engineers. 4. Coal is a non-renewable resource that should be saved for future National Security. 5. The coal terminals are being built in navigable waters of the United States.Why is the president silent? Are the people in charge of these leases keeping this under Obama’s radar? These coal exports would produce as much greenhouse gas as the Keystone Pipeline. The Army Corps has the authority to deny the permits for the terminals.“If you build it, they will come”, and if the terminals are not built, then there will be no exported coal. I can only speculate on why the president is silent. My guess is that he wants to make nice with China, and also with Warren Buffet who is the major stockholder in Peabody and BNSF.I urge the president to do all of the following: 1. Stop the sale of coal for export from Federal Land	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				Comment addresses policy issues that are beyond the scope of this chapter.

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		2. Put a high tax or tariff on export coal 3. Tell Army Corps to deny the permits for the terminals on the basis of National Security. 4. Or ask the Army Corp to widen the scope of the EIS to include regional and global impacts.Don Steinke Vancouver (not BC), Washington (not DC) ϑ					
Tom	Fiddaman	This figure, Trends in Flood Magnitude, cites,Hirsch, R.M. and K.R. Ryberg, 2012: Has the magnitude of floods across the USA 6 changed with global CO2 levels? Hydrological Sciences Journal, 57, 1-9 doi: 7 10.1080/02626667.2011.621895, [Available online at 8 http://www.tandfonline.com/doi/abs/10.1080/02626667.2011.621895]However, the figure does not appear in the article. A similar figure (#1) does appear, but it shows CO2/streamflow regression coefficients, not trends, and is not in color.Hirsch and Ryberg is not a reliable source on the significance of CO2/streamflow correlations, because it neglects: - integration between CO2 concentration and temperature - nonlinearity in CO2 forcing - control for non-CO2 forcings, anthropogenic and natural - spatial correlations in flows - spatial variation in expected flows (e.g., GCM predictions) Therefore the findings of significance are unreliable, and the interpretation of regression coefficients is problematic.While the underlying data and descriptive statistics that are the subject of the paper may be of some use, the conclusions should not be relied upon.	2. Our Changing Climate	2.20	56		This figure has been corrected and is now consistent with the figure from Peterson et al. 2012.
Prabhat	Misra	Respected Jerry M. Melillo Sir & team of Scientists,First of all thank you for this Globally important report/ assessment/ document/ research. This will be an ideal before World Community to consider while making plan/ draft for Climate Change. The current problem of 'climate change' is due to GLOBAL WARMING which in turn is the result of our past discovery of 'STEAM POWER' and 'FOSSIL FUELS' at the advent of INDUSTRIAL REVOLUTION. At that time, the policy makers, scientists and engineers did not judge the fate and impact of that industrial revolution. UNIPCC2007 report has predicted dark future of the earth. Here are few suggestions, which needs urgent attention:1. There should be a "WORLD COMMISSION FOR SCIENCE AND DEVELOPMENT" for promoting the researches and developmental works which have zero to low carbon emission.2. There should a compulsory constitutional amendment to make "ENVIRONMENTAL WAY OF LIFESTYLE" a compulsory duty.3. Our investment in R & D should be more on the forthcoming areas like solar, tidal, wind and water energies apart from on lowering carbon emission.4. There should be a big role for N.G.Os. in implementing environment friendly plans & projects of government.5. There should be effective AWARENESS programmes, at grass root level, to save the environment & terrestrial					Thank you for your comment, however policy issues are beyond the defined scope of the National Climate Assessment, a scientific document that provides the basis for decision making, but does not address policy.

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		"CO2 sink zones" i.e. forests from degradation. One such movement, running in Etawah district of Uttar Pradesh province of India, is RED TAPE MOVEMENT [http://unfccc.int/cc_inet/cc_inet/six_elements/public_participation/items/3530.php?displayPool=1526 & http://twitter.com/RedTapeMovement]. Such movements will be helpful in the conservation & safety of forests and biodiversity, with the help & involvement of local peoples.6. There should be the provision of financial help and green technology transfer to developing countries because the problem of Climate Change is GLOBAL & inter-related; it will be helpful in phasing-out the fossil fuels. Recently, Dec. 2012, The European Commission and the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) have each announced a €5 million contribution to United Nations Development Programme (UNDP) to help assist 25 developing countries around the world reduce their greenhouse gas (GHG) emissions. 7. Sustainable developments should be given priority. But recently it was reported by rainforestportal.org, on April 16, 2012, that sustainable management is not playing a good role in Rainforest areas as it is destroying Primary Rainforest [http://www.rainforestportal.org/issues/2012/04/earth_meanders_the_great_rainf.asp]. The portal says, "Old forests are a vital part of the biosphere's ecological infrastructure – and have a prominent, central role in making the Earth habitable through their cycling of carbon, energy, water, and nutrients. Primary rainforests cannot be logged in an ecologically sustainable manner; once logged – selectively, certified, legally or not – for throw-away consumer crap, their primary nature is destroyed, and ecological composition and dynamics are lost forever". So, on the name of Sustainable Management [http://www.brisbanetimes.com.au/environment/animals/extinction-risk-as-aceh-opens-forests-for-logging-20130114-2cpmr.html] , no-one should be allowed to destroy forests because our terrestrial biodiversity, human population, Oxygen production, CO2 sinking etc. depends on forests. Such steps are big BUT will be helpful in controlling GREEN HOUSE EFFECT and CLIMATE CHANGE. Regards Prabhat Misra Assist. Director [National Savings], Etawah, U.P., India www.facebook.com/prabhat.lovepeaceunity www.facebook.com/redtapemovement www.twitter.com/redtapemovement www.twitter.com/prabhatmisra					
Tom	Fiddaman	This section discusses flood trends corresponding with Figure 2. However, the source cited, Hirsch & Ryberg 2012, concerns CO2/streamflow regression coefficients, which are not strictly	3. Water Resource		113	38	We do not agree that the Hirsch and Ryberg analysis and conclusions

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		trends.Furthermore, Hirsch and Ryberg is not a reliable source on the significance of CO2/streamflow correlations, because it neglects: - integration between CO2 concentration and temperature - nonlinearity in CO2 forcing - control for non-CO2 forcings, anthropogenic and natural - spatial correlations in flows - spatial variation in expected flows (e.g., GCM predictions) Therefore the findings of significance are unreliable, and the interpretation of regression coefficients is problematic.While the underlying data and descriptive statistics that are the subject of the paper may be of some use, the conclusions should not be relied upon.	s				should not be relied upon. We have considered all the objections to use of CO2 as the independent variable in their analyses and do not agree. The use of CO2 as a dependent variable in climate-change trend analyses is an important, and arguably, more relevant independent variable than linear time. Climate changes, if driven by greenhouse gases, are more likely (or no less likely) to parallel the greenhouse-gas concentrations than year of common era, given that the greenhouse concentrations have not increased purely linearly in the observational period. Thus, in fact, we feel that the nonlinearity in CO2 forcing (at least relative to the more common reliance on linear time) was precisely what they did attempt to incorporate. Even if the connection between CO2 and temperatures is not completely understood, the analysis by H&R does not assume it; rather they only report on the relations between CO2 and floods. H&R carefully chose gages to analyze that are as free as available from non-CO2 flood forcings, like river management and land use changes. Spatial correlations between gages are essentially irrelevant to the conclusioons that we drew from their paper (as we did NOT rely on their regionalization of results to quarters of CONUS). And, H&R is an analysis of historical observations, not GCM projections, and left it to the reader to draw any conclusions as to whether there is a linkage (they seemed to find none); thus, their "neglect" of "spatial variations in expected flows (e.g., GCM predictions)" is not relevant in our use of their results. However, we have revised our description of the Hirsch

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							and Ryberg analysis in response to the comment.
David	Williams	I think you have Svante Arrhenius and Guy Callendar's pix reversed and I'm not sure your picture of Guy is correct as it doesn't look like pictures of Guy that I'm familiar with....	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z	10	1071		Agreed. Somehow the wrong picture got in there. It has been revised.
Alex	Au	What isn't mentioned is the elephant in the room - how the central barrier to adaptation is society itself (how it is organized) - not the limited financial attention given to adaptation projects. The elephant is "capitalism" - the pursuit of profit as the central decision-making rule. Capitalism is what blocks current action on climate change, and unless it is recognized as a central barrier, then the solutions presented will unlikely be successful. Capitalism implicitly opposes action on climate change because comparable profit cannot be made by constraining the use of natural resources (because you start out with less wealth). As a result, there is greater money power on the side of irresponsibly using natural resources versus conserving them. Moreover, recent history broadcasts the futility of creating regulations that multinational corporations can weaken and sidestep. Do not waste time perfecting a failing strategy that should have been implemented 15 years ago. Recognize that in any given situation, there is only ONE action that produces substantial results. In 1961, it was a trip to the moon. What will it be in 2013?Here is my proposal: at this stage in human history, it's futile to attempt an alternative to capitalism. (Again, if this is true, then the half-hearted efforts to regulate the capitalist urge to profit through consumption will only delays the inevitable). Therefore we must double down and use capitalism for what it has done best - create wealth through innovation. What we need, clearly, is a weather-control machine. If the energy required for this machine is greater than currently produced in-and-around the Earth, then so be it - we must radically uptick our ability to produce energy. Perhaps the authors of this chapter haven't realized it yet - but we've already reached the point of no return. We must innovate or feel Nature's wrath. Realize too that imagination is the missing ingredient. The moon captured it in 1961 - and even today, there are still plenty of opportunities to seize the day. Think of Hurricane Sally and Sandy Hook. These were great tragedies that did not unite the nation on a fervent and inspirational new vision of itself. But it could have been. Think of something great - like "the invincible island city" or "the moon's moon energy plant." Even if you embark on doing tedious bound-to-fail bureaucratic and cost-increasing, unsexy regulations (the opposite of Captain Planet), then you still need imagination. That is where this Adaptation chapter is severely lacking. You can be a loser, or you can be legendary - that decision is happening right now. Please get it together.	28. Adaptation				Thank you for your comment. Discussing how society is organized or the role and history of capitalism is outside the scope of this short chapter. We try to show how actions on adaptation are taking place on many scales, despite remaining barriers. No change to the chapter was made.
Brad	Carrier	I deeply appreciate this report.I appreciate all the expertise and effort that has gone into it.In an era when so many flippantly say "the government can't do anything right," this is doing something right. This dire situation must be quickly addressed by many efforts, private, corporate, voluntary group, and especially, our governments. Global challenges require global thinking and cooperative behaviors. Thank you, everyone, who contributed to this important document.Brad Carrier	Introduction: Letter to the American				Thanks very much for your comments.

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		Ashland, Oregon	People				
Sandra	Lewis	Data could include projected loss of busses, trains, and personal vehicles stored in an around storm surge potential lots. Hail is a major player in transportation, loss and climate. Hurricane Katrina/Sandy come to mind, as well as Joplin, Mo.	5. Transportation		218		The text has been revised in several places to incorporate this suggestion.
Sandra	Lewis	Consider data from repairs brought on by extreme heat and crumbling asphalt. Largely prevelant in the mid-west/southwest. Hail damage, missed aspect to project cost	5. Transportation		218		Thank you for your comments. We have changed the sentence to address hail and asphalt deterioration in response to this suggestion.
Horst	Henn	"which is driven primarily by human activity" is certainly not a statement which should show up in the top lines of an executive summary of a scientific report. Does this mean that human activities are responsible for 51% of climate change or is it 70%. If you can't agree on a scientific definition and measurement of "climate change" and an estimated value I recommend to replace the word "primarily" by the word "probably".	1. Executive Summary		3	6	The percentage of warming that is attributable to human causes is not known but is increasing over time as explained in Chapter 2.. This robust scientific attribution of observed changes to human influence extends to many other climate quantities, such as precipitation (Min et al. 2011; Pall et al. 2011), humidity (Santer et al. 2007; Willett et al. 2007), pressure (Gillett and Stott 2009), ocean heat content (AchutaRao et al. 2006), and tropospheric and stratospheric temperature (Santer et al. 2012) in addition to surface temperature. Further discussion of attribution is provided in the Commonly Asked Questions Appendix.
Paul	Marx	Not all species have the same degree of mobility when their habitat is being degraded. Predator species can reasonably be expected to migrate to their comfort zones. However, not all of their prey species have the same capability. Corals don't move at all, and shellfish of various kinds move only slowly. It may be informative to highlight that differing species may not be able to migrate, or adapt, with equal success. This may lead to some species losing access to vital food sources, while other species see falling reproduction and survival rates due to their inability to move geographically.	24. Oceans and Marine Resources		844		We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include.
Paul	Marx	The section on tourism may be strengthened by referencing effects of scarcity versus demand. In many national parks, for example, access is being regulated to prevent ecosystem damage from too many visitors at one time. This lowers access and increases cost. When coral reefs are reduced by 80 percent, the availability of recreational opportunities related to the reefs (fish species, eco-tourism, sport fishing) are equally reduced, while demand increases. This is likely to result in sharply increased cost, and logistical disruption for the tourism industry, with a potentially significant reduction in overall revenue.	24. Oceans and Marine Resources		845		After consideration of this point, we still feel the existing text is clear and accurate.
Paul	Marx	My comments come from the standpoint of adaptation. It seems to me that the increases in carbon emissions were decades in their establishment, and will be decades in their diminution. While we seek	24. Oceans				The chapter focused on broad trends related to observed trends and future

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		methods to reduce the carbon, it will continue to influence sea levels, water temperatures, acidity, and related ecosystem conditions. To effectively adapt to the changes that are coming will require that we explore likely avenues for adaptation now. Humans are quite mobile, as compared with ocean predator species. However, we suffer from the same limitation: our infrastructure and food sources are not as mobile as we are. An explicit goal of developing methods to adapt to these changing conditions would seem appropriate. By exploring what could be done to adapt, say by developing and "seeding" more adaptable shellfish and prey species in the areas where they are likelier to survive, we will more quickly identify the strategies that work or do not work. This may provide valuable case studies for the eventual adaptation of our own cities and towns.	and Marine Resources				projections of climate change impacts on marine ecosystems as well as the resulting effects on coastal communities and ocean services. We refer those interested in a deeper treatment of the topic of adaptation strategies to the Adaptation Chapter.
Paul	Marx	Our occupation and use of shoreline for residential and commercial purposes has radically altered the ability of that shoreline to support the marine ecology. This chapter is not the place to propose an entire new way of living, but it may be the place to mention how much the restoration of saltwater marshes, coastal habitat, and other measures could reduce the potential harm of future climatic events (such as Hurricane Sandy). The presence of human habitation so close to the shore is directly linked to the inordinate cost of the damage done by Sandy. But the lack of shoreside structure all along the eastern seaboard was a major contributing factor as well. It may be worthwhile to mention this here.	24. Oceans and Marine Resources		846		The points the comment raises are beyond the scope of this chapter. All such issues are deliberatively the purview of the Coastal Chapter rather than Oceans, which are focused offshore.
WAYNE	THOMPSON	"people and livestock get no respite" should be modified at a minimum to include "crops" - as it is shown that mitochondrial respiration (both C3 and C4) increases with increasing night temperatures - in maize causing decreases in grain number, size and density, and corresponding decreases in grain yields and quality. This portends a negative trend in productivity, also indicating a need for more seed to sustain current production levels. Journal articles supporting this observation are readily available, specifically addressing growing season nighttime temperature effects on yields and quality of rice, maize, sorghum, sunflower...	1. Executive Summary		3	34	The agriculture chapter describes impacts of heat on crops; although the authors agree that crops are affected, they have chosen not to include "crops" in this sentence.
Richard	Gierak	There is little doubt that climate change is a reality. However, the assertion that the causative factor is human activities is ludicrous. There is ample scientific data to indicate that a rise in temperature of one degree in the Ocean's releases more carbon dioxide than our industrial revolution. Data clearly indicates that the Pacific Ocean temperature, since 1970, has risen approximately 10 degrees as a result of historic activity within the Pacific Ring of Fire volcanos. There is indeed a planetary cycle in force at this time and the amount of Carbon Dioxide released by human activity cannot compare to what is being released by the Oceans of this planet. Agreed that our industrial activities aid in raising the level in our atmosphere, however, not detrimental compared to the release from our warming oceans due to a natural planetary cycle.	Introduction: Letter to the American People				The authors appreciate your comments, but the cause and effect relationships that you note are not consistent with our conclusions.
Robert	Young	I have searched the entire document for any reference to Amory B. Lovins and find none. It is absolutely amazing to me that this leading, foremost physicist, policy analyst and conceptual thinker is totally ignored. Have any members of this committee read "The Essential Amory Lovins Selected Writings" (ISBN 978-1-84971-226-1)? If you have not, shame! If this innovative thinker and effective writer and communicator has been totally ignored I believe this is an absolutely inexcusable oversight.					We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include.
Buford	Holt	There is a great deal of very useful data here and I thank you for your contributions. At this time, my only comment is the seeming absence of any comment on the fact that a good case can be made for our presence at the global peak of oil production. That resource constraint will itself create greate	4. Energy Supply and Use				Thank you for the accolade. A discussion of the literature on "peak oil" is beyond the scope of our

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		difficulties in responding to climate change because our current economy depends upon cheap oil. As one who first encountered the climate change issue in 1969 as a postdoc at Brookhaven National Laboratory, I can say with confidence that the case for peak oil is much easier to make than that for climate change was then or is now. For lucid introductions into thinking on this matter and its implications for the economy, search online for "Gale the Actuary". Her writings nicely capsulate the discussions and provide useful leads to the body of technical analyses. Alternatively, contact Dr. Charles Hall of Syracuse University, who has spent decades pursuing this problem and who has developed interesting estimates of the energy return on energy investment in various modes of energy production.It seems obvious that we will have limited capacity to undertake massive infrastructural fixes. The future is challenging.					chapter. Regarding concerns about "peak" oil production in the U.S., the U.S. Energy Information Administration (www.eia.gov) has documented the recent increase in oil production in the U.S. due to liquids production from shale formations. New geologic survey and production techniques are enabling an increase in production rather than a decrease.
Joseph	Craine	I checked the source. Property losses were $1.9Billion, not million.	8. Ecosystems, Biodiversity, and Ecosystem Services		296	19	This has been corrected as suggested.
Roger	Faulkner	There is no mention of a supergrid under the topic "Increasing transmission capacity within and between regions." Indeed it appears that the report does not recognize that there is a critical need for new technology to accomplish increasing transmission capacity within and between regions. How will we do this? Will it be with overhead power lines? (I do not think that is politically feasible.) Will it be with undergtound cables? (I do not think that is technically feasible.)It is ever more clear to me that we need a supergrid based on underground HVDC power lines. I have been promoting and developing elpipes, which are (I believe) the most practical method. Gas insulated lines (GIL) and superconducting lines are the ONLY other options.	4. Energy Supply and Use				Innovations in technology for adaptation actions in Table 4.2 were implied, but not directly stated. In response to this suggestion, we have revised the sentence in the Table 4.2 Caption to convey that innovations in technologies may provide additional opportunities and benefits to these and other adaptation actions.
David	Rice	"Climate change presents a major challenge for society."Perhaps this statement is not inclusive enough. "Society" can refer to the USA, or all of humanity. Maybe "Climate change presents a major challenge for humanity," or even "Climate change presents a major challenge for life on Earth." There is a danger of sounding America-centric, when the problem is vastly larger that just the USA and just humans.	Introduction: Letter to the American People		2	1	We appreciate the suggestion, but still feel the text is clear and accurate. Elsewhere in the Letter, we provide information on the full range of topics addressed by the NCA, including impacts on natural systems. The U.S. is the focus of the report. The Executive Summary addresses the importance of the international context.
Susan	Cutter	There should be an explicit recommendation on the vulnerability of different sectors and populations to climate change impacts. Report finding 4 is insufficient and the vulnerability section is buried within the bold recommendation.	1. Executive Summary		8		There have been some modifications to the language in this section; however, it will not be possible to have separate statements about the vulnerability of all sectors and populations in this finding.
Susan	Cutter	There are two findings within this section--one on impacts and one on vulnerability. I would separate as	1.		8	22	The authors believe the current

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		follows:4. Impacts related to climate change are already evident in many sectors and are expected to be come increasingly challenging across the nation throughout this century and beyond. [bold] keep lines 24-26; keep sentence beginning on line 30. 5. Climate change interacts with other environmental and societal factors in a variety of ways that either moderate or exacerbate the ultimate impacts. [bold]. The types and magnitudes of these effects vary across the nation and through time. Several populations--including children, the elderly, the sick, the poor, tribes and other indigenous people--are especially vulnerable to one or more aspects of climate change.	Executive Summary				language is appropriate.
Matthew	Dahlhausen	The legend should read "Enhancing efficiency in heavy trucks and airplanes", not "Enhanding efficiency in heavy trucks and airplanes".	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z	32	1110		We have updated this figure and corrected misspellings in the legend.
Blaikie	Worth	"Human-caused" should be in the first sentence of this leading paragraph of page one rather than in the third sentence.	Introduction: Letter to the American People		1	1	Thank you for your comment, but the authors prefer the current order of topics. The order in which the topics appear has been deliberately chosen to be accessible to the American people.
Falk	Huettmann	Dear Colleagues,greetings.Re. requested input for 'your' National Climate Assessment and Development Advisory Committee report, Alaska section, I propose you can add 6 more references:Murphy, K, J. Reynolds and J Jenkins, E. Whitten, N. Fresco, M. Lindgren and F. Huettmann (2012). Predicting Future Potential Climate-Biomes for the Yukon, Northwest Territories, and Alaska: A climate-linked cluster analysis approach to analyzing possible ecological refugia and areas of greatest change. Prepared by the Scenarios Network for Arctic Planning (SNAP) and the EWHALE lab, University of Alaska-Fairbanks on behalf of The Nature Conservancy Canada., Government Northwest Territories. http://snap.uaf.edu/webshared/Nancy%20Fresco/Cliomes/ Cliomes%20FINAL%20March%2031%202012.pdfMurphy, K, F. Huettmann, N. Fresco and J. Morton (2010). Connecting Alaska Landscapes into the Future. U.S. Fish and Wildlife Service, and the University of Alaska. http://www.snap.uaf.edu/downloads/connecting-alaska-landscapes-futureHuettmann, F. and S. Hazlett (2010). Changing the Arctic: Adding Immediate Protection to the Equation. Alaska Park Science: 118-121.Huettmann, F. (2012) Yet Another, But This Time Realistic, Polar Synthesis, Meta-Analysis, and Outlook: Protecting Ice, Snow, People, Species, Habitats, and Global Temperatures for Good? in F.Huettmann (ed) Protection of the Three Poles, Springer Tokyo, Japan, pp. 265-330 The latter two references deal with a MARXAN (Strategic Conservation Planning) analysis of	22. Alaska and the Arctic				We appreciate the suggestion, but feel the current references are appropriate and adequate given the chapter's space limitations.

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		the Arctic under change.Lastly, any of these works should emphasize, and build on, publicly available (raw) data (e.g. Zuckerberg et al. 2012), and ecological economics (H. Daly textbook).I would use at least two more citations on that in your report and for the science and framework you base your statements on.Thanks; these are my comments.Very bestF.Falk Huettmann PhD, Associate Professor-EWHALE lab- Biology and Wildlife Dept., Institute of Arctic Biology 419 IRVING I, University of Alaska Fairbanks AK 99775-7000 USA Email fhuettmann@alaska.edu Phone 907 474 7882 Fax 907 474 6716					
Nedal	Katbehbader	The impact of climate change on the ecosystem services should be clearly assessed and addressed.	1. Executive Summary				The Ecosystems, Biodiversity and Ecosystem Services chapter does this.
Nedal	Katbehbader	to add after threatens:human "live", health and well-being....	1. Executive Summary		8	34	The authors believe the current language is appropriate.
Nedal	Katbehbader	Tha impact of climate change on the National Security should be clearly addressed.	1. Executive Summary				Changes have been made to the Executive Summary in response to this comment, including a paragraph on National Security.
Nedal	Katbehbader	The impact of ClimateChange on tourism to be addressed.	1. Executive Summary				This topic is mentioned in a variety of chapters, for example, the Rural Communities Chapter, the SE and SW chapters.
Nedal	Katbehbader	The impact of Climate Change on displacement of people to be addressed.	1. Executive Summary				This is an important topic. A new report finding on Native Peoples addresses communities relocating due to climate change impacts.
Nedal	Katbehbader	Comparing US emmissions with the global trends and emmissions could be advise.	1. Executive Summary				Changes have been made in response to this comment in the Executive Summary and the mitigation chapters.
Nedal	Katbehbader	Some focus and highlight on national debates on climate change could have a positive impact that guide decision makers to understand the issue and guide them to the wise decisions.	1. Executive Summary				The authors agree that this is an important point, but this is a scientific assessment and there is limited capacity to handle every topic within this report.
Nedal	Katbehbader	Historinc Background on international negotiation (could be in the form of an annex) could have a positive shade.	1. Executive Summary				The authors agree that this is an important point, but this is a scientific assessment and there is limited capacity to handle every topic within this report.
Kathryn	Quick	I am simply writing to affirm the opening statement of the report - "Climate change, once considered	Introduct				The authors very much appreciate

First Name	Last Name	Comment	Chapter	Figure/ Table Number	Start Page	Start Line	Response
		an issue for a distant future, has moved firmly into the present" - and to strongly endorse the work you are doing with this report. In the 1990s I worked nearly full time on climate change avoidance and prevention strategies, doing bilateral advocacy and policy development work between Indonesia and the United States. I am completely in agreement that at that time, a mere 20 years ago, climate change seemed like "an issue for a distant future," and equally that there are ample signs of it occurring today. As the musical group They Might Be Giants puts it so aptly in their song, "Science is real," there is absolutely no doubt whatsoever that climate change is a real phenomenon that is occurring now. I applaud this research program and the current administration's commitment to act and respond aggressively, as marked by President Obama's comments at the 2013 inauguration that "Some may still deny the overwhelming judgment of science, but none can avoid the devastating impact of raging fires, and crippling drought, and more powerful storms."	ion: Letter to the American People				your thoughtful comments.
Malin	Pinsky	A more direct reference for the source of data for the figure would be:Pinsky, M. L. and M. Fogarty (2012) Lagged socio-ecological responses to climate and range shifts in fisheries. Climatic Change 115(3): 883-891 doi:10.1007/s10584-012-0599-xrather than Griffis & Howard 2012 as currently written.	24. Oceans and Marine Resources	24.5	848		We have added the suggested citation in our chapter assessment.
Malin	Pinsky	I believe the $700 million number refers to ALL fisheries from Maine to New Jersey. The text as currently written implies that the number applies only to groundfish fisheries (which have substantially lower landed value).	24. Oceans and Marine Resources		847	8	The text has been revised to incorporate this suggestion.
Ben	Wilson	It should address uncertainty of climatestrology. The NIPCC reports and their findings, the affect of the sun's cycles, the internal heat from the earth, the spontaneous genesis of hydrocarbons, the fact that temps have not risen in 15 years, while CO2 has, the gray literature used in the IPCC reports, the increasing antarctic ice, the earth's CO2 levels are at the lowest in geologic history near the lower threshold to sustain plant life, higher temps are better for all of humanity - more food production, fewer deaths from cold weather, adjusted temperature records...http://www.foxnews.com/science/2013/01/23/leaked-un-climate-report-slammed-for-citing-wwf-greenpeace/	1. Executive Summary				Clearly identifying what is known and what is not known is an important part of all assessments. A section that frames this issue has been added to the Exec. Summary.
Charles	Bauer	This is a very serious situation. The U. S. should actively mitigate the sources of climate change. Tax Carbon emissions. Use funds to enhance EPA enforcment, Purchase more sensitive lands, Plant and protect trees and Grasslands, educate public.					Thank you for your comment, however policy issues are beyond the defined scope of the National Climate Assessment, a scientific document that provides the basis for decision making, but does not address policy.
Alexander	Wolf	As a US citizen and a scientist, I strongly commend the US government for taking a well-documented, transparent approach to global climate change, including acknowledging not only that global climate change is occurring, but that humans are affecting this process. I am in strong favor of using the best and most recent peer-reviewed scientific literature to inform our nation and move forward in addressing global climate change in the best manner possible. I further commend the authors of this report for documenting the uncertainties and probabilities involved with this report, caveats which are	Introduction: Letter to the American People				Thanks very much for this comment.

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		inherent to scientific knowledge and are often missing from public debate on this topic.					
Michael	Coffey	This is a well written document. Clear and concise, easy to read.In Figure 5 on Page 1127 of the Appendix – Climate Science, the caption says that the figure includes major human-induced factors as well as the Sun. There is not a bar in the figure that indicates the warming or cooling influence of a changing Sun. Albedo, which is related to the Sun, is really a feature of the Earth.	Appendix: The Science of Climate Change	5	1127		We have redrawn the figure to include the sun's efffect just as was done in the IPCC version of this figure.
Debi	Shell	This report goes into great detail outlining the current weather trends and projecting what might happen in the future. It does not mention or take into account the devastation being impacted upon our area and other areas of the world by a full out assault of Chemtrails and Project HAARP and its aim of being able to control the weather by 2025. Our soils are being filled with metallic salts, our trees are falling over and dying, crops are failing due to the soil being polluted. The answer to these ills is not Genetically modified trees and crops. Man's desire to play GOD has taken over and will be killing us all before long! Scientific and man made, is never going to beat the system created by GOD. Man is the problem, man with an unnatural greed to harness and control, rather than live in HARMONY with an already perfect biosystem. Both of the above mentioned reasons for the anomalies we face currently, should be stopped immediately and Earth should be given a chance to right the many wrongs that are being forced upon it by those that seek to lower population,and destroy for purposes of greed and averous and a desire for control!	18. Midwest				This is a policy issue that is not the purview of the report, which focuses on peer-reviewed science and assesses the state of knowledge.
Michael	Wehner	"unknown" suggest unknowable. Suggest changing to "depends on the course of future human activities." or words to that affect.	1. Executive Summary		20	14	The language has been modified in response to this comment.
Michael	Wehner	There are no 30 mile resolution global models in the NARCCAP experiment. This is a regional model exercise. Statement as written is incorrect.	2. Our Changing Climate		29	22	The text has been revised to further explain the North American Regional Climate Change Assessment Program (NARCCAP). Two global models were actually run at 30 mile (50 km) resolution for limited time-slice experiments.
Michael	Wehner	"...largely follow recently observed patterns of change," This can not be true except by accident as the natural variability of precipitation is larger than the amount of anthropogenically driven change presently realized. It is not until well into the future that anthropogenically drived precipitation changes dominate over natural variations. This part of the sentence should be deleted.	2. Our Changing Climate		32	18	The text has been revised to incorporate this suggestion.
Michael	Wehner	change "are already dry" to "are naturally dry"	2. Our Changing Climate		32	25	The text has been revised to incorporate this suggestion, while recognizing that some currently dry regions may have been wetter in the distant past.
Michael	Wehner	"...typically about 60 miles". This is incorrect. For CMIP5 models, this is the towards the finest	2. Our		32	30	The text has been revised to say that

First Name	Last Name	Comment	Chapter	Figure/ Table Number	Start Page	Start Line	Response
		resolution available. "Typical" is far coarser, probably twice that. Change to “generally much larger than 60 miles across."	Changing Climate				resolutions typically vary from 62 to 125 miles.
Michael	Wehner	"White areas indicate confidence that the changes are small." I would prefer this to have " relative to natural variability." at the end of this sentence.	2. Our Changing Climate		34	15	The text has been revised to incorporate this suggestion.
Michael	Wehner	"attributable to human activity is difficult to quantify...". Add "at regional scales" as Min et al (2011) detected changes at the global scale.	2. Our Changing Climate		43	2	The text has been revised to incorporate this suggestion.
Michael	Wehner	Change "These four models" to "These four global models" for clarity	2. Our Changing Climate		45	14	The text has been revised to incorporate this suggestion.
Michael	Wehner	add this reference:B. D. Santer, C. Mears, F. J. Wentz, K. E. Taylor, P. J. Gleckler, T. M. L. Wigley, T. P. Barnett, J. S. Boyle, W. Br¸ggemann, N. P. Gillett, S. A. Klein, G. A. Meehl, Nozawa, D. W. Pierce, P. A. Stott, W. M. Washington, and M. F. Wehner ,”Identification of Human-Induced Changes in Atmospheric Moisture Content”, (2007), Proceedings National Academy of Sciences, 107, 15248-15253	2. Our Changing Climate		47	16	A citation was added as suggested.
Michael	Wehner	Remove Hansen et al citation. It is not a formal detection and attribution study.	2. Our Changing Climate		52	24	The text has been revised.
Michael	Wehner	"(4-day events)". This is incorrect. Should read "(1-day events)"	2. Our Changing Climate		53	21	The reviewer is correct. We have changed to "1-day events".
Michael	Wehner	Change "extreme heat wave" to "extremely hot day" as that is more correct.	2. Our Changing Climate		54	1	We have adopted this reviewer suggestion.
Michael	Wehner	"Confidence has risen in computer model projections because recent observations are consistent with past model projections." With a citation, this statement is meaningless. Suggest to delete.	2. Our Changing Climate		54	2	Sentence has been deleted, as the point is better made elsewhere in the chapter/appendices.
Michael	Wehner	Change "based on method from" to "based on data from"	2. Our Changing Climate		55	8	Figure and caption have been revised. Citation in caption is simplified to "Source: Kharin et al., 2012)".
Michael	Wehner	"culminating in summer melt that was far greater (97% of the Greenland Ice Sheet area)" This news was widely misreported in the popular media. Suggest changing to "summer surface melting" to avoid some of that confusion. Or similar wording highlighting that this unusual melting was confined to the surface.	2. Our Changing Climate		68	22	As suggested, have changed the text to say "summer surface melt". The paragraph also states that it is the "surface of the Greenland Ice Sheet that has been experienced increased summer melting.
Michael	Wehner	Add citation Schwalm, et al. (2012) Reduction in carbon uptake during turn of the century drought in western North America. Nature Geoscience 5, 551-556 (2012) doi:10.1038/ngeo1529 to accompany Dai and Hoerling citations.	2. Our Changing Climate		82	1	Additional references have been added to the main text, which then become the basis for the Traceable Accounts.

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Michael	Wehner	The observed increase in US precipitation should be put in context of natural variability. It is unlikely that any anthropogenic signal has yet emerged from the natural variability. Relating this observed changed to projected change is misleading as to cause and effect.	3. Water Resources		108	29	The text has been revised. We have added a new section on the relationship between historical and projected water cycle changes.
Michael	Wehner	Add Kharin et al (2013) citation from Chapter 2. Recently accepted	3. Water Resources		109	6	We have added the suggested citations in our chapter assessment.
Michael	Wehner	Figure 3.2/ Can some representation of natural variability be shown in this figure to place the magnitudes of the projected changes in context?	3. Water Resources		112	2	We appreciate the reviewer suggestion and have included a discussion in the revised text of streamflow changes in relation to historical variability.
Michael	Wehner	The statement is vague. Are processes other than increased potential evapotranspiration responsible for this change in runoff per unit precipitation?	3. Water Resources		113	19	This language is referring to multiple processes, not just ET, therefore we feel the text is clear and accurate
Michael	Wehner	Is this projected increase under the A2 scenario? This should be noted in the text itself.	3. Water Resources		120	23	The text has been revised to incorporate this suggestion
Michael	Wehner	"Conversely, increasing, but not extreme, precipitation ..." This phrasing is unclear as to what it means. Consider rephrasing.	3. Water Resources		125	1	The text has been revised to clarify.
Michael	Wehner	"Most areas in the U.S. are projected to experience increases in the number of days with precipitation exceeding one inch." What is the source of this projection? A citation is needed.	4. Energy Supply and Use		168	20	After review of this and other comments, this sentence has been removed from the chapter.
Michael	Wehner	"Recent climate data indicate an overall upward trend in annual precipitation across most of the nation". This statement and the next one are inconsistent with chapter 2 and the figures. Confidence in future upward trends in annual mean precipitation are confined to the northern states, particularly in the Northeast. See figure 2.5.	4. Energy Supply and Use		174	27	We have reworded the text to be more specific and consistent with Fig. 2.12 from Chapter 2: Our Changing Climate.
Michael	Wehner	"However, the Southwest faces lower precipitation year round." This statement is also inconsistent with chapter 2 and the appendix. Confidence in projected southwestern drying is limited to the winter and spring seasons. See figures 2.12, 2.13 and figures 18, 19 in the appendix.	4. Energy Supply and Use		174	28	We have reworded the text to refer to mean annual precipitation, for which projections of decreases in the far southwest are consistent among models.
Michael	Wehner	"Most of the U.S. is projected to have 15 more days per year with little precipitation." What is the source of this projection and under what scenario? Citation is needed.	4. Energy Supply and Use		174	30	The historical data and future projections are described in detail in Chapter 2: Our Changing Climate which is referenced at the beginning of this paragraph.
Michael	Wehner	Figure 4.4 is inconsistent with chapter 2. The NARCCAP projections undersample uncertainty relative to CMIP3 and CMIP5 (Wehner 2012). Furthermore, the NARCCAP model projections are biased wet compared to the CMIP3 multi-model mean (see Chapter 2). Confidence in the NARCCAP ensemble	4. Energy Supply and Use		175	1	This figure has been revised. Instead of NARCCAP data, the new figure displays CMIP3 model data for 15 models. This

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		results cannot be expressed in the same manner as in Chapter 2 and appendix due to limitations in the experimental. The additional detail in the downscaled projection is not particularly meaningful in this context without a confidence assessment.					new figure also shows an assessment of confidence.
Michael	Wehner	"...increased drought in the Southeast and the Southwest" What is the source of this projection? Chapter 2, figure2.22 and Appendix figure 32 project future increases in agricultural drought (in terms of soil moisture). Is this the type of drought that impacts transportation infrastructure?	5. Transportation		197	7	Thank you for your comments. We have changed the sentence to address this suggestion.
Michael	Wehner	"Arctic warming is also projected to allow the seasonal opening of the Northwest Passage to freight shipment (Arctic Council 2009)." Is this true for all future emissions scenarios? Can a range of dates be estimated for when this will first occur?	5. Transportation		197	33	A limited number of freighters cruise ships, and smaller vessels have traversed the Northwest Passage for several years and global climate projections to 2100 show extensive open water areas during the summer around the Arctic basin. We have modified the text to incorporate this information.
Michael	Wehner	"Hurricanes in the Atlantic are expected to increase in intensity and frequency." This statement is incorrect and at odds with Chapter 2. The total number of Atlantic (and global) hurricanes (of all strengths) is projected to decrease. The intensity of the strongest storms and the frequency of intense hurricanes (cat 4 and cat5 only) is projected to increases. See figure 2.24	5. Transportation		202	20	We have modified the text to address this comment.
Michael	Wehner	Also on a positive note, the National Hurricane Center forecast of storm track, accumulated precipitation and storm surge were remarkably accurate. This might be mentioned in the context of short term emergency planning.	5. Transportation		204	16	We appreciate the efforts of the National Hurricane Center, however we do not have any scientific citation that would substantiate the comment.
Michael	Wehner	"Future changes in extremes are less well understood" This is not really true. In some ways, changes in extremes, particularly precpitation, are better understood than changes in mean. Suggest rephrasing this clause.	6. Agriculture		228	23	We removed this sentence.
Michael	Wehner	"A warmer world brings higher humidity in wet years" Relative humidity will remain roughly constant while specific humidity will increase as the climate warms. Which measure of atmospheric moisture is being referred to in this statement.	6. Agriculture		238	23	The section that contained “a warmer world brings higher humidity in wet years” is no longer in the chapter.
Michael	Wehner	"In that region, climate change has decreased streamflow due to lower spring precipitation and reduced snowpack". This is stated as a fact but should have an associated likelihood statement consistent the underlying studies by Barnett, Pierce and others. Suggest that the clause, "it is likely that climate change has..." be added to this sentence.	8. Ecosystems, Biodiversity, and Ecosystem Services		292	25	Changed as suggested.
Michael	Wehner	Not all increased fire risk is due to climate change. Mention should be made of forest management practices and the affect on fuel loads.	8. Ecosystems, Biodiversity, and		296	15	Edited as suggested.

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			Ecosystem Services				
Michael	Wehner	Add these citations: Kharin, V.V., F.W. Zwiers, X. Zhang, and M. Wehner, accepted Changes in 34 temperature and precipitation extremes in the CMIP5 ensemble. Climatic Change and Sillmann, J., V. V. Kharin, F. W. Zwiers, X. Zhang, and D. Bronaugh, 2013a: Climate extremes indices in the CMIP5 multi-model ensemble. Part 1: Model evaluation in the present climate. J. Geophys. Res., accepted	9. Human Health		342	13	These are not references for this section.
Michael	Wehner	Add IPCC SREX report (2010) as citation for projections of future extreme events.	9. Human Health		343	16	The NCA Technical Support Unit has added the citation to the 2010 IPCC SREX report.
Michael	Wehner	Suggest replacing with figure 2.15 for consistency within the report.	9. Human Health		346	3	Authors propose using a different graphic from Chapter 2 to maintain view of future projected occurrences of extreme precipitation events.
Michael	Wehner	Suggest adding the equivalent map for projected # of 100F days at the end of 21st century under the SRES A2 scenario as a second panel to figure 10.1. Data is likely available from NOAA NCDC. See the similar figure on page 34 of 2nd US NCA for # of 90F days and this document figure 17.3 for southeastern 95F days.	10. Water, Energy, and Land use		390	1	Due to limited space, the authors deliberated and chose the best figures and materials to include.
Michael	Wehner	The section described utility scale solar power generation but no mention is made of household or small business scale generation of solar power (such as is widespread in Germany or other countries). Some discussion of the usefulness of smaller scale alternatives is warranted.	10. Water, Energy, and Land use		402	7	This section was revised to discuss alternative solar technologies and WEL linkages.
Michael	Wehner	Also cite Chapter 2, (Figures 2.12 and 2.13) and the Appendix (figures 18 & 19)	10. Water, Energy, and Land use		405	32	The text was revised to add the suggested references.
Michael	Wehner	Change "Climate change increases the frequency and intensity of extreme" to "Climate change increases the risk, frequency and intensity of certain extreme" as not all extremes, particularly cold events and certain aspects of hurricanes, are projected to become more severe.	11. Urban Systems, Infrastructure, and Vulnerability		421	13	Thank you for your suggestion. Based on your comment, edits have been made.
Michael	Wehner	"...especially given the expectation that this type of event will become more frequent with ongoing climate change." This statement is misleading. There is no evidence that storms like Hurricane Sandy will become more frequent. (It was a complicated storm given the interaction with the Nor'easter.) Rather, this statement should reflect that hurricane damages from storm surges are more likely because of sea level rise due to global warming interacting with the surges from such storms.	11. Urban Systems, Infrastructure,		425	7	Thank you for your suggestion. Based on your comment, edits have been made.

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			and Vulnerability				
Michael	Wehner	You might consider a citation to the Appendix 2, figure 31, which shows observed trends in number of western fires and acres burned.	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources		446	3	We added a reference to Appendix 2, Figure 31 to pg. 446 line 5, as suggested.
Michael	Wehner	This figure caption must be more specific about the seasonality of the projected temperature plotted. This is certainly not annual mean temperature. Is it summer (JJA) mean surface temperature? Or some other measure?	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources		452	13	The figure caption refers to projected ground temperature at a depth of 3.3 feet assuming different levels of emissions. The text has been revised based on the suggestion to help clarify the figure.
Michael	Wehner	Title is incorrect. Trends are not plotted here. Also, the changes do not show very clearly due to the chosen range of the vertical axes. This latter comment holds for figure 13.3 as well. Perhaps some other method of representing these changes can be used.	13. Land Use and Land Cover Change		477	2	Text has been modified.
Michael	Wehner	The urban heat island effect has been used incorrectly by some to discredit observations of recent temperature changes. It would be useful to note that reported large scale temperature changes have properly accounted for this effect and that the temperature is indeed increasing due to human induced atmospheric composition changes. Possible citation to NOAA NCDC.	13. Land Use and Land Cover Change		480	33	Due to chapter length constraints, this topic is not covered in the LULC chapter. However, the urban heat island effect is discussed in the NCA report's "Appendix: NCA Climate Science — Addressing Commonly Asked Questions from A to Z".
Michael	Wehner	Replacing "background" by "pre-industrial" would be a more accurate phrase.	15. Interacti		519	17	Thank you for your suggestion; Key Message #1 has been revised to

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			ons of Climate Change and Biogeochemical Cycles				incorporate this suggestion.
Michael	Wehner	Mention should be made here that methane oxidizes in carbon dioxide. And that although the residence time in the atmosphere of a methane molecule is much shorter than a carbon dioxide molecule, its radiative effect, and hence its influence on the climate, is much larger.	15. Interactions of Climate Change and Biogeochemical Cycles		523	13	Thank you for your comment; the text has been edited in regards to your suggestions.
Michael	Wehner	replace "data-based estimates" with "observationally based estimates" for clarity. Models produce data too.	15. Interactions of Climate Change and Biogeochemical Cycles		524	26	Thank you for your comment; the text has been revised to reflect your suggestion.
Michael	Wehner	Please provide a citation for the link between sulfate aerosols and eastern US cooling during the 1970-1990 period.	15. Interactions of Climate Change and Biogeochemical Cycles		526	10	Thank you for your comment. The Leibensperger reference is adequate for this citation. I have changed the wording slightly to make that clear.
Michael	Wehner	It is critical to state in this introduction that natural variations are larger at the regional scales than at the continental scales which in turn are larger than at the global scale.	Introduction to Regions		547	2	Significant new text has been added as suggested.
Michael	Wehner	This would be a good place to have a map showing the outlines of the regions.	Introduction to Regions		547	30	A map of the regions has been included.
Michael	Wehner	These sentences should be modified to reflect the uncertainties presented in figures 2.12, 2.13. Significant increases are projected for all of the Northeast in winter (under either A2 or RCP8.5) and over most of the Northeast in the spring under these scenarios. No significant changes are projected	16. Northeast		553	5	The text has been revised to incorporate this suggestion.

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		for summer or fall anywhere in the Northeast. Furthermore the quoted range of 1% to 29% implies a precision that is not provided by model projections. I suggest that the range either be deleted or replaced by a statement about the average multi-model projected increase and note that there is uncertaintly about this estimate. It is not possible to place a "likelihood" estimate on this range with a high degree of confidence.					
Michael	Wehner	Hurricane Sandy is discussed in Chapter 5 (Transportation) box 2 and should be referenced somewhere in this discussion.	16. Northeast		555	1	The text has been revised to incorporate this suggestion.
Michael	Wehner	Confidence is high that precipitation will increase during winter and spring in the Northeast. The principle reason is due to the increased specific humidity due to Clausius-Clapeyron relationship. Climate models robustly reinforce this understanding of the physical mechanisms.	16. Northeast		568	1	After consideration of this point, we still feel the existing text is clear and accurate.
Michael	Wehner	The reference period for figure 17.3 must be stated in the caption. Presumably it is 1901-1960 for consistency with Chapter 2.	17. Southeast and Caribbean		587	6	The text has been revised to incorporate this suggestion.
Michael	Wehner	More precise statements are possible by considering figures 2.12 and 2.13. Spring and summer decreases in precipitation in the Caribbean are a robust result of expansion of the Hadley Circulation. In some models, such as CMIP3/A2, this decrease extends into the Southeastern US during the spring, but not in others, such as CMIP5/RCP8.5. The increase in Florida during the fall is robust but not well understood. It is tempting but inappropriate to think that this increase is a result of increased precipitation coming from hurricanes as these models are not finely resolved enough to produce credible tropical cyclones. No changes in annual precipitation in the southeast are judged to be significant by the criteria laid out in Chapter 2 (figs 2.12, 2.13). Hence, I suggest that this assessment statement be revised to "Projections of future precipitation patterns are less robust than projections for temperature increases with most projected changes in the southeast smaller than long term natural variations. However, in the Caribbean regions, pronounced reductions in spring and summer precipitation are projected under the A2 scenario at the end of the 21st century." And that thisCaribbean reduction be judged "high" in the traceable accounts section.	17. Southeast and Caribbean		587	17	he text has been revised to address the question and is consistent with other chapters and Chapter 2 material. Rather than low resolution Ch2 figures, the NOAA tech report for the SE (Kunkel et al 2013; figure 37) was the basis for regions. Also, that report used CMIP3 rather than CMIP5 and the Caribbean was not included in the projections, and so was not discussed - that is a goal for the next NCA report.
Michael	Wehner	Refer to Chapter 2. Key message 8	17. Southeast and Caribbean		587	23	The text has been revised to incorporate this suggestion.
Michael	Wehner	Figure 10.1 shows 100F days. There is a possible opportunity for a cross chapter consistency in this figure.	17. Southeast and Caribbean		588	1	We appreciate this suggestion, but still feel the current figure is most appropriate for conditions and concerns in the Southeast.
Michael	Wehner	This layout in figure 17.5 is confusing. Suggest add to the red figure (indicating change) the reference period and the projection period.	17. Southeast and		589	1	After consideration of this point, we still feel the existing text is clear and accurate, and the suggestion is

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			Caribbean				redundant.
Michael	Wehner	Add reference to Chapter 9, figure 9.13 for Katrina diaspora.	17. Southeast and Caribbean		593	11	The text has been revised to incorporate this suggestion.
Michael	Wehner	The amounts of warming reported imply more precision than is actually contained in projections. Suggest rounding to integer and half integer quantities.	18. Midwest		618	39	After consideration of this point, we still feel the existing text is clear and accurate. The degree of precision is standard reporting for the average from climate models, despite the large range of the various models.
Michael	Wehner	Add reference to chapter 2.	18. Midwest		618	42	We have added the suggested citation in our chapter assessment.
Michael	Wehner	Cooling degree days is not defined. The typical NCA3 reader will not know what this is. Please define in the caption or text.	18. Midwest		620	15	The caption has been revised to incorporate this suggestion.
Michael	Wehner	Is this the projected # of deaths for the entire 2081-2100 period or per year. Figure title should be more specific.	18. Midwest		624	14	We thank the reviewer for the helpful suggestion, and have removed the figure in favor of text explanation.
Michael	Wehner	Annual precipitation changes are not as robust as seasonal changes nor as important to impacts. Referring to figures 2.12 and 2.13, winter and spring precip increases in the northern midwest are indicated as significant This is direct consequence of the Clausius Clapeyron relationship as well as increased poleward water transport due to circulation changes and is reflected in the model projections. Note that summer and fall changes are not judged to be significant relative to natural variations. I suggest deleting the sentence about annual changes and replacing with the more precise assessment: "Winter and spring precipitation are confidently projected to increase in the northern states of the midwestern region under the A2 scenario. However, summer and fall precipitation are not projected to significantly change anywhere in the Midwest." high confidence in this statement can be made in the Traceable Accounts section. Reference Chapter 2 and the Appendix.	18. Midwest		627	14	The text has been revised to incorporate this suggestion.
Michael	Wehner	"...climate models project less snow" This statement may or may not be at odds with figure 2.12, 2.13. Is there a citation for this part of the statement?	18. Midwest		629	14	The text has been revised to incorporate this suggestion.
Michael	Wehner	Annual precipitation changes are not as robust as seasonal changes nor as important to impacts. Referring to figures 2.12 and 2.13, winter and spring precip increases in the northern great plains are indicated as significant This is direct consequence of the Clausius Clapeyron relationship as well as increased poleward water transport due to circulation changes and is reflected in the model projections. Note that summer and fall changes are not judged to be significant relative to natural variations. I suggest deleting the sentence about annual changes and replacing with the more precise assessment: "Winter and spring precipitation are confidently projected to increase in the northern states of the Great Plains region under the A2 scenario. However, summer and fall precipitation are not projected to significantly change anywhere in the Great Plains." High confidence in this statement can be made in the Traceable Accounts section. Reference Chapter 2 and the Appendix.	19. Great Plains		660	9	The text has been revised to incorporate this suggestion.

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Michael	Wehner	"Projected increases in precipitation in the Northern Plains will benefit agricultural productivity by increasing water availability and reducing reliance on irrigation." Is this statement still true if precipitation increases are confined to the winter and spring seasons? See my comment about page 660. lines 9-13	19. Great Plains		664	6	The text has been revised to incorporate this suggestion.
Michael	Wehner	The mean precipitation statements are inconsistent with figures 2.12 and 2.13 and can be made more precise. Winter and spring precipitation decreases are a robust consequence of the expansion of the Hadley circulation and a poleward shift in storm tracks. This physical understanding is reinforced by both CMIP3/5 multi-model projections. However, due to large natural variability in the North American monsoon, projected changes are judged not significant by the criterion of chapter 2. Suggest revising this assessment to "Under a high emissions scenario (A2), significant reductions in winter precipitation is projected for the southern part of the Southwest and significant reductions in spring precipitation for the entire Southwest region by 2100. Summer and fall precipitation is not projected to significantly change anywhere in the Southwest region." For the traceable accounts, confidence in this assessment is high for the desert southwest and medium for Northern California. The latter is due to uncertainties in the amount of poleward shift of extratropical cyclones.	20. Southwest		689	11	We have rewritten the text in Chapter 20 to reflect current understanding of the seasonal precipitation projections.
Michael	Wehner	add reference to chapter 7 and appendix, figure 31	20. Southwest		695	14	Thank you for your suggestion. We have added text pointing to chapter 7, but report policy is not to point to the appendix.
Michael	Wehner	"Almost complete loss of subalpine forests is expected by the 2080s." Statement is unclear. Is this assessment dependent on a high emission scenario?	21. Northwest		721	21	The text has been revised to incorporate this suggestion.
Michael	Wehner	"3.3_F to 9.7_F" implies a level of precision that the projections do not provide. Suggest rounding to "3_F to 10_F"	21. Northwest		722	23	The degree of precision is standard reporting for the average from climate models, despite the large range of the various models. Sufficient precision also permits retrieval of original centigrade values from Fahrenheit.
Michael	Wehner	"Seasonally, model projections range from modest decreases to large increases in winter, spring, and fall". This statement is indeed the case. Per figures 2.12 and 2.13, this type of behavior in projections results in the amount of change not to be judged significant relative to natural variability. This assessment statement would be improved by indicating that large changes in these seasons are not expected in coastal Northwest.	21. Northwest		722	28	The text has been revised to incorporate this suggestion. The figure in question comes from GCM results, and the spatial patterns are not robust at the scale suggested by the reviewer. NARCCAP results (Kunkel et al. 2012) show a quite different, and more believable, pattern.
Michael	Wehner	The projected decrease in summer Northwest precipitation is remarkably robust across generations of models (figures 2.12 and 2.13), also see the appendix. Confidence in this projected change would be increased if a plausible physical mechanism of change is offered. I note that no assessment of confidence is made in the Traceable Accounts for this projection. Is the understanding of the mechanisms behind the model projections high enought that one be made?	21. Northwest		722	34	The text has been revised to incorporate this suggestion. However, it is not our role to evaluate mechanisms of modeled change unless that has been done in peer-reviewed papers.

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Michael	Wehner	The is also a seasonal dependence on the sign and magnitude of extreme precipitation. The NARCCAP models project both negative and positive changes in seasonal maximum and 20 year return value in the Northwest. However, the projected changes are not particularly robust, partly due to structural problems in the experimental design. See M.F. Wehner (2013) Very extreme seasonal precipitation in the NARCCAP ensemble: Model performance and projections. Climate Dynamics 40, 59-80. DOI: 10.1007/s00382-012-1393-1 but don't feel obligated to cite this self reference.	21. Northwest		724	9	The text has been revised to incorporate this suggestion.
Michael	Wehner	"...Modeling studies indicate, with near 100% likelihood, that reductions in summer flow will occur by 2050 in basins" Under which scenario? Both B1 and A2? This statement should be made conditional.	21. Northwest		725	9	The text has been revised to incorporate this suggestion.
Michael	Wehner	There are two issues in this statement. First, precision of climate model projections is not to 0.1 degrees F. The numbers as quoted imply a level of precision that does not exist. Second, the citation is to CSIRO, one of the CMIP modeling groups. Confidence in projections comes from many sources. One of these is consistency among different modeling groups. The range of projected temperature changes in this assessmen should come from the CMIP multi-model average not from a single model. The same comment applies to page 807, lines 30 to 36. Data is readily available from Chaoter 2 authors.	23. Hawaii and U.S. Affiliated Pacific Islands		805	18	After consideration of this point, we still feel the existing text is clear and accurate. n fact, the cited reference is for the PCCSP, which used 18 CMIP3 models best suited for the Pacific to construct the regional climate projections. The Kunkel NOAA Tech Rpt, for instance, only covered HI itself, and so was not suitable for this chapter. Regarding second point, the numbers carry over the precision as reported in the source document. Sufficient precision also needs to permit retrieval of original Centigrade values.
Michael	Wehner	"(In scenario A1B, emissions are similar to scenario A2 through 2050, then reduce towards scenario B1 levels, with emissions in 2100 midway between A2 and B1" This statement is a poor description of the differences between the SRES scenarios. A1B CO2 concentrations stabilize at 720ppm in the middle of the 22nd century while B1 concentrations are stabilized at 550ppm by 2100, A2 concentrations never stabilize. Please delete or revise this description as it should be detailed elsewhere in the NCA3.	23. Hawaii and U.S. Affiliated Pacific Islands		807	5	The text has been revised to incorporate this suggestion. The definition of A1B will be provided in a glossary link in the final document and so is not needed here.
Michael	Wehner	As properly noted in the chapter, natural variations in Hawaiian precipitation are large. Hence, recent observed drying cannot be confidently linked to anthropogenic global warming. Furthermore, climate models as a group have large biases in the tropical Pacific that do not lend confidence to any projected changes. (For instance, many climate models cannot properly simulate the location and structure of the ITCZ.) As a result, mechanisms of change in tropical precipitation are poorly understood. Recent literature suggests that the "wet get wetter, dry get dryer" mechanism does not hold in the tropics and a more complicated picture is emerging. In my opinion, no confident statement can be made about the sign of the change in future Hawaiian precipitation can be made until these issues are more fully understood and the models substantially improved in this regard.	23. Hawaii and U.S. Affiliated Pacific Islands		807	37	The text has been revised to incorporate this suggestion.
Michael	Wehner	What are the units of this figure? Is it population growth by county?	25. Coastal Zone Develop		868	6	The legend has been clarified.

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			ment and Ecosystems				
Michael	Wehner	Suggest changing :"Climate conditions are changing" to "Climate conditions are changing and are projected to continue to change"	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		926	10	The text has been modified as suggested.
Michael	Wehner	Refer to Figure 1.1 or to the temperature figure in the appendix that was removed but may be replaced.	27. Mitigation		958	33	We now refer to the figure on Average U.S. Temperature Projections, which has been moved to the Appendix on Commonly Asked Questions.
Michael	Wehner	Chapter 27 about mitigation only briefly mentions here the 2C target as agreed to by UNFCCC. B1 is not a temperature target based mitigation scenario but a 550ppm stabilization scenario. Under the B1 scenario, global temperature increases reach 6F (~3C) at 2100 and continue to increase due to the high ocean heat capacity. I realize that most of the report focuses on SRES scenarios but a more frank discussion of the 2C target is critical for this report. Figure 1.1 (and chapter 2) compares SRES and RCP scenarios. In particular, the RCP2.6 scenario which does stabilize near 2C, requires negative emissions (removal of GHG from the atmosphere) as pointed out in the box. Since such technologies do not exist yet at scale, it would be useful if this chapter could comment on the high likelihood of exceeding this target in the absence of significant geoengineering projects. In fact, the point that the planet is on track to exceed 2, 3 and 4C targets should be a highlighted finding in chapter 1!	27. Mitigation		964	39	The chapter is already clear that current patterns of emissions and concentrations are not on a track to hit a 2C target.
Michael	Wehner	Another factor to consider are the direct effects of large scale land use changes on the climate itself that a massive conversion to biofuels would cause. Jones et al (2012) J. Climate. http://dx.doi.org/10.1175/JCLI-D-12-00377.1	27. Mitigation		966	26	This is an important scientific concern, but beyond the scope of the mitigation chapter.
Michael	Wehner	Another barrier, albeit sensitive, to adaptation is politics. For instance, the North Carolina rules about sea level rise.	28. Adaptation		1004	2	Thank you for your comment. This is a good point and the authors believe this is covered under the text within the institutional constraints section.
Michael	Wehner	"Given the likelihood of having less water because of climate change," Refer to Chapter 2 (figures 2.12, 2.13, 2.22), chapter 3 (figures 3.1 & 3.7) and the appendix.	28. Adaptation		1010	15	We thank the commenter for this cross referencing suggestion and will incorporate into the final edits.

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Michael	Wehner	A key research priority that is missing is investment in high performance computing (HPC). Climate modelers are still limited by their access to and in their sophistication to HPC. More exensive, higher resolution models are necessary to provide the detail regional information required by decisionmakers as well as to advance understanding of several of the key uncertainties, particularly clouds and atmospheric chemistry. See the DOE ASCR report by Warren Washington http://science.energy.gov/~/media/ascr/pdf/program-documents/docs/Climat...	29. Research Agenda for Climate Change Science		1036	20	We have incorporated this suggestion in the section on the cross cutting research capability of observations, monitoring and infrastructure (CCRC#1).
Michael	Wehner	The Representative Concentration Pathways have superseded the SRES scenarios. The RCPs should be discussed in considerable more detail here. See Special Issue: The Representative Concentration Pathways in Climatic Change, Climatic Change, Volume 109, Numbers 1-2, November 2011	29. Research Agenda for Climate Change Science		1042	23	We no longer mention SRES specifically but do discuss the need for better scenarios more generally in the section on scenarios.
Michael	Wehner	For the report on sustained assessments, I suggest that a survey of the CLAs and LAs of this report be conducted.	30. The NCA Long-term Process: Vision and Future Development		1052	25	The comment is directed to a statement in the Traceable Account and concerns the in prep Sustained Assessment Special Report. No change is suggested to the chapter itself and so no action is necessary; however, the NCADAC may want to take this recommendation under advisement.
Michael	Wehner	The cooling of the stratosphere is another important indicator of climate change and should be included in this figure.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1059	13	After consideration of this point, we still think the figure is clear and accurate. The authors have deliberated and decided on the most important information to include in the figure.
Michael	Wehner	"It is virtually certain that future global temperatures averaged over climate timescales of 30 years or more will be higher than preceding periods". "Virtually certain" should be revised to "Very Likely" as it is difficult to rule out a 30 year hiatus with 1% chance.	Appendix: NCA Climate Science - Addressing Commonly Asked		1067	18	We have removed the phrase "it is virtually certain" and have revised the text to incorporate this suggestion.

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			Questions from A to Z				
Michael	Wehner	(Need Source) must be fixed. Also, the Antarctic graphic at top is of poor quality.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1086	11	The graphic has been replaced and the source fixed.
Michael	Wehner	change "to continue change" to "to continue to change"	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1089	26	The text has been revised to incorporate this suggestion.
Michael	Wehner	Add some measure of uncertainty	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1090	2	Uncertainties due to forcings are included in the revised figure.
Michael	Wehner	add 40-60 uncertainty bars at 2100	Appendix: NCA Climate Science - Addressing Common		1099	2	As with figure in CAQ N, uncertainties due to forcing scenario are included in figure; across-model ranges have not been evaluated and would complicate the figure, detracting from the message about scenario dependence.

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			ly Asked Questions from A to Z				
Michael	Wehner	The multi-panel figure comparing maps of temperature change projections under different scenarios is missing. This important figure was intended to be interactive for different periods and should be restored in the final draft.	Appendix: The Science of Climate Change		1147	9	Added this figure back into the appendix. Redrawn by NCDC.
Michael	Wehner	redraw with NCDC color and projections	Appendix: The Science of Climate Change		1148	1	The figures have been revised.
Michael	Wehner	I have read the entire report and find that it is a comprehensive assessment of a broad spectrum of climate change activities, from the state of the science, to impacts, and to solutions. The message that climate change is happening and will continue is loud and clear. However, the message that we are on track to exceed the UNFCCC target of 2C by a large margin could be made much stronger. This is important enough to be part of the executive summary, in my opinion.The report would benefit from more cross-chapter coordination. I see that as its weakest aspect. I found only a few inconsistencies, which I tried to comment on. However, there are some substantial duplications, which at the least should reference each other if not be consolidated. In particular, the recent severe hurricanes are discussed by name in several chapters without any apparent coordination.	Introduction: Letter to the American People				Your comment regarding the current emissions pathway is well taken - but this topic is already mentioned several times in the executive summary . In the electronic version of the text there will be easier ways to link across chapters than in the current draft, where this is very difficult.
Michael	Wehner	UNFCCC is spelled wrong	27. Mitigation		979	36	We have edited the text.
Michael	Wehner	UNFCCC is spelled wrong	27. Mitigation		964	40	The text has been revised as suggested.
Joachim	Seifert	The role of natural forcings are described in the lowest manner:[A.] Given are only a minimum of three "natural factors", such as 1. solar forcing, 2. volcanoe forcing 3. ocean cycle variability. Completely omitted are five macro-climate drivers, which govern the Holocene and beyond. The paper: http://www.knowledgeminer.eu/eoo_paper.html The 5 macrodrivers are meticulously proven over a 20,000 year period. [B.] Natural cycles are omitted, as the 60-year Nicolas Scafetta cycle <www.ns2002@duke.edu>. Paper: <www.Testing an astronomically based decadal-scale empirical harmonic climate model versus	2. Our Changing Climate		28		We have reviewed the source of information suggested by the Comment and find that is does not meet the Guidance on Information Quality Assurance to Chapter Authors of the National Climate Assessment: Question Tools (2/21/2012), which is used by the NCADAC to assure for each source used in the NCA Report: (1) utility, (2) transparency and traceability, (3) objectivity, and (4) Integrity and security. The abstract of

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		the IPCC (2007) general circulation models> <www.arXiv:1201.1301v1> As long as natural forcings are massively disregarded and anthropogenic forcings are massively overestimated in their effects, the FACCAR must be rejected to be good President´s policy. JSei.					the suggested reference refers to mechanisms that would not have any effect on the climate over the time scales examined in climate models.
John	Garver	This note includes a few comments about the "Northeast" chapter from the perspective of a geoscientist directly involved with watershed studies and hydrology in NY State. I am most concerned with problems of communicating climate change issues in the Northeast that do not recognize critical differences regionally. While it may be argued that these differences are trivial in the big picture, we have spent quite a bit of time suggesting otherwise. The difference could result in billions of dollars spent in an incorrect way. Our research has shown that the in the last few decades – since 1970 or 1980 – there has been a dramatic increase in flooding and extreme events in the Catskills and not in areas further upstate in NY (Garver and Cockburn, 2011, 2012). This work is based on hydrology of the uniquely situated Mohawk Watershed, which captures and partitions continental-tracking storms and Atlantic tracking storms. There is no question that we are seeing more extreme events, but these are not evenly distributed in the Northeast and to imply that they are dilutes the message. Specific Points:1) Reference or Citation needed: The comment (line 15-16) "The Northeast has experienced a greater increase in extreme precipitation over the past few decades than any other region in the U.S.; between 1958 and 2010, the Northeast saw a 74% percent increase in the amount of precipitation falling in very heavy events." Needs to be referenced, in part because I don't believe the data bear this out. The increase in extreme events is especially profound in the Atlantic coastal sector, but the effect is virtually unchanged far inland (in the "Northeast"). 2) Inappropriate Reference: The comment "Projections of precipitation changes are less certain than projections for temperature increases (Kunkel et al. 2012)." Cites: Kunkel, K.E., L.E. Stevens, S.E. Stevens, L. Sun, E. Janssen, D. Wuebbles, J. Rennells, A. DeGaetano, and J.G. Dobson, 2012: Climate of the Northeast U.S. Draft. I cannot find this using a simple Google search, and hence it is unlikely released on the internet. A statement like this needs a peer-reviewed reference. It almost reads like this source is an internal memo. 3) We cannot rely on naturally occurring hurricanes to demonstrate Climate Change. Comments like the following presuppose that hurricanes are climate change driven, which they are not: "Hurricanes such as Irene and Sandy provided a "teachable moment" by demonstrating the region's vulnerability to extreme weather events and the efficacy of existing and evolving adaptation/response plans." It is true that these storms tested our plans, but in probably 99% of the cases these plans were not really adaptation plans.4) This statement has just simply has to be incorrect: "The rainfall associated with Irene exceeded the estimated 1-in-500-year storm at Delanson, NY and Waterbury, VT." There is no citation for this statement, and it is inappropriate given the actual rainfall in Irene. Having dealt directly with Irene, we know where the bullseye of rain was (12-18 inches – see Westergard et al., 2012): it was NOT in Delanson, it was in the more remote headwaters of the Schoharie drainage (Greene County), and the value is well estimated by a few rain gauges and NWS Doppler estimates. ASIDE from this, however, the report would be better and more accurate if focused on IRENE hydrology (not rainfall) and to point out that in the Schoharie River it was a 500 yr flood (Gazoorian, 2012). These data are better quantified, and we have better and longer records for water flow in this relatively remote area. References:Westergard, B., J. Villani, S. DiRienzo, H. Johnson, V. Koleci, K. Lipton, G. Maglaras, K. McMahon, T. Scrom, and T. Wasula, 2012, Hydrology of Tropical Storms Irene and Lee, IN Cockburn, J.M.H. and Garver, J.I., Proceedings of the 2012 Mohawk Watershed Symposium, Union College, Schenectady, NY, March 16, 2012, p. 43.Gazoorian, C., 2012, How Extreme was Irene? A Comparison of	16. Northeast				In reference to the first point about the catskills: certainly regional variations are critical, but this report cannot provide specificity at such small landscape scales, and projections at that scale are even more uncertain than at the larger scale of GCMs. Given how large natural variability is for extreme preciipitation events, local trends may not be a good local predictor of extreme precipitation. We do spatial mention variation in flood risk though on p558, lines 11-15 that highlights valleys such as the Catskills. 1) on p551, we added Groisman et al 2013 who created the figure used in Ch2 with this fact. Groisman, PY, RW Knight, and OG Zolina, 2013, Recent Trends in Regional and Global Intense Precipitation Patterns, Climate Vulnerability, http://dx.doi.org/10.1016/B978-0-12-384703-4.00501-3 2) the reference is now a NOAA technical report NESDIS 142-1 available on the NCA website and from NOAA. 3) the sentence does not imply we are 'relying' on them, just that they can help focus attention on gaps in current response plans and future plans. 4) The text has been revised to incorporate this suggestion.

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		the 2011, 1996 and 1987 Floods along the Schoharie Creek, IN Cockburn, J.M.H. and Garver, J.I., Proceedings of the 2012 Mohawk Watershed Symposium, Union College, Schenectady, NY, March 16, 2012, p. 17-22.Garver, J.I., and Cockburn, J.M.H., 2011, Changes in the Hydrology of the Mohawk Watershed and implications for watershed management, In Cockburn, J.M.H, and Garver, J.I. (eds) Mohawk Watershed Symposium 2011, Union College Schenectady NY, 18 March 2011, p. 16-21.Garver, J.I., and Cockburn, J.M.H., 2012. Change in the Mohawk Watershed and vulnerability to Infrastructure. In Cockburn, J.M.H, and Garver, J.I. (eds) Mohawk Watershed Symposium 2012, Union College Schenectady NY, 16 March 2012, p. 12-16.					
Connie	Barlow	The line reads: "4) assisted migration to help move species and populations from current locations to 11 those areas expected to become more suitable in the future;"My comment: Thank you for using the original term for this adaptation method ("assisted migration") rather than alternative terms suggested later in the scholarly literature (terms include "assisted colonization" and "managed relocation"). "Assisted migration" is not only the original term (named by Brian Keel), but it is the only term that suggests assistance as part of a natural process -- the process of species migration as climate changes. I am the citizen naturalist who founded Torreya Guardians, and in 2008 we helped the highly endangered conifer tree Torreya taxifolia move 600 km to the north (from the Apalachicola River of Florida panhandle, where it has not been able to reproduce since the 1960s) to Waynesville in the mountains of North Carolina. Torreya is an ancient genus, tens of millions of years old. Surely it has migrated north and south a number of times as climate has shifted. (Its pollen is indistinguishable from genera Cupressus and Taxodium, so unfortunately there is no fossil evidence in the Appalachian Mountains to prove its prior residence there).If you are receiving pressure to change the term from "assisted migration" to something else, please resist that pressure. The name is very important to present this adaptation strategy as a little human assistance in an otherwise very natural process. For the history and arguments on this naming concern, please see, "Assisted Migration or Assisted Colonization: What's In a Name?" http://www.torreyaguardians.org/assistedmigrationdebate.htmlIf you are interested in learning more about the assisted migration project that we Torreya Guardians have already undertaken, visit our website: http://www.torreyaguardians.orgWe are very excited that our 2008 migration effort is proving successful, and we now have data that indicate the genus's habitat preferences in its new post-climate-change "native" habitat. Go to this page to learn more: http://www.torreyaguardians.org/learnings.htmlOne more thing: Our entire project was undertaken by citizen naturalists using our own free labor, plus a little of our own money for transportation and to purchase seedlings from a nursery. We suggest that our effort should set a good precedent for responsible citizen naturalists to undertake similar projects with little or no taxpayer assistance -- other than supervisory roles played by funded scientists. To economize on funding, and to ensure that every species is given an opportunity to migrate, Americans must make use of the voluntary labor lovingly provided by experienced citizen naturalists.	8. Ecosystems, Biodiversity, and Ecosystem Services		300	10	Thanks for the nice comment!
Edwin	Sheffner	One of the key messages in the chapter describes the impacts of increased warming on wildfires and ecosystems in the region. One of the key impacts to ecosystems is the change in "natural" ecosystems due to invasive species. Such changes are encouraged by wildfire, for example, the spread of Bufflegrass	20. Southwest				Thank you for your comment. Due to the size of the region/topic, and the page limit for the chapter, we focused on broad trends rather than delving too deeply or providing such a level of

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		(Pennisetum cilare) in the Sonoran Desert region. This species not only increases the intensity of wildfires but also out competes native species for re-growth in post-fire environments. Although the problem of invasive species is described in overall chapters of the report, the term does not appear in chapter 20. This seems to be a significant omission - deserving of at least a line or two of recognition in the chapter.					specificity. However, we have incorporated the topic of the spread of invasive plants after wildfire into the text, as well as a reference for it.
Alexander	Cannara	Referring to...http://ncadac.globalchange.gov/ http://ncadac.globalchange.gov/download/NCAJan11-2013-publicreviewdraft-chap4-energy.pdfPlease let us move away from the fundamentally incorrect use of the term "energy" when referring to combustion fuels, or other power sources that require more than one physical/chemical resources be combined to release stored energy.For example -- Figure 4.1: Paths of Hurricanes Katrina and Rita Relative to Energy Production FacilitiesExtraction and refining systems/sites are not "Energy Production Facilities" -- these are all sources of chemicals. They do not source "energy". They assume, as almost all the combustion industry does, that users of their products will have their own sources of the other component(s) needed to release some of the product's energy -- i.e., the petroleum or coal customer is assumed to have oxygen freely available to release chemical energy from oxidation.In contrast, common nuclear energy is released by fission of individual atoms, purchased as a complete energy source, and not requiring co-consumption of other purchased materials. Solar PV/hot-water also is a direct, complete power source via just one input -- sunlight.So, referring to fossil-fuels as "energy" sources is fundamentally incorrect and leads to confusions in the general public's mind regarding both science and policy.	4. Energy Supply and Use				Although there are some technical bases on which we can agree with your comment, we are strongly aware that in industry and public vernaculars, the word "energy" has become synonymous with "energy resources" or "energy fuels". In our efforts to engage both technical accuracy and accessibility in public audiences, we will continue to use conventional terms associated with energy production and use.
Edward	Jones	I am writing to you because of my concern about a lack of detail in NCADAC reports about changes in regional weather patterns. I have noticed a significant change in the storm tracks in the Eastern Pacific area as they approach North America. In all of your documents that are available on the internet, I find few, if any, references to this geographic area.I have been involved in weather associated with aviation in the United States since 1971. I was trained in weather observation and pilot weather briefing by the National Weather Service and FAA in 1971-1972, and was a Flight Service Specialist until 1985. Since then, I have been involved in military and civilian flight test, which has necessitated keeping up with weather patterns. I have almost 40 years of experience in this field.Here is what I have observed about the weather patterns.From 1971 through about 1990, low pressure systems with their associated cold fronts formed in the Gulf of Alaska, and would move to the southeast making contact with southeastern Alaska and British Columbia, then Washington, Oregon, and then northern California. The storms would then move almost straight east, with the southern "tail-end" brushing southern California. Additionally, the storm speed would decrease by about 1/3 as it moved onshore and encountered more resistance from the land mass than compared to open water.Since the early 1990s, I have observed storms forming south of the Gulf of Alaska, moving south over the Pacific toward warmer water, then finally changing direction toward the east, coming onshore more often in California and Oregon, sometimes missing Washington almost completely. Because of their more southerly track, the storms are warmer than pre-1990, dropping more rain than snow. As they move onshore, they are not slowing as much, either.I would caution you against relying too heavily on the National Weather Service for information on this phenomenon. When I was in training in the 1970s, my Weather Service instructors freely admitted that they had little knowledge of United States weather west of the Rocky Mountains. They talked about Weather Service forecasters calling long-time FAA air	2. Our Changing Climate				The study of storm tracks is a very active area of research and we provide some basic information in the "Changes in Storms" section of the report with associated references. The comment points to a shift in storm tracks to the south over the North Pacific during the past 2 decades relative to the 1970s and 1980s. There is no evidence for this shift in the published literature. We also did an analysis ourselves, motivated by this comment, on the main winter storm season of November through March and found no shift in storm tracks. In fact, we found that there has been a higher number of storms affecting the coast during the 1990s and 2000s, relative to the 1970s and 1980s, all the way from central California to Alaska. No change made to the text.

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		traffic controllers in the western U.S. for insight into the weather patterns there. A good example of Weather Service deficiency in that regard, is the fact that their computer models for forecasting winds aloft for aviation purposes consider the Rocky Mountains and Sierra Nevadas to be no more than 10,000 feet high, when in fact, much of both ranges are at 12,000 to 14,000 feet.I am not qualified to suggest causes, but what I have described is the effect of something. I have found no detail on this kind of change in your documents, and that is the cause of my concern. This constitutes a major gap in your data. I am sure that if you were to investigate, you could find people all over the world who could tell you about regional weather pattern changes. Without such input, and a rigorous investigation that could potentially tie this information to the rest of what you have amassed, I don't think you can come to a competent conclusion about climate change.					
Vladimir	Abramov	The warning notices of two Super storms disclose costs of excessive emissions for USA at 21st century: (1) some machine uses only huge motor(s) power (s) that eliminates needed levers as is gear-transmission; (2) many thousands pounds of over 250 million vehicles are accelerated by gas or magnet field; (3) transmission struggle with acceleration system because motor wastes up to 80% mechanical energy in the form of its heat, and (4) 3 billion machine tools with excessive powers of motors are required using too many number of dirty power plants. As an USA inventor of the above 1,000 gearbox apparatus designs of forced energy economy system (GAFEES) and many years experience at gear-transmission designs and manufacture in Russia and the United States of America, I would like transform the existing propulsions of transportation, machine tools, heavy-duty equipment and other motorized machines to non-accelerated propulsions for interest of their customers. The GAFEES with computer produces all needed speeds by least number of gears for 1 (one) second in automatic regime. It eliminates acceleration system by gas or magnet field and uses only idle speed or highest torque of existing motor. For example, driver of the long haul tracking saves above $25,000 per year by diesel ($3) economy (USA patent 8,011,274 at 09/06/2011).For example, chosen gearbox apparatus of car could open an opportunity to replace also the existing motor power by motor with reduced power and cost up to power of the first steel vehicle of Carl Benz at January 29, 1886, Germany (patent #37435) according to two physics laws of lever and inertia. There is customer of existing motorized machine has energy economy more than 2 times. Revolutionary innovation is finalist at Cleantech and Energy. An article is appeared in 2012 Minnesota's TEKNE AWARDS magazine.	5. Transportation				We appreciate your comment. However, your suggestion is outside the scope of the National Climate Assessment.
Vladimir	Abramov	The warning notices of two Super storms disclose costs of excessive emissions for USA at 21st century: (1) some machine uses only huge motor(s) power (s) that eliminates needed levers as is gear-transmission; (2) many thousands pounds of over 250 million vehicles are accelerated by gas or magnet field; (3) transmission struggle with acceleration system because motor wastes up to 80% mechanical energy in the form of its heat, and (4) 3 billion machine tools with excessive powers of motors are required using too many number of dirty power plants. As an USA inventor of the above 1,000 gearbox apparatus designs of forced energy economy system (GAFEES) and many years experience at gear-transmission designs and manufacture in Russia and the United States of America, I would like transform the existing propulsions of transportation, machine tools, heavy-duty equipment and other motorized machines to non-accelerated propulsions for interest of their customers. The GAFEES with computer produces all needed speeds by least number of gears for 1 (one) second in automatic regime. It eliminates acceleration system by gas or magnet field	10. Water, Energy, and Land use				Thank you for your comment, but your suggestion is outside the scope of this report.

First Name	Last Name	Comment	Chapter	Figure/ Table Number	Start Page	Start Line	Response
		and uses only idle speed or highest torque of existing motor. For example, driver of the long haul tracking saves above $25,000 per year by diesel ($3) economy (USA patent 8,011,274 at 09/06/2011).For example, chosen gearbox apparatus of car could open an opportunity to replace also the existing motor power by motor with reduced power and cost up to power of the first steel vehicle of Carl Benz at January 29, 1886, Germany (patent #37435) according to two physics laws of lever and inertia. There is customer of existing motorized machine has energy economy more than 2 times. Revolutionary innovation is finalist at Cleantech and Energy. An article is appeared in 2012 Minnesota's TEKNE AWARDS magazine.					
Vladimir	Abramov	The warning notices of two Super storms disclose costs of excessive emissions for USA at 21st century: (1) some machine uses only huge motor(s) power (s) that eliminates needed levers as is gear-transmission; (2) many thousands pounds of over 250 million vehicles are accelerated by gas or magnet field; (3) transmission struggle with acceleration system because motor wastes up to 80% mechanical energy in the form of its heat, and (4) 3 billion machine tools with excessive powers of motors are required using too many number of dirty power plants. As an USA inventor of the above 1,000 gearbox apparatus designs of forced energy economy system (GAFEES) and many years experience at gear-transmission designs and manufacture in Russia and the United States of America, I would like transform the existing propulsions of transportation, machine tools, heavy-duty equipment and other motorized machines to non-accelerated propulsions for interest of their customers. The GAFEES with computer produces all needed speeds by least number of gears for 1 (one) second in automatic regime. It eliminates acceleration system by gas or magnet field and uses only idle speed or highest torque of existing motor. For example, driver of the long haul tracking saves above $25,000 per year by diesel ($3) economy (USA patent 8,011,274 at 09/06/2011).For example, chosen gearbox apparatus of car could open an opportunity to replace also the existing motor power by motor with reduced power and cost up to power of the first steel vehicle of Carl Benz at January 29, 1886, Germany (patent #37435) according to two physics laws of lever and inertia. There is customer of existing motorized machine has energy economy more than 2 times. Revolutionary innovation is finalist at Cleantech and Energy. An article is appeared in 2012 Minnesota's TEKNE AWARDS magazine.	2. Our Changing Climate				We thank the reviewer for their comment. However, there is nothing in the comment that has any effect on the chapter materials.
Vladimir	Abramov	The warning notices of two Super storms disclose costs of excessive emissions for USA at 21st century: (1) some machine uses only huge motor(s) power (s) that eliminates needed levers as is gear-transmission; (2) many thousands pounds of over 250 million vehicles are accelerated by gas or magnet field; (3) transmission struggle with acceleration system because motor wastes up to 80% mechanical energy in the form of its heat, and (4) 3 billion machine tools with excessive powers of motors are required using too many number of dirty power plants. As an USA inventor of the above 1,000 gearbox apparatus designs of forced energy economy system (GAFEES) and many years experience at gear-transmission designs and manufacture in Russia and the United States of America, I would like transform the existing propulsions of transportation, machine tools, heavy-duty equipment and other motorized machines to non-accelerated propulsions for interest of their customers. The GAFEES with computer produces all needed speeds by least number of gears for 1 (one) second in automatic regime. It eliminates acceleration system by gas or magnet field and uses only idle speed or highest torque of existing motor. For example, driver of the long haul tracking saves above $25,000 per year by diesel ($3) economy (USA patent 8,011,274 at	Appendix: The Science of Climate Change				We thank the reviewer for their comment. However, there is nothing in the comment that has any effect on the chapter materials.

First Name	Last Name	Comment	Chapter	Figure/ Table Number	Start Page	Start Line	Response
		09/06/2011).For example, chosen gearbox apparatus of car could open an opportunity to replace also the existing motor power by motor with reduced power and cost up to power of the first steel vehicle of Carl Benz at January 29, 1886, Germany (patent #37435) according to two physics laws of lever and inertia. There is customer of existing motorized machine has energy economy more than 2 times. Revolutionary innovation is finalist at Cleantech and Energy. An article is appeared in 2012 Minnesota's TEKNE AWARDS magazine.					
Vladimir	Abramov	The warning notices of two Super storms disclose costs of excessive emissions for USA at 21st century: (1) some machine uses only huge motor(s) power (s) that eliminates needed levers as is gear-transmission; (2) many thousands pounds of over 250 million vehicles are accelerated by gas or magnet field; (3) transmission struggle with acceleration system because motor wastes up to 80% mechanical energy in the form of its heat, and (4) 3 billion machine tools with excessive powers of motors are required using too many number of dirty power plants. As an USA inventor of the above 1,000 gearbox apparatus designs of forced energy economy system (GAFEES) and many years experience at gear-transmission designs and manufacture in Russia and the United States of America, I would like transform the existing propulsions of transportation, machine tools, heavy-duty equipment and other motorized machines to non-accelerated propulsions for interest of their customers. The GAFEES with computer produces all needed speeds by least number of gears for 1 (one) second in automatic regime. It eliminates acceleration system by gas or magnet field and uses only idle speed or highest torque of existing motor. For example, driver of the long haul tracking saves above $25,000 per year by diesel ($3) economy (USA patent 8,011,274 at 09/06/2011).For example, chosen gearbox apparatus of car could open an opportunity to replace also the existing motor power by motor with reduced power and cost up to power of the first steel vehicle of Carl Benz at January 29, 1886, Germany (patent #37435) according to two physics laws of lever and inertia. There is customer of existing motorized machine has energy economy more than 2 times. Revolutionary innovation is finalist at Cleantech and Energy. An article is appeared in 2012 Minnesota's TEKNE AWARDS magazine.	29. Research Agenda for Climate Change Science				This is not a technology assessment. We are unable to provide this level of detail on mitigation in the chapter.
Sol	Shapiro	After scanning the Executive Summary, I have seen what I consider a glaring omission. There is no discussion of Solar Radiation Management (SRM) as a means of putting climate change on hold in short order and the need to study whether using SRM will see a "better" result than not deploying SRM. There is an ethical/moral imperative to study SRM because climate change may be causing increased deaths and destruction in this generation which may possibly be avoided with SRM. Is it ethical to ignore SRM and kill people in this generation to gain marginal leverage to change the world's energy base?	1. Executive Summary				The authors agree that this is an important point, but this is a scientific assessment and there is limited capacity to handle every topic within this report.
Nedal	Katbehbader	to add after more acerage: and tens of millions of trees.	Introduction: Letter to the American People		1	19	The authors appreciate the suggestion, but still feel the text is clear and accurate.
Nedal	Katbehbader	to change (and assesses observations and research) to: and assessing observations and scientific research findings.	Introduction: Letter to		1	32	Good suggestion, changes will be made.

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			the American People				
Nedal	Katbehbader	to add after society: and government.	Introduction: Letter to the American People		2	1	This sentence has been modified in response to another comment.
Nedal	Katbehbader	to add after people: and thier environmet.	1. Executive Summary		3	2	After consideration of this suggestion, we still feel the text is clear and accurate. Impacts of climate change on the environment are addressed elsewhere in the Executive Summary.
Nedal	Katbehbader	to change activity to; activities.	1. Executive Summary		3	6	The authors prefer the existing language.
Nedal	Katbehbader	to add after Americans' the word: Lives, health....	1. Executive Summary		3	7	The authors prefer the existing language.
Nedal	Katbehbader	to add after warming: at an alarming rate.	1. Executive Summary		3	20	After consideration of this point, the authors still feel the existing text is clear and accurate.
Nedal	Katbehbader	next few decade: it is adviseable to define periods in years.	1. Executive Summary		3	26	It is not scientifically possible to specify the exact numbers of years related to this statement.
Nedal	Katbehbader	to add after (referred to as the "A2senario"):. This raise in temreature is expected to have serious impact on lives, livelyhood and ecosystems.	1. Executive Summary		3	31	This description of the A2 scenario is not intended to include a discussion of impacts. It is important to distinguish the scenarios themselves from the associated impacts.
Justin	Yarros	The following is from American Security Project's CEO Brigadier General Stephen Cheney, USMC (Ret.):ASP is encouraged by the draft climate report released by the National Climate Assessment and Development Advisory Committee (NCADAC). We commend the NCADAC for releasing this timely report, which confirms that climate change presents national security threats to the United States. Rising sea levels, drought, severe storms, excessive precipitation, and changing temperatures threaten our infrastructure and economic output. The report presents some scary statistics to strengthen its case. U.S. average temperatures have increased 1.5°F since 1895, with more than of 80% of the increase coming after 1980. Global sea level is 8 inches higher than it was in 1880 and is projected to rise by 1 to 4 feet by 2100. Ice volume is quickly decreasing; 2012 set a record for minimum area of Arctic ice. In some places, heat waves, floods, and droughts are expected to increase in ferocity and frequency; meanwhile, hurricanes overall have become stronger and the amount of Category 4 and 5					We greatly appreciate your positive comment.

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		hurricanes has gone up in the North Atlantic since 1980.The report recommends a three-tiered approach to this: the reduction of emissions, adaption, and preparation. These three strategies will allow us to avoid the worst effects and mitigate the realities of the climate change threat. We believe climate change is a serious national security threat and the issues in the NCADAC's report highlight the need to find long-term solutions.					
Matthew	Rollins	The statistics attributed to Hedde 2012 on p296, p308, and p309 are incorrect. 8.7 million acres burned in wildfires in 2011. A better citation would be the Online information at the National Interagency Fire Center in Boise, ID. There is a full report available, but this specific stat may be found here:http://www.predictiveservices.nifc.gov/intelligence/2011_statssumm/charts_tables.pdfWhat really caught my eye was the 1.9 million in property losses. This is off by at least one order of magnitude. A total for property loss is hard to come by, but the National Fire Protection Association has the the following: "$541,000,000 in fires outside of structure with value involved, a significant increase of 31.0% (this reflects the Bastrop County Texas Complex Wildfire with an estimated property loss of 400,000,000)"Citation here: http://www.nfpa.org/assets/files/pdf/os.fireloss.pdfThe Hedde 2012 citation in the references points to a dead link to a Fox News channel in Connecticut. Digging further, the specific report from the Munich Reinsurance organization that Hedde is affiliated with is protected, and only available to 'members' of the Munich Reinsurance America web data portal.	8. Ecosystems, Biodiversity, and Ecosystem Services				Changed as suggested.
David	Victor	I have scanned the totality and read 8-10 chapters in some depth, including all the chapters relevant to energy issues plus the chapter on adaptation and some of the regional chapters. On the one hand, the activity is impressive for the sheer number of people and topics it engages. On the other hand, none of the chapters goes into much depth on any topic—instead, most of the chapters are thin overviews of issues that people who work on climate already know. (And people who don't work on climate probably won't read this.) The chapters each focus on a few key findings, but it is hard to know what to do with the findings. A big rethink throughout the whole document is needed--what can be done to offer more practical, actionable findings that real people will understand? For example, the chapter on water, energy and land use (ch.10) talks about the various ways that water availability affects energy systems. Yet even the most basic statistics (e.g., water consumption per Mwh of electricity produced) are not presented in ways that allow for a standardized comparison across options. The folks in the energy business know a lot about all this already (not so much because of climate change but more because of a slate of new cooling water rules known as "316(b)" after the relevant portion of the Clean Water Act.) There are interesting regional maps regarding water stress, but nothing is done to connect those issues to the nuts and bolts of the grid or other aspects of the energy system. The chapter on mitigation is completely mystifying. It includes some really profound graphics (figure 27.1, for example). But it never really puts the picture together into a strategy or even a holistic vision. One of the macro conclusions concerns voluntary and state-based initiatives (which are very important) yet no effort is made to quantify the totality of those efforts. And perhaps the oddest part of this chapter is that it is silent about the international picture even though the executive summary for the whole NCA makes a special point of underscoring the international nature of the climate issue and nothing the US does at home should be done without some sense of how that affects the international. I thought the regional chapters were generally more solid and focused—I read, in particular, the southwest chapter and learned a lot from that. I still wonder what actual regional and local planners will do with this					Due to the number of topics that could be relevant, and the page limits for the chapters, and the general audience for the report, we focused on broad trends rather than delving too deeply or providing such a level of specificity. We appreciate these suggestions, but the author team has deliberated and agreed on the most important information and illustrations to include. Many of these suggestions have been incorporated in the revisions in individual chapters, in response to specific comments on those chapters.

First Name	Last Name	Comment	Chapter	Figure/ Table Number	Start Page	Start Line	Response
		information. Similarly, I am a bit puzzled as to what planners and other policy makers will do with the chapter on decision support (#26), which outlines some idealistic visions for how collaborative decision-making processes should be structured, a few general ideas about how real humans perceive risks and make decisions, and then some broad conclusions. For me, the most interesting chapter was #28 (adaptation). There is a striking figure (#28.1) about the status of climate adaptation plans at the state level. (IN brief, the states are way behind—and the coastal blue states are, hands down, doing much better then all the rest, even the gulf states.) The chapter includes a fire hose of information about regional and local adaptation plans (part II), which is interesting to read but hard to digest in totality. It includes a fascinating statistic that 59% of local governments are engaged in some kind of adaptation planning (p.992). The case studies are interesting to read through—in part because they make it clear that "adaptation" isn't a single effort or planning activity. It's a million things done by a million actors, largely driven by self-interest. There's a LOT of work to be done understating how adaptation will really unfold, the potential role for outsiders in helping societies adapt, etc.					
Jacob	McCandless	Carbon dioxide reacts with water in the liquid state or the gaseous state.http://www.nuffieldfoundation.org/practical-chemistry/reaction-between-carbon-dioxide-and-waterCarbon dioxide is a component of rainwater. It is attributed to acid rain.http://www.chemistry.wustl.edu/~edudev/LabTutorials/Water/FreshWater/acidrain.htmlThe following reaction was proposed as a means of sequestering CO2 by spreading Olivine. Mg2SiO4 + 4 CO2 + 4 H2O > 2 Mg2+ + 4 HCO- + H4SiO4ftp://ftp.geog.uu.nl/pub/posters/2008/Let_the_earth_help_us_to_save_the_earth-Schuiling_June2008.pdf	27. Mitigation		957	6	We have clarified the sentence to be clear that CO2 in the atmosphere does not have important chemical interactions that change its concentrations appreciably.
Sean	Kelly	Test – copy word document…..					This comment does not appear to be relevant to the material at hand.
Thomas	Foote	"(DAYCENT) assumes that water supplies and nutrients are maintained at adequate levels". I am a small farmer north of Spokane. My aquifer depends on snowpack runoff to meet increasing ag and residential demands. You cannot assume "adequate" levels of supply and still be able to project consequences on agriculture. Western snowpack is the critical source of irrigation water for ag in the west. Every study to date has shown, despite projected increases in winter precipitation (in the form of rain) in my area (Eastern Washington State), there will be decreasing snowpack, meaning less water for our aquifers, and earlier runoff, meaning the runoff will be available even earlier than it is needed. Studies also show an increase in length of dry periods as well. You must factor in decreasing water supplies and increased competition for those supplies. Over the next couple of years I am going to digging cisterns to hold early runoff to try and meet my demands later in the summer. I have discovered that sequestration of rainwater is illegal in WA state as it is other states. I worry that these laws will start to be enforced as time goes by.	6. Agriculture		232		We appreciate your comment. We have modified the text to clarify that the crop model used in this analysis assumes that water supplies (soil moisture) and nutrients are maintained at adequate levels, while temperature increased with the projected CO2 increases concurrent with these emission scenarios.
Rebecca	Romsdahl	I suggest adding a citation (Romsdahl et al. 2013); this was a large survey of government officials dealing with natural resource management throughout the Great Plains, the findings support this sentence. Reference: Romsdahl, R.J., Atkinson, L., and Schultz, J. (2013) Planning for climate change across the US Great	14. Rural Communities		505	32	Thank you for your comment. We have added the suggested citation in our chapter assessment.

First Name	Last Name	Comment	Chapter	Figure/ Table Number	Start Page	Start Line	Response
		Plains: Concerns and insights from government decision-makers. Journal of Environmental Studies and Sciences. DOI: 10.1007/s13412-012-0078-8					
Rachel	Riley	The author R. Peppler has been omitted from the citation. The citation should read:Riley, R., P. Blanchard, R. Peppler, T.M. Bull Bennett, and D. Wildcat, 2012: Oklahoma Inter-Tribal Meeting on Climate Variability and Change. Meeting Summary Report, from December 11, 2011 Meeting, Norman, OK	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources		467	23	The text has been revised to incorporate this correction.
Rebecca	Romsdahl	A North Dakota case study, which surveyed participants in the Conservation Reserve Program, can help support the statement; I suggest adding the citation- (Atkinson et al. 2011)Reference: Atkinson, L., Romsdahl, R.J. and M.J. Hill. (2011) Future Participation in the Conservation Reserve Program in North Dakota. Vol. 21:2 p. 203. Great Plains Research.	19. Great Plains		666	6	We have added the suggested citations in our chapter assessment.
Rebecca	Romsdahl	I suggest adding: “The population of counties in western North Dakota has doubled in the last 10 years (2010 census) due to an oil boom in the regional Bakken Formation. As US policy continues to emphasize domestic oil and gas production, further development in this northern plains region will have increasing impacts on: land use changes, habitat fragmentation, stress on the surrounding communities, and global climate change.”	19. Great Plains		668	15	The text has been revised to incorporate this suggestion.
Rebecca	Romsdahl	I suggest adding a citation (Romsdahl et al. 2013); this was a large survey of government officials dealing with natural resource management throughout the Great Plains. Based on this study, I also suggest an additional bullet to those listed: “mainstream climate planning into existing natural resource, public health, and emergency management processes (Romsdahl et al. 2013)”Reference: Romsdahl, R.J., Atkinson, L., and Schultz, J. (2013) Planning for climate change across the US Great Plains: Concerns and insights from government decision-makers. Journal of Environmental Studies and Sciences. DOI: 10.1007/s13412-012-0078-8	19. Great Plains		671	15	We have added the suggested citations in our chapter assessment.
Rebecca	Romsdahl	Based on a large survey of government officials dealing with natural resource management throughout the Great Plains, I suggest a revision- “Although there is tremendous adaptive potential among the diverse communities of the Great Plains, many local government officials do not yet recognize climate change as a problem that requires proactive planning (Romsdahl et al. 2013). Some positive steps toward greater community resilience have been achieved through local and regional collaboration and increased two-way communication between scientists and local decision-makers, but more work is needed."	19. Great Plains		672	3	The sections identified have been rearranged to incorporate your suggestion. We did not add "but more work is needed" because policy issues are beyond the defined scope of the National Climate Assessment, a scientific document that provides the basis for decision making, but does not address policy.
Rachel	Riley	The citation "Riley, R., 2011: Oklahoma Inter-Tribal Meeting on Climate Variability and Change"should	19. Great		683	28	The text has been revised to

First Name	Last Name	Comment	Chapter	Figure/ Table Number	Start Page	Start Line	Response
		read: "Riley, R., P. Blanchard, R. Peppler, T.M. Bull Bennett, and D. Wildcat, 2012: Oklahoma Inter-Tribal Meeting on Climate Variability and Change. Meeting Summary Report, from December 11, 2011 Meeting, Norman, OK"Subsequently, the "Riley 2011" in-text citations throughout the chapter should be changed to "Riley et al. 2012."http://www.southernclimate.org/publications/Oklahoma_Intertribal_Climate_Change_Meeting.pdf	Plains				incorporate this suggestion.
Rebecca	Romsdahl	I suggest the following revision, based on findings from a large survey of government officials dealing with natural resource management throughout the Great Plains. "...unfolding in municipalities of varying sizes and in diverse geographical areas, however, some regions lag behind others (Romsdahl et al. 2013)."Reference: Romsdahl, R.J., Atkinson, L., and Schultz, J. (2013) Planning for climate change across the US Great Plains: Concerns and insights from government decision-makers. Journal of Environmental Studies and Sciences. DOI: 10.1007/s13412-012-0078-8	28. Adaptation		992	16	The Romsdahl reference has been added.
Rebecca	Romsdahl	I suggest adding the following citation to increase support for these claims- (Romsdahl et al. 2013); this was a large survey of government officials dealing with natural resource management throughout the Great Plains.Reference: Romsdahl, R.J., Atkinson, L., and Schultz, J. (2013) Planning for climate change across the US Great Plains: Concerns and insights from government decision-makers. Journal of Environmental Studies and Sciences. DOI: 10.1007/s13412-012-0078-8	28. Adaptation		1004	6	Thank you for your comment. We have added the Romsdahl reference to the barriers table.
Saidur	Rahman	1. Adaptation is like high tech idea and low tech response. In this chapter, more on taking advantage of the existing situation to be described rather than risk transfer or mitidation. 2. Another table can be added to show the opportunities for in case of infrastructure. Table columns as Infrastructure type, Existing condition, Adaptative measures, Disadvantages, Opportunities and Adaptation costs etc. The more we mitigate less we have to adapt. 3. Lessons learned will not work for climate change adaptation. 4. Promote innovative material for adaptive design. Cite some appropriate examples in the document. Example: Mixing of limestone producing bacteria with concrete for marine structure to extend their lives. Another example: Tsunami proof building that is form from artificial coral reefs. the Kogami project involved to increase the capacity of the community to deal with disastes. The conceprt works from scientific concept of cathode accretion by putting a small electrical charge in the water that draws calcium carbonate out of solution and onto an iron-based skeleton. The calcium slowly accumulates and creates an artificial reef and water barrier. 5. Provide a relationship for mitigation and adaptation. Both are comprehensive response strategy. 6. In case of infrastructure in our lifelines, adaptation starts from initial design. There should be a	28. Adaptation				Thank you for your comment. It's unclear how the commenter would like us to change in the text. As such, no change was made.

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		checklist for adaptive options in the design. Example" In bridge design, freeboard should be higher as sea level will be higher in th efuture. That is possible for new design but what about existing design? Probably no option. Movable bridges will b emostly affected. Elevated highways should be ok but how vulnerable are those foundations? Adaptive measures may scour guard or protection. 7. Design criteria for highway elevation. We have to elevate obvert points of the maintenance holes and prioritize the areas for flooding. 8. Lacking of engazing right people at the right time. Scientists understand, researchers make hypothesis and engineers to implement. economocal, societal and technological risks are related. These risks can be categorized for adaptation levels. 9. Adaptive measures can be categorized for interactive risk prioritized list (from likelihood and impact rating). 10. A chart can be produced showing adaptive capacities of existing structures.					
Saidur	Rahman	1. Vulnerability assessment is required. 2. Promote community resiliency. 3. Cite more examples from recent natural disasters in USA 2. No regrets is not an option.	11. Urban Systems, Infrastructure, and Vulnerability				We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include.
Saidur	Rahman	1. Vulnerability assessment of structures is required. 2. promote community resiliency 3. No regret is not an option	11. Urban Systems, Infrastructure, and Vulnerability				We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include.
David	Hart	The phrase "Sustainable Solutions Initiative" should be "Sustainability Solutions Initiative."I am the director of this initiative (http://www.umaine.edu/sustainabilitysolutions/), which is why I noticed this discrepancy.	16. Northeast		565	24	The text has been revised to incorporate this suggestion.
Wendy	Ring	Section on Increased Pollen Production- add increased allergenicity and expansion of range for allergenic plants A Review of the Impact of Climate Variability and Change on Aeroallergens and Their Associated Effects (Final Report) EPA 2008 National Center for Environmental Assessmen Office of Research and Development http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=190306Section on Insect Borne Disease- Effect is NOT so uncertain for some diseases. WHO has maps showing the expansion of areas suitable for dengue since 1960 and into the future. Similar map exists for Chagas.	9. Human Health				We thank the reviewer for the helpful suggestions and have incorporated several additional citations into the text. Because the scope of the report is largely U.S.-focused and space is very limited, not all the relevant international studies can be discussed.

First Name	Last Name	Comment	Chapter	Figure/ Table Number	Start Page	Start Line	Response
		Effect of temperature on the vector efficiency of aedes aegypti for dengue 2 virus Douglas Watts, Donald Burke. BURKE,Department of Pathogenesis and Immunology, Disease Assessment Division, Walter Reed Army Institute of Research, Washington, DC Potential effect of population and climate changes on global distribution of dengue fever: an empirical model Simon Hales, Neil deWet Lancet 2002; 360: 830–34. http://www.bvsde.paho.org/bvsasv/fulltext/potential.pdf Environ. Res. Lett. 7 (2012) 034003 (6pp) Potential impacts of climate change on the ecology of dengue and its mosquito vector the Asian tiger mosquito Section on Fire- low birth weight from exposure to wildfire smoke in any trimester of pregnancy has been demonstrated in CA Birth Weight following Pregnancy during the 2003 Southern California Wildfires Environ Health Perspect. 2012 September; 120(9): 1340–1345. Colleen E. Reid, David M. HolstiusAdditional effects that should be mentioned:Increased immigration of environmental refugees from Asia/Pacific Islands will increase MDR TB and viral hepatitis in US.Drought increases concentrations of contaminants in drinking water which are harmful to human health, specifically nitrates, which cause miscarriages and congenital defects with acute and cancers with prolonged exposure. WHEN EVERY DROP COUNTS Protecting Public Health During Drought Conditions: A guide for public health professionals http://www.cdc.gov/nceh/ehs/Docs/When_Every_Drop_Counts.pdf A National Look at Nitrate Contamination of Ground Water B Nolan, et al Water Conditioning and Purification, January 1988,39,12:76-79 Water and Nitrogen USGS Water Science School http://ga.water.usgs.gov/edu/nitrogen.html Groundwater quality surrounding Lake Texoma during short-term drought conditions.Kampbell DH, An YJ, Jewell KP, Masoner JR.ENVIRON POLLUT. 2003;125(2):183-91 US Environmental Protection Agency, Office of Research and Development, National Risk Management Research Laboratory					
Wendy	Ring	Section on food security- Known increases in paralytic shellfish poisoning and Vibrio due to increased coastal water temperatures. Emerging Vibrio risk at high latitudes in response to ocean warming Craig Baker-Austin, Joaquin A. Trinanes, Nature Climate Change (2012) doi:10.1038/nclimate1628 Decompensation of US patients with chronic medical conditions due to evacuation and interruption of health care during extreme events is well documented. Over 7 million people in US evacuated from their homes since 2005. Dust storms due to drought in Southwest and coccidiodomycosis. Climate Factors Influencing Coccidioidomycosis Seasonality and Outbreaks. A Comrie. Environ Health Perspect.2005 June;113(6): 688–692. Experts Say Valley Fever Cases At Epidemic Levels in some Areas of California http://www.californiahealthline.org/articles/2012/9/13 Increase in Coccidiodomycosis Arizona MMWR 52 (26): 109-112Increased dust arriving from Asia and	9. Human Health				Thank you for this reference suggestion, these topics are discussed in detail in the review article (Backer and Moore 2011; Moore et al. 2008) that we reference in the text. Space limitation preclude a full discussion of HABS. Thanks for the suggestion, space limitations preclude our inclusion of all impacts of extreme events. Text and references have been added to chapter to reflect last suggestion in this comment.

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		Africa due to projected expansion of desert area. Asian dust contains pesticides and heavy metals. Dust storms in Asia result in decreased pulmonary function in children and increased cardiopulmonary hospital admissions in adults.					
Dr. Jim	Corey	So far I have read about increasing temperatures and the melting of the permafrost. This is not good, but there is something even worse. Trapped in the permafrost is methane gas CH4 which is 21 times more heat trapping than CO2. The release of this gas into the atmosphere is having a profound effect on atmospheric temperatures. Which is to say, it is compounding the problem of global warming.	1. Executive Summary				This topic is discussed in the climate science chapter and in the Alaska chapter.
Mark	Capron	General Comments (These comments apply to the document as a whole. For example, a suggestion to change the type of document from PDF to wiki. A location for holistic comments was not obvious. The Executive Summary seems an appropriate location.) Note: your job would have been easier, if this comment system had allowed strike-thru and underlining to indicated changes in suggested wording.1. We now realize our use of fossil fuels is causing more than climate change and more than global warming. We are causing rapid planet change. Our understanding of the changes the planet is experiencing and the time scales of past changes has improved since the Second National Assessment. We have learned the changes involve more than warming and climate. See Specific Comment on Chapter 1, Page 3, Line 21-. Temperature is a surrogate for all the other rapid changes to Earth ecosystems. The rapid rise of temperature in the Marcott et. al graph could represent ocean pH, severe weather, droughts, sea level, etc. It happens that temperature can more accurately and reliably be inferred from many other preserved features. The rapidity of change may cause more economic damage and loss of life/species than the overall change.The graph is from "A Reconstruction of Regional and Global Temperature for the Past 11,300 Years," Shaun A. Marcott, Jeremy D. Shakun, Peter U. Clark, and Alan C. Mix, Science 8 March 2013: 1198-1201. [DOI:10.1126/science.1228026]2. Publish the Third National Rapid Planet Change Assessment as a wiki for at least two reasons: • Decision-makers will be able to click on text or graphics and be transported to other locations in the document or even outside the document for more detail and to see how the chapters relate to each other; and • A wiki can be updated continuously, a feature which fits the Chapter 26 – Decision Support conclusion "that an "iterative adaptive risk management" framework, in which decisions are adjusted over time to reflect new scientific information and decision-makers learn from experience, is appropriate …"3. Publish the Third National Rapid Planet Change Assessment as a tablet-friendly wiki. That is with the format of an e-book for easy reading on TV screens, desktop monitors, laptops, tablets, and smart phones. (Not the two-column format of print magazines or journals.) Readers should be able to save the wiki as a PDF for reading off-line. Decision-makers may subscribe to email, text, or twitter update notices for the subject area and urgency they select.4. Publish the Sustained National Rapid Planet Change Assessment as a wiki in keeping with Chapter 30 – Sustained Assessment.5. Recommend developing a collection of Rapid Planet Change games/scenarios which play on all computer media: smart phones, notepads, notebooks, and desktop computers. Places within the document where mentions of such a game may be appropriate include:Chapter, page, lines 29, 1040, 14-40 and 1041, 1-7 – A collection of games can be "more effective means to communicate interactions of multiple stresses and levels of scientific confidence and uncertainty …"	1. Executive Summary				You are right to point out the increase in utility that online versions allow. This report is being delivered to the government in electronic format, but produced in multiple formats, including within a website, as a downloadable pdf, and in html that is searchable. There are multiple applications also being designed.

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		29, 1041, 31-37 – Gamification is a proven approach to education. 29, 1042, 1-2 – A game can develop “a more climate-informed civil society” across all languages and even with illiterate people. Inform 7 billion people with about the same expense as informing 350 million. The basic structure of the game can be an internationally shared expense. 29, 1042, 3-5 – Education is more lighting a fire than filling a bucket. A game can improve “STEM education and training programs” by lighting a fire. If you want to target a particular audience, hire young members of that audience to add their insights into the game. 29, 1042, 32-36 and 1043, 1-5 – A collection of games is a collection of scenarios explained in a way decision-makers and stakeholders (all 7 billion stakeholders) can understand.Appendix A is a draft plot for a Planet Change scenario game.6. Add a relative investment indicator (1 to 100%) of how much money to spend implementing the recommendations of each chapter and within each chapter. For example, within Chapter 29 – Research Agenda: 5% Goal 1: Deepen understanding of the climate system, feedbacks, and impacts. 20% Goal 2: Develop local, regional, national, and international options to adapt to rapid planet change. 40% Goal 3: Explore and develop options and actions that reduce the rate and magnitude of rapid planet change. 10% Goal 4: Maintain …observations and data systems essential to understanding climate rapid planet change and responding to it. 5% Goal 5: Inform and enable decision-makers to address the challenges of rapid planet change and its consequences. 15% Goal 6: Capacity Building, Education, and Workforce Development 5% Goal 7: Enhance scenarios/games to include essential attributes of coupled human and natural systems.7. Add suggestions for how we might shuffle federal budgets relative to their return on investment for the citizens of 2050 and 2100. For example, move some money from space exploration to satellites monitoring Earth, exploring and understanding oceans, and developing holistic ecosystems to address energy, food, biodiversity, and rapid planet change such as Ocean Afforestation.8. Chapters 26 and 29 should recommend finding a mechanism to decrease the cost and time for publishing peer-reviewed research related to rapid planet change. Scientists currently have two choices for peer-reviewed publication: 1) The journal must recover the cost of peer review and editing by charging for the article; or 2) The Scientist can pay in advance to allow “free” downloads. In the first case, if the research is particularly “outside the box” or multi-disciplinary, the publication must wait for a special issue journal where its topic will “fit.” In the second case, useful planet science goes unpublished.Appendix A					

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		Mad Babies vs Planet ChangeSummaryBabies catapult seaweed forest seed pods to combat Planet Change. The babies' objective is to establish enough thriving seaweed forests to return CO2 concentrations to what they were in the 1930s before ocean acidification burns most every little creature.BackgroundA human emission of greenhouse gases, mostly carbon dioxide from burning fossil fuels, has three primary effects: 1. The ocean absorbs carbon dioxide which causes it to be more acidic. Tiny shellfish cannot form shells in acid and die. The fish that eat the shellfish die of starvation. Humans won't have fish to catch and eat. 90% of ocean species go extinct. Maybe we'll be left with jellyfish. 2. Weather becomes more extreme and changes. Droughts are more common and damage more because water evaporates faster. Warmer air carries more water to make record floods more common. People have less (or more expensive) food because crops are destroyed more often. 3. The air, water, and land are generally warmer. Oceans expand as they warm. Glaciers melt. Sea level rises relatively unnoticed until storm surge on a high tide destroy cities. (Sandy hits New York.) Corals die in warmer water.(It is easier to understand the game plot with the pictures, you may email request the plot description as MSWord or PDF. This picture is a Google earth of the North Pacific from the U.S. West Coast to Hawaii.) Figure 1 – Ocean, seed pod launchers, and seaweed forestsAll the above happens in the thin layer of air and water covering Earth. Business as usual for coal, oil, and natural gas companies through 2030 essentially dooms babies born in the 21st Century to a planet where most species go extinct and humans experience more heart-ache in a decade than their parents did in a lifetime. (Or worse, for ocean creature babies.)The seed pods start seaweed forest ecosystems. The ecosystems are explained in Dr. Antoine N'Yeurt's "Negative carbon via Ocean Afforestation."Game descriptionThe playing surface is Earth viewed from space, perhaps based on Google Earth. See Figure 1. A player is given several seed pod launchers and several seed pods. The player may select any terrestrial location to set and point seed pod launchers. (Islands must have at least half their surface area more than 5 meters above 2010 sea level.) We might start with a few still pictures for background, if not the actual Google Earth.(This picture is the Indian Ocean from the Indonesia to Africa.) Figure 2 (Simple paint program has only four possible arrow directions.)Each launcher consists of a wind-up catapult and the player's selected avatar. Avatars provided in the game are babies with mad expressions. Avatars may be customizable. The player aims the catapult, winds it up, and loads one or two seed pods. The amount of winding determines the catapult's range. One winds by moving a finger in a circle on a touch screen or moving a mouse in a circle. One points by touching one end of the catapult and swinging it. Per Figure 2, the launched seed pods describe a ballistic arc to (hopefully) land in a good ocean place. Ocean creatures are relieved to have a seed pod land near them.(This figure is the South Pacific with South America on the right.) Figure 3 – Seaweed forests start to overlapWhile playing, the earth is cooking, little sea creatures are burning in acid, some places are flooding, some places are drying up, crowds of people are moving to escape sea level rise or drought. The intensity of all this is increasing over time smoothly, from a "now" to "everything dies" over about a month when you first get the game, unless there are successful					

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		seaweed forests. Each actual year, we adjust the “now” in an update of the game to match the past actual CO2 emissions.You start with one catapult and forty seed pods. Day 1 the baby can launch two pods. Day 2, four seed pods. Day 3, eight seed pods. Day 4, ten seed pods. Day 5 and any day after Day 5, you can launch up to ten seed pods. You can launch no more than ten seed pods per day.Each “successful” seed pod becomes a 10,000 hectare seaweed forest within a couple hours. If the forest continues to be effective it doubles in size each day. The player needs seaweed forest covering about 3,200,000,000 hectare (9% of ocean surface) to prevent “everything dies.” The forests need to be large and overlapping, like in Figure 3, in order to win. (Need to tweak the number of seed pods and how fast the forests grow to give a 20% chance of winning.)Version 1Researchers involved in Ocean Afforestation provide a sketch of “target areas” for the seed pods to land. Each target area has a probability of success. Some areas are 95%, some areas are 0%.The babies, catapults, flight of the seed pods, and growth of the seaweed forests are crudely animated. The seed pods and forests are simple colored blobs.Winning is a simple race against time. The earth keeps “cooking” at the same rate independent of the seaweed forest area. As soon as your forest area exceeds 3.2 billion hectares, the earth stops cooking and all the critters are happy. If you have only 3,199,999,999 billion hectares covered by forest after 30 days, everything dies.Features for successive versionsThe seed pods become animated, trash talking, animals: baby dolphins, whales, sharks, tuna, oysters, coral, etc.Everything is understandable without audio or subtitle language in a way that all 7 billion of us can play.The area of growing forest counts the overlapped areas only once.The seaweed forests are micro-animated: a teaming, swarming, wriggling, happy mass of seaweed; associated ecosystem creatures; and the harvesting-digestion-nutrient recycling processes. This is in contrast to the creatures in other parts of the open ocean, including marine sanctuaries, burning in acid and increased heat.The “cooking earth” is more graphic and specific, interrupting your viewing and catapult firing by flipping the picture to the affected location and describing the event: 100 Muscovites die from heat exhaustion and wildfire smoke; Flood makes 500,000 homeless Pakistanis; Beef prices double during second year of American mid-west drought, Ocean acidification kills U.S. Pacific Northwest oyster industry; Superstorm Sandy floods New York, …The “cooking earth” examples become more personal to the game player’s location. A player in the California sees proportionally more California examples. Say 10% California; 20% other continental U.S.; and 70% from outside the continental U.S. Similar for a person in Bangladesh. People are actively harvesting energy and food from the seaweed masses and paying the player with more seed pods and catapults.The seaweed forests are macro-animated: moving and deforming with ocean currents; storms move the seaweed; seaweed is sometimes piled on beaches by storms; forests swell and shrink (energy and food products increase and decrease) as herbaceous fish population soar and shrink depending on roaming fish predators (humans, tuna, dolphins,…).Purchase an upgrade each year for the pace of “cooking” to match actual progress on reducing greenhouse gas emissions and the past year’s improved understanding of feedbacks, tipping points, effects.Increase the teaching and learning features. Many actions or results trigger links or sidebars of information you cannot skip until you correctly answer a few questions about the information in that link. The education features would allow sales directly to schools. Schools are experimenting with “blended” schedules where students would have an hour a week per general subject (Math, Language, Science, and Social Science) to work on their own. Teachers need good assignments for blended time. An educational computer game would be a good assignment.Increase the “take action” features. Perhaps the app is free, if people list a valid email address and the game developer then sends notices: Please sign this petition to UK parliament; Please grab a piece of plastic trash out of a gutter; …					

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Mark	Capron	Evidence for climate rapid planet change abounds, from the top of the atmosphere to the depths of the oceans. This evidence has been compiled by scientists and engineers from around the world, using satellites, weather balloons, thermometers, buoys, and other observing systems. The sum total of this evidence tells an unambiguous story: the planet is warming rapidly changing. The ocean is becoming more acidic. Sea level is rising as the oceans expand while warming, glaciers melt, and groundwater aquifers are emptied. Climates are changing. Ocean deadzones have increased while fish stocks decrease. The planet has always been changing, but the changes we are experiencing over a couple hundred years today occurred over tens of thousands of years in the past.	1. Executive Summary		3	17	All of the suggested topics are covered in subsequent paragraphs of the Executive Summary except the increase in the pace of change. Language has been modified to emphasize this point.
Mark	Capron	Move paragraphs discussing temperature below (subsequent to) paragraphs discussing, in order: 1) Sea level rise, 2) ocean acidification, 3) weather extremes [floods followed by droughts, tornadoes, etc.], 4) climate change [different precipitation, earlier spring, etc.], and 5) general warming. A smooth and gradual (on a human scale) warming is not uniformly recognized as harmful. The noise in the warming signal makes it a less reliable indicator for policy decisions. The U.S. should adopt a more stable measure of rapid planet change with an accompanying goal; perhaps a combination of average ocean surface acidification and sea level rise.	1. Executive Summary		3	21	Many impacts described in this report are driven by underlying changes in temperature; the authors prefer the existing order of topics.
Mark	Capron	Move Box 1 below (subsequent to) the ocean acidification discussion. Below what is now 807, 21. The rest of the report has plenty of temperature discussion. Temperature change is difficult to see in the noise of weather variation. Sea level rise and ocean acidification have much less noise in the signal.	23. Hawaii and U.S. Affiliated Pacific Islands		804	12	The sections identified have been rearranged to incorporate your suggestion.
Mark	Capron	Update the temperature graph, Figure 23.3, through 2012, even if you need to indicate a couple years of “preliminary results.”	23. Hawaii and U.S. Affiliated Pacific Islands	23.3	804		The figure has been deleted.
Mark	Capron	Hawai’i and U.S affiliated Pacific Islands can identify adaptations which evolve to both adaptation and mitigation. For example, Ocean Afforestation promises local increases in pH and supplies of biomethane. Early versions of Ocean Afforestation are likely to emphasize food production which would replace faltering terrestrial food production.	23. Hawaii and U.S. Affiliated Pacific Islands		815	13	Thank you for pointing out that reference, which came out after our cutoff date of 31 July, 2012. Regardless, the intent of assessments are to identify planned or active adaptation activities so although this one might be feasible, there are no current plans to implement it.
Mark	Capron	New sub-goals matching the title of Goal 3 – Explore and develop options and actions that reduce the rate and magnitude of climate rapid planet change. Goal 3 needs sub-goals which actually explore options, particularly multi-disciplinary options.• “Fund those “pre-Angel” an “pre-Venture” renewable energy, negative carbon, food, and biodiversity concepts promising large scale (100+ quadrillion BTU,) economic and environmental sustainability.” In essence, fund more of ARPA-E, with more emphasis on holistic solutions. .	29. Research Agenda for Climate Change Science		1038	32	Mitigation research goal is now focused on integrated approaches to mitigation and adaptation, referring readers to other reports for more detailed recommendations on emissions reductions. but we do now highlight the need to understand how policies interact and tradeoff.

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		• “Find managed ecosystem options promising renewable energy, improved biodiversity plus at least one other self-supporting product at large scale.” Humans tend to think in boxes: energy, or food, or water, or climate change, or jobs, or biodiversity, etc. Businesses start in boxes. The U.S Department of Energy issues funding opportunity announcements in tight boxes. But anthropomorphic green house gas emissions span many boxes and emissions are not the only issue humans (and nature) face in the 21st Century. The more sustainable options addressing rapid planet change are likely to address many boxes better than they address any one box. Ocean Afforestation is among the best examples of a multi-product option which may scale to a complete solution.Look at spaceship Earth. Our thin layer of life sustaining water and air transports “food” and “waste” in complex cycles. When we push in one area, something unintended squeezes out in another area. For example, when we push production of corn ethanol, ocean deadzones increase. The multi-threat nature of Planet Change requires multi-disciplinary research goals for holistic managed multi-product ecosystems. • “Research ways to most efficiently include the current and future costs of anthropomorphic GHG emissions in the free market. Ideally with a mechanism the U.S. can lead. It should b neutral to the U.S. balance of trade and places trading partners at a disadvantage until they follow suit.” The current emissions situation is “the tragedy of the commons.” The tragedy is averted by making everyone’s short-term gain from use of the commons proportional to their cost of maintaining the commons. The country with the most imported goods is in the best position to lead. Nature evolved, or God designed, spaceship earth such that nothing is “waste.” The urine, feces, and CO2 waste humans excrete is the food of creatures which become our food. But when people and their animals are concentrated humans must assist nature to convert wastes before they overwhelm us. Luckily, CO2 is colorless, odorless, and is rapidly diluted such that nature can recycle CO2 excreted by humans and animals. But our machines are excreting CO2 from stores of carbon laid down over hundreds of millions of years in a few centuries. Exceeding nature’s CO2 recycling capacity has an economic cost as surely as filling football stadiums with feces faster than we can flush. Football fans pay for waste recycling rather than have it pile up around them. Similarly, fossil fuel users should expect to pay for excreting fossil CO2.					
Mark	Capron	Adjust the subgoals of Goal 3 – Explore and develop options and actions that reduce the rate and magnitude of climate rapid planet change. None of the January draft sub-goals appear to “reduce the rate and magnitude of climate change.” These “understanding” sub-goals appear to better fit Goal 1 – Deepen understanding of the climate system, feedbacks, and impacts.	29. Research Agenda for Climate Change Science		1038	32	The research goal is now focused on interdisciplinary research on mitigation options.
Mark	Capron	Research on improving Demonstrate and evaluate existing and new ways to improve STEM education and … Native Americans United States … “Demonstrating” implies large-scale trials as opposed to ivory tower “research.” Why target one group?	29. Research Agenda for Climate Change Science		1042	3	The section has been edited to provide a description of the more general need to build capacity, including in Tribal Colleges.
Xiaofeng	Xu	1. Page 519, line 17. The “background levels” is not appropriate because the background is implicitly described.2. Page 519, lines 23-24, the sentence is not correct. The cooling effects were partially offset by warming effect from other gases like methane and nitrous oxide; the net effect of CO2, CH4 and	15. Interactions of				Thank you for your comment; Key Message #1 has been revised.

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		N2O still is cooling effect.3. Page 520, line 1, remove the first "act".4. Page 525, Figure 15.3 The texts in the figure are too small.5. Page 527, Figure 15.4. The land cover change probably is the most important factor affecting biogeochemical cycle at global scale. Suggest to add land use change as one of the factors.	Climate Change and Biogeochemical Cycles				
Emma	Daniels	Not clear what is caused, i suggest:protected the coasts has receded, and fall storms now cause more erosion. The damage is severe enough that some communities are already facing relocation.	Introduction: Letter to the American People		1	20	Changes have been made to this sentence.
Emma	Daniels	It is not clear why the resolution of models is mentioned here. What are the implications for the projected changes mentioned before?	2. Our Changing Climate		32	27	Details of projected changes in both temperature and precipitation are dependent on local topography. For example, in mountainous regions, models with grids at 62-125 miles in scale do resolve the spatial details of either temperature or precipitation (and especially snow). We have added references to the Climate Science Appendix, which contains a section on the limitations associated with model resolution.
Nedal	Katbehbader	It is adviseable to issue:Summary for Policy Makers. (SPM) targeting policy and desicion makers .Summary fo All. (SfA) targeting general public aiming at influencing behavior and consumoption patterns.Estimated Cost of Climate Change. (rough estimation of economic cost of CC will be a very important tool that lift the fog from above the cost and who serious is CC)					Several products will be made available when the report is finalized, including an electronic version and a high-level summary that will also be available in a printed version. Economic aspects of climate change have been included in the report wherever the author teams determined that appropriate sources existed.
Nedal	Katbehbader	to add after Human: lives and livelyhood, health, natural ecosystems, water supply, ...	1. Executive Summary		4	6	Livelihoods are mentioned on the previous page - this construction is intended to parallel chapter construction.
Nedal	Katbehbader	after vaval bases (Comment): the impact of CC on National Security should be clearly addressed including impact on US military bases worldide.	1. Executive Summary		4	26	National Security has been added to the Exec. Summary elsewhere.
Nedal	Katbehbader	to add after risk-based analysis: which is expected to have severe impact on densely populated and economically active coastal areas.	1. Executive		4	31	The stakes for people and the economy are discussed later in this

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			Summary				paragraph.
Nedal	Katbehbader	to add after fossil fuel: and charcoal burning....	1. Executive Summary		4	35	No change is recommended here.
Nedal	Katbehbader	to add after human: lives and livelyhood, health, ...	1. Executive Summary		5	1	No change is recommended here.
tammy	reiss	U.S. Global Change Research Program Attn: National Climate Assessment Report 1717 Pennsylvania Ave. NW, Suite 250 Washington DC 20006Let's look at the carbon deficit we're amassing during the mining process called hydrofracking, for natural gas.For thousands of years up to the dawn of the Industrial Age 200 years ago, the Earth's atmosphere contained 280 parts per million of the heat-trapping greenhouse gas carbon dioxide. Today that number is nearly 400 p.p.m with 450 p.p.m routinely cited as the tipping point where we create the conditions for out-of-control acceleration. No one should be exempt from being held accountable for ALL the emissions released while producing, extracting or manufacturing a product. Carbon emissions from diesel trucks used in the fracking process need to be factored into the heat-trapping gas emissions. THE FRACKING PROCESS:If one well requires 2 million gallons of water for ONE fracking, thats 366 diesel trucks hauling fresh water, 183 diesel trucks hauling waste water. Total 549 truck trips per well per fracking. Each well can be fracked up to ten times during its productive life. An average fracking is 3.5 million gallons, that is 960 truck trips or 9,600 diesel truck trips per the life of a hydrofracked (horizontal) natural gas well. FLUID DISPOSAL:Product water or Flowback from a natural gas well that is FRACKED is toxic waste that will need to be trucked to disposal sites. Some Deep Well Injection wells can be thousands of miles from the natural gas wells. AIR POLLUTION: Each well site emits air pollution. In addition to trucked materials (sand, chemicals, water and etc.) and heavy machinery used in the initial start up of each well and other carbon emissions from diesel generators, drill rigs, transfer stations, condensation tanks and the scheduled flaring to burn off the build up of gases by the oil & gas industries wells. This heavy industry going unregulated is a significant source of VOC's and nitrogen oxide which reacts with sunlight to form ozone. CARBON TAX: Most industrialized nations tax carbon emitting energy use at a much higher rate than the United States to combat climate change. Average effective tax rates on carbon emissions, in dollar per metric ton - high end, Switzerland charges $141 per metric ton, while the United States only charges $6.00 p.m.t by the Federal government. ACCOUNTABILITY: The natural gas industry must be held accountable for all Co2 released into the atmosphere from diesel truck traffic to the flaring of all vertical or horizontal (hydrofracked) wells. At some point, when we allow so much carbon to build up in the atmosphere, our mightiest efforts to cut emissions through energy efficiency, conservation and new technologies will only enable us to stay in place if we don't hold ALL Co2 emitting parties accountable. Our elected officials and the public need to agree on spending cuts, tax increases and new investments in renewable energy that would be phased in as the economy improves as well as higher efficiency standards for power plants, buildings, vehicles and appliances that would be phased in, too.A carbon tax would reinforce and make both strategies easier. Please except these comments for the National					Thank you for your comment, however policy issues are beyond the defined scope of the National Climate Assessment, a scientific document that provides the basis for decision making, but does not address policy. o In recognition of the importance of addressing response strategies, this report explicitly assesses adaptation, mitigation and decision support responses, in addition to identifying research needs associated with these topics, in Chapters 26-29.

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		Climate Assessment Report for 2013. Sincerely,Mrs. Tammy Reiss 181 Wilbur Hill Road Unadilla, NY 13849					
Robert	Hirsch	The following are some general comments from Robert Hirsch and Karen Ryberg of the U.S. Geological Survey on Chapters 2 and 3 of the Draft Climate Assessment Report (Draft Report), January 2013 version. We have more specific comments on several sections of those two chapters, and we have entered each of them in the proper place, but we wanted to make a few general comments. Our comments are all on water-related issues, particularly focused on flood hazards and most particularly focused on our published paper, Hirsch and Ryberg (2012) which is cited several times in these two chapters. Our primary concern is that the results of our paper seem to be misrepresented in the Draft Report and we would like to set the record straight. We have already informed Glynis Lough of the USGCRP that figure 2.20, which is attributed to Hirsch and Ryberg (2012), is incorrect. Specifically, the symbols on the figure are identical to the ones in our 2012 paper (except that they have been colored in this version) but the legend indicates the wrong units. In our paper, the symbols represent the term beta1, which is the slope of a regression of the log of the annual flood on global mean CO2. The caption says that they represent trend magnitudes, which is not true. Note that the implication of the current version of figure 2.20 is that trends in flood magnitude for the Red River of the North is about 0.017% per decade. The graphic in the Peterson et al. (submitted) paper shows them to be about 15% per decade (an error of about 3 orders of magnitude). We have been working with Dr. Lough to correct the figure (essentially to make it match what is in the Peterson, et al., submitted), with proper attribution. By the way, it seemed odd to us that the Peterson, et al. paper, which has been submitted to Bulletin of the American Meteorology Society, is cited numerous times as 2012, although in the reference list it is shown as "submitted."Before addressing additional details of these two chapters of the Draft Report, three general comments are in order. 1) The first concern is one of balance. With respect to water, the report seems to highlight situations in which conditions appear to be getting "worse" and tends to ignore situations in which conditions appear to be getting "better." We think that this undermines the credibility of the many useful and valid points that the Draft Report makes. 2) We have strong objections to the idea that our paper (Hirsch and Ryberg, 2012) provides the observational basis for some of the messages of the Draft Report. The Draft Report's flood message is one of increased flood magnitudes. Our observations and study demonstrate a mixture of increases and decreases. 3) Finally, the idea that "confidence" on the topic of floods is anything but "low" strikes us as unfounded. It is widely recognized that there are serious uncertainties for both changes to date and projections for the future. The fact that reported precipitation trends and reported flooding trends appear so contradictory should be sufficiently alarming as to indicate the need to assess the flood conclusions as ones with "low confidence."					Thank you for the comments and for bringing these issues to our attention. Figure 2.20 was produced inadvertently as a combination of two similar figures from Peterson et al 2013 and Hirsch and Ryberg 2012. The figure has been corrected, and the reference list has been updated. Also, throughout the report, the authors have made revisions to improve the balance of tone about the positive or negative nature of impacts. The authors of the Climate Science chapter and the Water chapter have responded in detail to your specific comments.
Robert	Hirsch	What is the evidence that floods "have become more frequent and intense?" What are the studies of the changing frequency of floods? There are several studies on changes in magnitude, but this statement says there are changes in frequency. What is the documented evidence for this? We should add that most of the studies of changes in flood magnitude indicate a mix of increases and decreases over time. We elaborate on this comment below in our discussion of the top of page 83.	2. Our Changing Climate		26	15	The text in the chapter under this Key Message provides the references. The Key Message itself has been revised for better clarity.
Robert	Hirsch	This is highly selective reporting. Where floods are increasing, the text ignores the nearby areas of decrease, but where floods are decreasing, the text highlights the nearby areas of increase. We suggest	2. Our Changing		55	9	We have modified this statement to be clearer about the areas of increase

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		the need for a more balanced approach. Yes, there are increases in flooding in the "northern half of the eastern Great Plains and much of the Midwest" but there are areas of the Midwest that are showing decreases (which the Draft Report does not mention). Then in reference to the Southwest, the report says "Flooding has decreased in the Southwest" and that statement is followed by "although there have been small increases in other western states." Why is the exception to the broad pattern mentioned here and not for the case of the Midwest? We assume that this verbal summary is based on Figure 2.20. Given that, a more objective statement would be something like, "Flood magnitudes have increased in the northern portion of the eastern Great Plains. In the Midwest there are generally increases in the southern part and decreases in the northern part. Flood magnitudes have decreased substantially across the Southwest, for the the Rocky Mountains and Northwest the tendency is toward decreased flood magnitudes as well, although there are a few areas of slight increase."	Climate				and decrease, incorporating the suggested wording in Comment 142/35071.
Robert	Hirsch	It is certainly true that there has been a change in the "timing and magnitude of snowmelt and resulting streamflow" but this is a section on hydrologic extremes not a section on timing of runoff. Where has it been shown that this change in timing has resulted in changes in flood magnitudes? In Peterson et al. (submitted) the following statement is made about this topic. "For some regions of the U.S. where snowpack is an important component of the hydrologic system, there is evidence for earlier melt and changes in the rain to snow ratio (see Dettinger and Cayan, 1995; Hodgkins et al., 2003). These changes may be influential in changing river flood behavior, but their nature could be either decreases or increases in flood magnitudes depending on watershed characteristics." The reason is, of course, that less snow means a decrease in the snowpack available to produce catastrophic flooding in rain-on-snow storms. In the interest of balance, the Climate Assessment should make clear that these changes in the snow/rain ratios could result in increases or decreases in the magnitude of floods.	2. Our Changing Climate		55	15	Agreed that this material is misplaced and have removed it from this section.
Robert	Hirsch	Although the Draft Report seems to be attempting to deal with both floods and droughts, why is there no mention of the truly widespread increases in annual minimum low flows in streams? This result has been reported in many studies for areas from the Great Plains to the Midwest to the northeast. For example, in a recently published report (Spatial and Temporal Trends in Runoff at Long-Term Streamgages within and near the Chesapeake Bay Watershed, by Rice and Hirsch, USGS SIR 2012-5151) we estimated increases in annual 7-day low flows in the northern part of the Chesapeake Bay watershed of between 2% and 15% per decade over the period 1930-2010 (with no decreases). This comes from a new report, but there are many prior reports that document similar findings regarding low flows. We urge the authors of the Draft Report to consider making the assessment more balanced. Yes, we have drying conditions in the southwest, but perhaps the report should also mention the wetting conditions in other parts of the country. The selectivity of the reporting undermines the credibility of the whole report.	2. Our Changing Climate		56		We have added a new paragraph about the increases in low streamflows, citing papers by Small et al. (2006) and Rice and Hirsch (2012).
Robert	Hirsch	Figure 2.22 brings up a problem of balance again. Why would you only show the US west of the Mississippi River? What about soil moisture in the east.	2. Our Changing Climate	2.22	58		We would like to show the entire U.S. However, this state-of-the-art hydrologic model (VIC) was only run for the western U.S. (we are using the work done by other organizations who had a western US focus). Because of the quality of the model and the large number of simulations performed for the western U.S., we think that it is important to include these results in

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							the assessment. We have added a sentence to the caption explaining why only the western U.S. is shown
Robert	Hirsch	Section on description of evidence base:For floods and droughts there are 5 papers cited. One of those is Peterson et al. (submitted) of which we are co-authors. The statement presented here does not seem to correspond to the paper. Peterson et al. (submitted) says, "While much of the U.S. shows little or no change in flooding, some areas have spatially coherent changes." The paper goes on to list some areas with upward and downward trends. Perhaps the text of "description of evidence base" should indicate that the trends include some areas in which they are increasing and some in which they are decreasing. We are concerned about the selective use of references. Hirsch and Ryberg (2012), cited elsewhere in the Draft Report says: "What these results do indicate is that except for the decreased flood magnitudes observed in the SW there is no strong empirical evidence in any of the other 3 regions for increases or decreases in flood magnitudes in the face of the 32% increase in GMCO2 that has taken place over the study period." Is this finding not relevant?	2. Our Changing Climate		82		Additional references have been added to the main text, which then become the basis for the Traceable Accounts.
Robert	Hirsch	Top of table:"Floods have become more frequent and intense in some regions." We have two issues here: What are the studies that show that they are becoming more frequent? The material in Peterson et al. (submitted) relates to the annual flood and has nothing to do with a change in the frequency of floods above some threshold. It says that floods have become more "intense" in some regions (by this we assume the authors mean larger in peak flood discharge, but intense could have other meaning, such as days above flood stage or accelerated rate of rise, and should be defined). Indeed, there are some regions where floods have become larger in magnitude, but the entire US west of the 100th meridian has a very strong preponderance of watersheds in which the magnitudes have decreased (in some cases by a large amount) over the past century. Is this not worth mentioning?	2. Our Changing Climate		83		Additional references have been added to the main text, which then become the basis for the Traceable Accounts.
Robert	Hirsch	Section on assessment of confidenceWe do not understand why the confidence on the matter of floods would be anything higher than "Low" ¬— the evidence is clearly "inconclusive", the sources are "limited", findings are "inconsistent" (e.g. different types of findings by Groisman versus a body of work by Wolock, McCabe, Lins, Slack, Douglas, Hirsch, and Ryberg), "methods not tested," and finally "disagreement among experts." Let us elaborate on "methods not tested": In general the methods of projection are based on GCMs, typically downscaled by RCMs, then run through hydrologic models. Our question is: do the authors know of any tests of this method? A test, in our minds, would involve using the method to hindcast the 20th century and demonstrate that an ensemble of such hindcasts would show flood records that bear even a rough similarity to the observed. For example, would any model hindcast with historical greenhouse forcing give us upward trends like those observed in the eastern Great Plains or in southern New England, or the downward trends observed in the Southwest? To us, the body of science on this topic is just about a perfect fit to the definition of "Low Confidence Level."	2. Our Changing Climate		83		Additional references have been added to the main text, which then become the basis for the Traceable Accounts.
Robert	Hirsch	It is curious that this section on groundwater appropriately pays attention to the influence of humans living on the local landscape, as well as the influence of climate change. Why would the same approach not be used in discussing floods? We think that the approach for groundwater is appropriate (particularly since we think the activities on the landscape will likely be large drivers of hydrologic change). Perhaps these local actions (e.g. pavement and land drainage) may be much more significant than anthropogenic climate change.	3. Water Resources		107	27	The section on floods has been revised to reference non-climate factors.
Robert	Hirsch	This discussion of water quality is too simplistic. It is one thing to say that a particular high flow event increases pollutant runoff. But the real question is, what is the likely impact of a different flow	3. Water Resource		107	33	We appreciate the suggestion, but space is limited. The author team has

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		distribution? Is the downstream flux of nutrients going to change because of climate? There is only so much N and P being applied at the land surface, is changing the flow distribution going to change the amount that moves downstream?	s				deliberated and agreed on the most important information to include.
Robert	Hirsch	What is the evidence for this increase in flood magnitudes because of a change in the ratio of rain to snow? The Draft Report references Knowles, Dettinger and Cayan (2006), which simply has a comment about flood risks in the last paragraph. There is no accompanying analysis to back up that comment. McCabe et al. (2007) has no analysis of floods, only of precipitation and temperature. The two Mote papers are entirely about snowpack or snow water equivalents and not floods [by the way, the reference for Mote (2003) is incomplete]. Again, what can be said about the connection to floods? This is not, in any way, a challenge to the conclusions about streamflow timing. The question we are raising is, what does this mean for flood hazards? Peterson et al. (submitted) makes the following statement about this topic. "For some regions of the U.S. where snowpack is an important component of the hydrologic system, there is evidence for earlier melt and changes in the rain to snow ratio (see Dettinger and Cayan, 1995; Hodgkins et al., 2003). These changes may be influential in changing river flood behavior, but their nature could be either decreases or increases in flood magnitudes depending on watershed characteristics."	3. Water Resources		114	4	The text has been revised to clarify in response to this perspective, and a reference has been added.
Robert	Hirsch	A list of severe floods in the past few years in a report on climate change suggests that there is a linkage between the two. If that is the intent of the list, the list is incomplete, as other areas of the country experienced severe flooding 2009-11. However, we could talk about other years in the same way and this would lessen support of the connection. What about the 1970s? The United States experienced deadly floods across the country, including flooding related to 1972 Hurricane Agnes, the Rapid City, South Dakota, Flood of 1972, and the Big Thompson, Colorado, Flood of 1976? Our point is, if one wants to, one can find that some particular year was extreme in a number of places. The question that needs to be asked is, are we experiencing more extreme floods than we have in the past? This question has been asked and answered for topics like extreme temperatures. We do not believe that it has for floods. Without a reference to demonstrate that something very different is happening, we think this selective list of floods has no place in a scientific assessment.	3. Water Resources		123		We have revised the flood box and key message on floods. We note that strong directional changes in national average flood magnitudes have not been uncovered. The key message indicates that floods may intensify in many regions of the U.S.
Robert	Hirsch	This section lacks balance. In addition to those areas that have gotten dryer, there are large parts of the US that have been getting wetter in terms of annual runoff and in terms of low flows. Is there a reason not to mention this?	3. Water Resources		125	24	After consideration of this point, we still feel the existing text is clear and accurate. This section is about drought; in other sections of the chapter, particularly the precipitation section, we identify areas where annual average precipitation increases have been observed. The section has been revised and now indicates that there are few areas where increases in summer precipitation are projected.
Robert	Hirsch	The Seminole subbasin is mentioned in the caption but is not indicated on the map. The many lines in the bottom panel are unlabeled, other than the caption description of the thick red line. What specifically do the other lines represent?	3. Water Resources	3.8	128		The graphic has been updated.
Robert	Hirsch	Section on "description of evidence base".In reference to Hirsch and Ryberg (2012; please correct spelling of Ryberg), it says that the data are from the USGS HCDN network. This is simply untrue. Of the	3. Water Resource		135		Our description of the gage data set used by Hirsch and Ryberg (2012) has

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		200 streamgages used, only 140 are from the HCDN.More importantly, the text says that the Hirsch and Ryberg (2012) paper provides the principle observational basis for the flood message. Let's look at what we said in the conclusions: "What these results do indicate is that except for the decreased flood magnitudes observed in the SW there is no strong empirical evidence in any of the other 3 regions for increases or decreases in flood magnitudes in the face of the 32% increase in GMCO2 that has taken place over the study period." This can hardly be called the basis for the report's findings. We strongly object to our report being considered the principle observational basis for the flood message. The observational basis we provide shows a mixture of increases and decreases in floods, the key message makes no mention of decreases.Regarding projections, we have serious concerns about their reliability. In general, the methods of projection are based on GCMs, typically downscaled by RCMs, then run through hydrologic models. Our question is: do the authors know of any tests of this method in terms of flooding trends? A test, in our minds, would involve using the projection method to hindcast the 20th century and demonstrate that an ensemble of such hindcasts would show flood records that bear even a rough similarity to the trends that have observed? For example, would any model hindcast with historical greenhouse forcing give us upward trends like we have seen in the eastern Great Plains or in southern New England, or the downward trends we see in the Southwest? Do we have any demonstration that the methods used in these projection studies are reliable for projecting trends? Section on "new information and remaining uncertainties"The Draft Report makes the following statement: "However, precipitation extremes are expected to intensify as the atmosphere warms, and many floods result from larger portions of catchment areas receiving rain as snowlines recede upward. As rain runs off more quickly than snowfall this results in increased flood potential; furthermore occasional rain-on-snow events exacerbates this effect." The last part of this statement makes no sense (and "exacerbates" should be "exacerbate". If the catchment gets less snow, then the influence of "rain-on-snow" will decrease. The amount of snowpack available to melt in such an event will be smaller than would be the case in a colder climate. We return to the comments we made regarding page 55. In Peterson et al. (submitted) the following statement is made about this topic. "For some regions of the U.S. where snowpack is an important component of the hydrologic system, there is evidence for earlier melt and changes in the rain to snow ratio (see Dettinger and Cayan, 1995; Hodgkins et al., 2003). These changes may be influential in changing river flood behavior, but their nature could be either decreases or increases in flood magnitudes depending on watershed characteristics." The reason is, of course, that less snow means a decrease in the snowpack available to produce catastrophic flooding in rain-on-snow storms. In the interest of balance, we would argue that the Draft Report should make clear that these changes in the snow/rain ratios could result in increases or decreases in the magnitude of floods.Section on "Discussion of Confidence"We do not understand why the confidence on the matter of floods would be anything higher than "Low"—the evidence is clearly "inconclusive," the sources are "limited," findings are "inconsistent" (e.g. different types of findings by Groisman versus a body of work by Wolock, McCabe, Lins, Slack, Douglas, Hirsch, and Ryberg), "methods not tested," and finally "disagreement among experts." See our comments above under "page 135, description of evidence base." To us, the body of science on this topic is just about a perfect fit to the definition of "Low Confidence Level."	s				been corrected. As to their findings of no regional trends, we have re-evaluated their results--including now a new figure that shows the gages with statistically significant changes in floods, rather than their original fig 1--and have furthermore compared their results to work by Villarini et al (2009) and Villarini and Smith (2010). We have revised the key message and supporting text with respect to regional scale flood trends. As to projections of future floods, our discussions are based on the idea that if storms continue to intensify and catchment areas receive more rain rather than snow, then floods in some cases are expected to increase -- even where precipitation and overall streamflow decline. Thus we do not rely overly on details of GCM projections. We have expanded our discussion to provide more or a sense of how variable flood responses may be, and believe that we are still making reliable statements about future floods. The comments regarding rain-on-snow do not take into account the kinds of changes already documented by McCabe et al (BAMS 2007) historically and which may be expected to hold for some time to come under continued warming trends: that is, that snowpacks do not entirely disappear so that rain-on-snow continues to occur as warmer storms drop rain at higher and higher elevations, onto whatever snowpacks still remain at those higher altitudes. Rain-on-snow will continue to be a concern until essentially all snow is eliminated, and that is not projected to occur this century. Finally, we still believe that the assessment of confidence is

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							accurate.
Robert	Hirsch	Under Description of Evidence Base, It is stated here that Hirsch and Ryberg (2012) provide evidence of the water cycle for several regions "changing toward dryer conditions." Our paper only considered annual floods, it made no analysis and provided no conclusions regarding the "water cycle.".Under new information section:We applaud the authors for the statement "The debate is over whether this trend is part of a multi-decadal climate cycle, and, at some future time, it will reverse direction." We also applaud the statement "GCMs continue to be uncertain with respect to precipitation, but they are very consistent with respect to temperature. Runoff, streamflow, and soil moisture depend on both variables and are thus less susceptible to GCM precipitation uncertainty." However, we would note that when it comes to floods, the matter of importance is precipitation. Temperature plays a very minor role. In addition, the matter of importance is extreme precipitation, which we would suggest is even more uncertain than precipitation in general. These matters are reasons why one should exercise great caution in relying on GCMs in the projecting of flood magnitude and frequency. It might be useful to add some statement to that effect.	3. Water Resources		141		The reference to Hirsch and Ryberg 2012 was included incorrectly in this TA and has now been deleted. A Flood Box which includes discussion of precipitation has been added.
Robert	Hirsch	We have already informed Dr. Glynis Lough of the USGCRP that figure 2.20, which is attributed to Hirsch and Ryberg (2012), is incorrect. Specifically, the symbols on the figure are identical to the ones in our 2012 paper (except that they have been colored in this version) but the legend indicates the wrong units. In our paper, the symbols represent the term beta1, which is the slope of a regression of the log of the annual flood on global mean CO2. The caption says that they represent trend magnitudes, which is not true. Note that the implication of the current version of figure 2.20 is that trends in flood magnitude for the Red River of the North is about 0.017% per decade. The graphic in the Peterson et al. (submitted) paper shows them to be about 15% per decade (an error of about 3 orders of magnitude). We have been working with Dr. Lough to correct the figure (essentially to make it match what is in the Peterson, et al., submitted), with proper attribution. We believe that Dr. Lough has the necessary materials to make the change.	2. Our Changing Climate	2.20	56		This figure has been corrected and is now consistent with the figure from Peterson et al. 2012.
Paul	Hanson	Improvements to this chapter should be made to clarify major differences that exist in the response and sensitivity of western vs. eastern forests of the United States. Although much of the text is well crafted and specific to the forests being discussed, many instances occur where a particular effect or modeled expectation might be presumed to apply to all forests when the root evidence might instead be appropriate to only a portion of all US forests. The following comments point to specific examples within the text that might be edited. This chapter focuses on mortality as a measure of change, however, much of the experimental and modeled data for climate and environmental responses are better characterized by a discussion of growth changes (decreased or increased).	7. Forestry				We have considered this comment in the context of other comments that state the risks for eastern forests are being understated or being and have modified the text as follows to match our assessment of the current best understanding of the situation: "Extensive tree mortality or decline in growth rates are projected to increase under future climate conditions for western forests, and to some extent also eastern forests, especially if extreme changes in these factors also occur in eastern regions (Adams et al. 2009; Allen et al. 2010; Bentz et al. 2010; Dale et al. 2010b)." We have also added the Dale et al. 2010b citation to this sentence earlier in the chapter: "Nonetheless, mortality of

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							some eastern tree groups are related to rising temperature (Dietze and Moorcroft 2011), and is expected to increase as climate warms (Dale et al. 2010b)." We have also included a new figure to emphasize the focus on warmer temperatures and drought effects.
Paul	Hanson	This statement suggests that climate change increases vulnerability of all forests. I don't believe this can be supported and suggest a minor wording change to 'sensitive or susceptible forests' and let the subsequent text and the supporting technical report (Vose et al. 2012) provide the detailed discussion necessary to identify how various forests would respond. The Forest Sector Technical report was especially good at this characterization and the authors of the Forest Chapter might return to that report for key summary conclusions.	7. Forestry		263	14	The text has been revised to incorporate this suggestion. However, rather than using the specific phrase "sensitive and susceptible" which might suggest that it is known which systems fit that category, the text was changed by inserting "many" before "forest ecosystems", because many of the forests are potentiall vulnerability if they are exposed to an extreme climate event.
Paul	Hanson	The phrase "but could be more sensitive to periodic drought' is not adequately justified by the science in the technical report produced by Vose et al. 2012 and should be removed. Key quotes from Vose et al. 2012 related to eastern forest responses include:"Overall, in the eastern U.S., productivity or forest C storage is expected to increase with projected changes in climate, N, and CO2. This is because the increased precipitation projected for the Northeast allows more photosynthesis under increased temperature and CO2. " is not reflected in this added phrase. "Tree mortality not caused by fire or insect outbreaks has also increased in the West (van Mantgem et al. 2009). We have no information on tree mortality trends in the eastern U.S., but tree mortality rates there are very sensitive to air pollution exposure (Dietze and Moorcroft 2011). Tree regeneration after disturbance is critical for maintaining forest cover and the associated C stocks (McKinley et al. 2011). " "Predicted effects on Eastern forests where precipitation is currently in excess—In the next 30 years, projected changes in CO2, temperature, and precipitation are not likely to change forest C storage and uptake from current levels or may even increase them, if tropospheric ozone levels are managed to remain at or below current levels (fig. 2.17). Changes in species composition through time will probably remain driven by competition between plants and interactions with pests and pathogens, except for sites with shallow or coarse textured soils that increase the effects of drought. Towards the end of this century, net C gain by eastern U.S. forests will probably be reduced by a warming-induced increase in seasonal water deficits, but the impacts will not be large. The beneficial effects of elevated CO2 and the extended growing season length will allow ample opportunity for C gain, even though the probability of water stress occurrence in the summer months will increase. On coarse textured or shallow soils, the forest will show reduced annual C uptake (fig. 2.17)."" Key Findings • Forest growth and afforestation offset 16 percent of fossil fuel CO2production in 2009 according to recent survey results from USDA Forest Service Inventory and Analysis.	7. Forestry		263	17	The text has been edited to clarify that eastern forests may not be vulnerable unless more extreme conditions occur, in which case the science on tree mortality supports that numerous species are near their point of vulnerability, including the recently published global review of embolism relationships of Choat 2013. The text now states that eastern forests are predicted to have smaller disturbances but if more extreme conditions occur, especially severe drought, they could be rapidly and extensively impacted as well. We have also included a new figure to emphasize the focus on warmer temperatures and drought effects.

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		• In the western U.S., increased fire, bark beetle outbreaks and droughts have likely reduced forest C storage, and these reductions will likely be larger in the future, slowing or halting the current U.S. C sink. • In the eastern U.S., elevated CO2and temperature and sufficient water will increase forest growth and will likely increase C storage, except on sites with shallow soils more subject to drought. • Warmer temperatures will probably lead to increased nutrient cycling, promoting increased forest growth and elevated N levels in streams and rivers." These collective statements appear at odds with the phrase attached to Key Message #1.					
Paul	Hanson	Please add quantitative statements for phrases like "reduce U.S. fossil fuel consumption." By how much? Is this reduction large or only incremental?	7. Forestry		263	25	The text has been revised to incorporate this suggestion: 16% of CO2 emissions (USEPA 2013).
Paul	Hanson	Please provide a quantitative estimate in carbon units to go along with the 13% value.	7. Forestry		264	8	The text has been revised to incorporate this suggestion. We added this information in the Forest Carbon Sequestration and Carbon Management section of the chapter.
Paul	Hanson	The phrase "but could be more sensitive to periodic drought' is not adequately justified by the science in the technical report produced by Vose et al. 2012 and should be removed. Key quotes from Vose et al. 2012 related to eastern forest responses include:"Overall, in the eastern U.S., productivity or forest C storage is expected to increase with projected changes in climate, N, and CO2. This is because the increased precipitation projected for the Northeast allows more photosynthesis under increased temperature and CO2. " is not reflected in this added phrase. "Tree mortality not caused by fire or insect outbreaks has also increased in the West (van Mantgem et al. 2009). We have no information on tree mortality trends in the eastern U.S., but tree mortality rates there are very sensitive to air pollution exposure (Dietze and Moorcroft 2011). Tree regeneration after disturbance is critical for maintaining forest cover and the associated C stocks (McKinley et al. 2011). " "Predicted effects on Eastern forests where precipitation is currently in excess—In the next 30 years, projected changes in CO2, temperature, and precipitation are not likely to change forest C storage and uptake from current levels or may even increase them, if tropospheric ozone levels are managed to remain at or below current levels (fig. 2.17). Changes in species composition through time will probably remain driven by competition between plants and interactions with pests and pathogens, except for sites with shallow or coarse textured soils that increase the effects of drought. Towards the end of this century, net C gain by eastern U.S. forests will probably be reduced by a warming-induced increase in seasonal water deficits, but the impacts will not be large. The beneficial effects of elevated CO2 and the extended growing season length will allow ample opportunity for C gain, even though the probability of water stress occurrence in the summer months will increase. On coarse textured or shallow soils, the forest will show reduced annual C uptake (fig. 2.17)."" Key Findings • Forest growth and afforestation offset 16 percent of fossil fuel CO2production in 2009 according to recent survey results from USDA Forest Service Inventory and Analysis.	7. Forestry		266	2	The text has been edited to clarify that eastern forests may not be vulnerable unless more extreme conditions occur, in which case the science on tree mortality supports that numerous species are near their point of vulneability, including the recent global review of embolism relationships in Choat 2013. The text now states that eastern forests are predicted to have smaller disturbances but if more extreme conditions occur, especially severe drought, they could be rapidly and extensively impacted as well. We have also included a new figure to emphasize the focus on warmer temperatures and drought effects.

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		• In the western U.S., increased fire, bark beetle outbreaks and droughts have likely reduced forest C storage, and these reductions will likely be larger in the future, slowing or halting the current U.S. C sink. • In the eastern U.S., elevated CO2and temperature and sufficient water will increase forest growth and will likely increase C storage, except on sites with shallow soils more subject to drought. • Warmer temperatures will probably lead to increased nutrient cycling, promoting increased forest growth and elevated N levels in streams and rivers." These collective statements appear at odds with the phrase attached to Key Message #1.					
Paul	Hanson	The words "sensitive to" might be more appropriately phrased 'correlated with'.	7. Forestry		266	23	The text has been revised to incorporate this suggestion.
Paul	Hanson	This statement needs a reference.	7. Forestry		266	26	The text has been revised to incorporate this suggestion. We added references and a modifying statement that the literature generally emphasizes western forests but also relevant for eastern forests.
Paul	Hanson	The phrase "underlying trends" is not well defined. That is, I don't understand the intent.	7. Forestry		266	30	The text has been revised to clarify this issue of underlying trends such as changes in mean conditions.
Paul	Hanson	I think land use changes dominate over drought as a driver for past forest dynamics throughout the US. Perhaps this statement is to apply to agents other than land use and management.	7. Forestry		266	30	The text has been revised to clarify this issue as the focus here is past die-off events in forests, not the broader issue of land use and forests, discussed in a later section.
Paul	Hanson	The Adams et al. 2009 article is a discussion of western forests not all US forests.	7. Forestry		266	35	We have added the following text to the Traceable Accounts section to address the issue raised: "Although the effect of temperature on the rate of mortality during drought has only been shown for one species (Adams et al. 2009) and like differs among species, the basic physiological relationships for trees suggest that warmer temperatures will exacerbate mortality for other species as well (McDowell et al. 2008, 2011)".
Paul	Hanson	This paragraph strikes an appropriate discussion of how forests across the US differ in their response. Good job.	7. Forestry		266	38	We greatly appreciate your positive comment.
Paul	Hanson	This statement is not applicable to all forests and the add on of 'and eastern forests' seems unjustified	7.		267	3	We have modified the text to clarify

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		by details discussed in Vose et al. 2012. The cited references are all discussing western forests.	Forestry				the associated caveat: Extensive tree mortality or decline in growth rates are projected to increase under future climate conditions for western forests, and to some extent also eastern forests, especially if extreme changes in these factors also occur in eastern regions (Adams et al. 2009; Allen et al. 2010; Bentz et al. 2010; Dale et al. 2010b). We have also included a new figure to emphasize the focus on warmer temperatures and drought effects.
Paul	Hanson	I would add 'climate' and 'soils' to the list of factors driving forest cover.	7. Forestry		269	7	The text has been revised to incorporate this suggestion.
Paul	Hanson	A good example of the nature of eastern forest responses as characterized in Vose et al. 2012.	7. Forestry		269	14	We greatly appreciate your positive comment.
Paul	Hanson	I found this figure extremely confusing and did not gather a take home message from it. Please try again. There is an important message lost here.	7. Forestry	7.3	270		The figure has been deleted from the text. This figure is currently in journal review and consequently will not meet the requirements of literature cited for the NCA document. We have replaced this figure with Figure 2.17 from Vose et al. 2012.
Paul	Hanson	Climate change will affect US Forests directly through changes in temperature, precipitation, and atmospheric CO2 concentrations in addition to disturbance events.	7. Forestry		271	5	After consideration, we still feel that the text is clear and accurate. The climate related impacts (temperature, precipitation, CO2) on forest productivity are discussed earlier in the text. The focus here is on the carbon cycle which includes productivity.
Paul	Hanson	Please add a reference for this statement. Depending on the scenario and future time trajectory increases might also be expected.	7. Forestry		271	17	We have added a citation for this text in Figure 7.4. And we have added a temporal reference to the projection of reduced forest CO2 uptake. Vose et al. (2012) state: annual C additions could decline more rapidly and U.S. forests could become a net C emitter of 10s to 100s of Tg•C-1•yr-1 within a few decades."
Paul	Hanson	Change "climate change" to 'greenhouse gas emissions'. I don't see the need to jump all the way to climate change.	7. Forestry		272	4	After consideration, we still feel that the text is clear and accurate. This

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							statement already has explanatory text in parenthetical notation. This is climate change report, so linking forest management to climate is important.
Paul	Hanson	Please add a statement as to the amount of land and the percent of US land area this represents to this discussion. My point is that this number may not be achievable.	7. Forestry		272	7	The text has been revised as suggested. Text added "an amount almost equivalent to the current annual carbon storage in forests).
Edgar	Ross	"...affected by increased risks from climate..." Please change to, "...affected by climate..." (My life would be affected by getting cancer; much more than by my risk of getting cancer.)	1. Executive Summary		5	18	Agree, this language has been modified.
Edgar	Ross	Please change "Same..." to "Some..."	1. Executive Summary		13	3	Change has been made.
Greg	Robie	In its context, and without a modifier, the phrase "Americans face choices" is without meaning due to the following reasoning: to the degree freedom is the right to be responsible, and Americans have been irresponsible in their exercise of freedom, they now face limited choices. Americans always face choices, as do all of humanity. It is not that we face choices that is pertinent here, but that our irresponsible choices now have unavoidable consequences that make the continuation of familiar choices impossible.I'm getting my feet wet with this comment system. I appreciate the opportunity/responsibility it may represent. And I've already learned that it is responsible to save early and often. ;)	1. Executive Summary		5	40	The authors believe that choices will strongly affect future impacts. The existing language is acceptable as is.
Greg	Robie	The stated relationship is only relevant to the degree new natural positive feedbacks are less than any mitigation taken and, together with mitigations, yield a decrease in emissions approaching 40% of 1990 levels by 2020. Current observations, with a high degree of probability, point to feedbacks being triggered that define a different relationship between mitigation and adaptation. Nothing but Congress, responsibly exercising its constitutional power to "coin money and establish the value thereof,...and of foreign coin," and declaring the federal reserve currency a foreign currency with no value, while, concurrently, establishing a constitutional currency denominated in sustainable carbon credits, constitutes scientifically significant mitigation. In lieu of this action—and with mathematical certainty—everything else amounts to little more than pious wishful thinking and more irresponsible choices. Greed must be systemically aligned with need for motivated reasoning to be avoided when talking about mitigation; for adaptation to be rationally engaged in. Capitalism is a failed and failing economic paradigm. In its current iteration it cannot be mitigated, nor can it be trusted when thinking about what constitutes mitigation. Its thinking is the thinking that created the problem and cannot be rationally used to think about solutions to the problem it created.	1. Executive Summary		6	3	Thank you for your comments; the authors agree with several of your points, and some changes have been made in response. For example, the need to work more on the relationship between adaptation and mitigation is emphasized at the end of the Introduction – new Context and Background section.
John	Drake	First sentence is very ambigous. First of all it seems to be a statement about the political state of affairs and the renewed engagement of the US government. But it also alludes to the growing sense that weather patterns and climate conditions are changing more rapidly and that this is now being experienced and noticed by a growing population. Unfortunately, the first sentence also raises a scientific red flag and the issue of speaking of climate as a thing that is experienced in the present and	Introduction: Letter to the American				Thank you for your comments. The authors still feel the first sentence is clear and accurate. Regarding the sentence on detrimental effects, the authors have chosen not to make the

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		not a 30 year average of weather. Suggest you choose one meaning that you think best represents the spirit of the national assessment and make it clear in this first sentence.Line 30. I dont think you want to say that society has been "designed". You might want to use the word "adapted" since that is the process that you will advocate as part of our appropriate response to continuing climate change.	People				suggested change. However, the sentence has been revised for greater clarity.
Zhengh ong	Tang	Zhenghong Tang's comments: (ztang2@unl.edu)Overall, this chapter was well-organized and made a thorough literature review on the adaptation efforts in U.S. Based on my conversations with Shannon McNeeley, I may suggest the working group to consider the below two articles in your references:Tang, Z., Brody, S.D., Quinn, C., Chang, L., Wei, T., 2010, Moving from Agenda to Action: Evaluating Local Climate Change Action Plans, Journal of Environmental Planning and Management 53(1): 43-62. One of the major findings of this study is that current local climate change action plans focus predominantly on the built environment (e.g. energy, transportation, wastes and buildings) and pay little attention to the natural environment. In addition, although these plans made appropriate policies in communication and coordination, relatively few strategies were employed for implementation. Local jurisdictions need more innovative policies, tools and strategies to respond to climate change (e.g. carbon tax, carbon fees). Local jurisdictions have considerable authority for land development, waste management, transportation planning, and can play more critical roles in climate change mitigationTang, Z., Brody, S.D., Li, R., Quinn, C., Zhao, N., 2011, Examining Locally-Driven Climate Change Policy Efforts In Three Pacific States, Ocean & Coastal Management 54: 415-426. The results identified geographical clusters and spatial variations among the jurisdictions. We examined local climate policy actions and found that a large portion (60%) of local jurisdictions still lack sufficient local leverage and have little engagement in climate change actions. In general, local jurisdictions in three Pacific states have made important efforts in climate change policies, but there is still room to improve efforts, because more than 60% of local jurisdictions have not taken any actions to respond to climate change.	28. Adaptati on				Thank you for these references. We have added the first one into the local section but have chosen not to utilize the second as we didn't think it supported the material already within the text.
Donald	Albertso n	The Forestry Chapter seems not to mention the negative effects of climate change on the Christmas tree and maple syrup/sugar industries. One example is that all the seedlings planted in 2012 died at a large, well established Christmas tree farm in Doylestown, Ohio. I have read that climate change will force the maple syrup industry to move northward.	7. Forestry				Due to the size of the sector, and the page limit for the chapter, we focused on broad trends rather than delving too deeply or providing such a level of specificity, for example, the maple syrup industry.
Donald	Albertso n	More coverage of the grape/wine industry would be good especially on pages 230 and 232. Having the right soil and weather is essential for good quality and yields. I know (1) the French wine industry has already been negatively affected, (2) the Napa Valley is threatened long term and (3) the warm March 2012 hastened the harvest near Erie, PA by 18 days.	6. Agricultu re				We have revised the text to incorporate more information on the grape/wine industry.
Ralph	Stahl	I suggest the authors consider information provided in the following publications:Landis et al. (2013) Environmental Toxicology and Chemistry, Vol 32 (1), p.79-92.Moe et al. (2013) Environmental Toxicology and Chemistry, Vol 32 (1), p. 49-61.Rohr et al. (2013) Environmental Toxicology and Chemistry, Vol 32 (1), p. 93-101.	8. Ecosyste ms, Biodivers ity, and				No change. We were only supposed to look at literature through 2012.

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			Ecosystem Services				
Ralph	Stahl	I suggest the authors consider the publication below:Balbus et al. (2013) Environmental Toxicology and Chemistry Vol 32 (1), p. 62-78.	9. Human Health				Thank you for the reference but the intended context of this publication is unclear.
tammy	reiss	Corporate Power and Climate Change Citizens United held that the already court-granted First Amendment rights of all corporations include speech, and that money is speech, including election campaign money. This had a dramatic effect on the 2012 elections, resulting in massive amounts of money spent by the two main political parties and overwhelming individual contributions. Right before the election, Chevron made the largest single campaign donation since the Citizens United decision, pouring millions of dollars into Republican congressional races. Corporations having personhood began with the notorious 1886 Santa Clara County Case. Since 1886, courts have struck down hundreds of local, state and federal laws that humans enacted to protect themselves from corporate harm. Armed with these "rights," corporations have wielded increasing control over jobs, natural assets, politicians, judges, the law, and now our vary existence as we know it through climate change. The mining process known as Hydrofracking is a good example of how corporations and government worked in tandem to exempt this heavy industry, set mainly in rural communities, from the Clean Air and Water Acts. Corporate fossil-fuel power is preventing us from moving rapidly away from burning stuff. A recent study showed that global subsidies to the oil and gas industry were $582 BILLION (thats with a B) compared to around $80 million (thats with an M) to renewables. Since 1975 the Department of Energy provided more than $100 million-and billions more in tax break - for the drilling firms pioneering the technique so as to hydrofrack for natural gas. In the fiscal cliff negotiations, tax subsidies to the fossil-fuel industry were preserved intact. The evidence of anthropogenic global climate change is indisputable. The industrial Revolution did as much good and greater bad, the latter resulting in global climate change, and the contamination of clean air, soil, and water that can NEVER be reclaimed. American communities scarred by centuries of industrial pollution and corporate domination as the leading cause for climate change need to take back the control of our destiny on this plant before any true efforts towards climate change can be accomplished. Only then can we as a nation usher in a new era of sustainability. Winston Churchill once said, "Americans can be counted on to do the right thing after exhausting all other options," we just need to do so before it is to late. Mrs. Tammy Reiss 181 Wilbur Hill Road Unadilla, NY 13849					Thank you for your comment, however policy issues are beyond the defined scope of the National Climate Assessment, a scientific document that provides the basis for decision making, but does not address policy.
Ashvin	Shah	Below are my seven comments posted on 4/12/13 using the NCA review templateThese first time chapters on Adaptation, Mitigation, Decision Support, and Sustained Assessment Process contain only introductory information so I have only seven comments on some text in these chapters. In the interest of maintaining continuity of my seven comments, I am providing all the seven comments under this chapter. In keeping with the requirements of NCA comment template, I have identified the page number and line number of the text for the seven comments provided below.1. In Introduction to Response Strategies: The text on page 923 starting on line 11 says:For the first time, this Assessment includes chapters on Adaptation, Mitigation, and Decision Support, in addition to identifying research needs associated with these topics. Further, this report includes a chapter on the Sustained Assessment	27. Mitigation		955	20	Thank you for the comments. We appreciate these points, but the NCA cannot take a policy position based on these findings. Policy issues are beyond the defined scope of the National Climate Assessment, a scientific document that provides the basis for decision making, but does not address policy. The transparent

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		Process, which describes the rationale for ongoing assessment activity to achieve greater efficiency and better scientific and societal outcomes.Comment on Introduction to Response Strategies text on page 923 starting on line 11:The inclusion of chapters on Adaptation, Mitigation, and Decision Support, and a chapter on the Sustained Assessment Process for the first time is timely and necessary in view of the lack of progress in over 25 years in the global conversation on climate at the UN where American experts participated through the USGCRP. It is timely also because a recent poll found 4 out of every 5 Americans said climate change will be a serious problem for the United States if nothing is done about it. American public is looking for action on climate from American experts.It is clear that the American NCA process would have to develop on its own, independent of the UN process, a comprehensive national policy on climate change adaptation and mitigation to respond to the American public's interest to take timely action on climate change. The implementation of such a national policy on climate would profoundly affect the American economy over time. Therefore, in the development of such a national policy on climate, the participation of all stakeholders in the American economy is essential on a continuing basis. These new participants would bring to the NCA process on climate their experience in mainstream American market in addressing issues involving public welfare, health, and safety. As an engineer, I welcome this development. 2. In Chapter 26, Decision Support:The text on page 925, Key Message 3 starting on line 30 says: Steps to improve collaborative decision processes could include training more "science translators" to help bridge science and decision-making; integrating development of decision support tools into fundamental scientific research; improving reward structures and institutional recognition for those who work at the boundary of science and decision-making; increasing support through the USGCRP for research to develop decision support tools; and incorporating assessment of decision support resources for sectors and regions into the ongoing National Climate Assessment (NCA) process. Comment on Key Message 3 of Chapter 26, Decision Support on page 925: As an engineer, I support the statement that we need "to improve collaborative processes …to help bridge science and decision-making" and I am glad to see the NCA recommending "increasing support through the USGCRP" for those "who work at the boundary of science and decision-making." The above message of NCA experts is consistent with the ASCE Policy Statement 418, The Role of Civil Engineers in Sustainable Development.1 This ASCE Policy describes the role of engineers in sustainable development as to "provide the bridge between science and society" and calls for engineers to "actively promote and participate in multi-disciplinary teams with other professionals" to address the "challenges of sustainable development." The challenges of sustainable development include the sustainable use of material resources as well as the sustainable use of energy resources. As such, sustainable development includes climate change mitigation and energy conservation also promotes material conservation. I suggest the USGCRP invite engineers to actively participate in a collaborative decision-making process on climate change adaptation and mitigation and offer to support their participation. 3. In Chapter 27, Mitigation:The text on page 955, Key Message 2 starting on line 24 says: To meet the rapid emissions reduction (B1) scenario used in this assessment, global mitigation actions would, within the next 25 years, need to limit global greenhouse gas emissions to a peak of around 44 billion tons of carbon dioxide per year. In 2011, global emissions were around 37 billion tons, and have been rising about 0.9 billion tons per year for the past decade. The world is therefore on track to exceed this level within a few years."Comment on Key Message 2 of Chapter 27, Mitigation on page 955: As an engineer, I am concerned about the NCA assessment that the world is on track to exceed the B1 scenario level of greenhouse gas emissions "within a few years." Actually, there is no comprehensive American plan of action to "meet the rapid emissions reduction (B1) scenario used in this assessment" nor a similar plan for "global mitigation actions [that] would,					process for development of the third NCA report is documented on our website and has included numerous avenues for the public and stakeholders to engage.

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		within the next 25 years, … limit global greenhouse gas emissions" to limits specified in the B1 scenario. Clearly, we need ASAP a comprehensive American plan of action to start reducing the greenhouse gas emissions. American engineers are already active in climate change adaptation and mitigation, individually in their practice and collectively in engineering institutions. The ASCE Policy Statement 488, Greenhouse Gases2 states that ASCE supports "the public sector and private sector strategies and efforts" listed in the Policy "to achieve significant reductions in greenhouse gas emissions from the existing and future infrastructure systems." I suggest the USGCRP begin to create ASAP a collaborative decision-making process working with engineers to develop a comprehensive national plan of action to start reducing the greenhouse gas emissions. 4. In Chapter 27, Mitigation:The text on page 956, Key Message 5 starting on line 37 says: Even absent a comprehensive national greenhouse gas policy, both voluntary activities and a variety of policies and means at federal, state, and local levels are currently in place that lower emissions. While these efforts represent significant steps towards reducing greenhouse gases, and often result in additional co-benefits, they are not close to sufficient to reduce total U.S. emissions to a level consistent with the B1 scenario analyzed in this assessment.Comment on Key Message 5 of Chapter 27, Mitigation on page 956 As an engineer, I am concerned about the statement that implies that in the absence of "a comprehensive national greenhouse gas (GHG) policy" voluntary actions that lower emissions "are not close to sufficient to reduce total U.S. emissions to a level consistent with the B1 scenario analyzed in this assessment." The American Society of Civil Engineers (ASCE) in its Policy Statement 488, Greenhouse Gases2 supports establishing "clear and reasonable targets and time frames for the reduction of greenhouse gas emissions." The two pervious ASCE policy statements mentioned in Comments 2 and 3 along with this third policy statement suggest creating a collaborative decision-making process to start reducing the GHG emissions corresponding to clear and reasonable targets and timeframes.I suggest that USGCRP support a national level effort, to be jointly undertaken in a collaborative process with engineers to develop a comprehensive national plan of action to reduce total U.S. emissions of greenhouse gases to a level consistent with the B1 scenario by a date certain. 5. In Chapter 27, Mitigation:The text on page 964, the third bullet under Voluntary Actions starting on line 1 says:Under the American College and University Presidents' Climate Commitment (ACUPCC), 677 institutions have pledged to develop plans to achieve net-neutral climate emissions through a combination of on-campus changes and purchases of emissions reductions elsewhere. Comment on Voluntary Actions in Chapter 27, Mitigation on page 963The national level effort on GHG reductions suggested above would need to be coordinated with "the host of voluntary actions [that] are being carried out by corporations, individuals, and non-profit organizations" identified on this page including the voluntary actions on campus climate-neutrality commitment of 677 educational institutions through a common monitoring program. This campus climate program offers local engineers an opportunity to work with these institutions to start a bottom-up process of taking action on campus climate neutrality. Many local engineers would be members of local sections of engineering societies. The college teams and local engineers together can incrementally test and implement on ground the comprehensive national plan of action in a continuous interaction between the top/down national policy level work and the bottom/up local implementation work. The local engineers would also be instrumental in working with other voluntary efforts of local and state governments.The involvement of the younger generation in making campuses and local communities climate-neutral would lead in time to broader acceptance by the American public that climate neutrality of American economy as a whole by a date certain is feasible. 6. In Chapter 28, Adaptation:The text on page 983, Key Message 4 starting on line 30 says:Climate change adaptation actions often fulfill other societal goals, such as sustainable development, disaster risk reduction, or					

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		improvements in quality of life, and can therefore be incorporated into existing decision-making processes. Comment on Key Message 4 of Chapter 28, Adaptation on page 983The adaptation of the built environment to the effects of climate change is indeed best developed and implemented working with existing stakeholders of the built environment. The ASCE Policy Statement 360, Impact of Climate Change 3 “supports the government policies that encourage anticipation of and preparation for possible impacts of climate change on the built environment.” This ASCE policy was first approved over two decades ago in 1990, about the same time the USGCRP was established, indicating the responsiveness of engineers to the issues affecting the built environment. During the past several decades engineers and architects have worked with stakeholders for the built environment of buildings within a well-established voluntary consensus process in developing and implementing the local and national building codes and standards to protect public welfare, health, and safety. For the built environment of infrastructures the stakeholders are not working in a unified process. The USGCRP interest in adaptation to climate change may well help unify the stakeholders in built infrastructures to work together at least on the adaptation to climate change. This is possible because attempts are underway in the engineering community to unify some common elements of different built infrastructures such as the green infrastructure rating system of the Institute for Sustainable Infrastructure co-founded by ASCE with two other engineering organizations. USGCRP’s outreach to engineers to incorporate climate change adaptation actions into existing decision-making processes engineers follow to protect public welfare, health, and safety would be timely and welcomed by engineers and other stakeholders in built environment.7. In Chapter 30, Sustained Assessment:The text on page 1048, Contributions of a Sustained Assessment Process, item 5 on line 32 says:Create a network of scientific, decision-maker, and user communities for extended dialogue and engagement regarding climate change. Comment on Contributions of a Sustained Assessment Process, Item 5 on page 983:The process followed by stakeholders in built environment (described in Comment 6 above) is a voluntary consensus process that includes the three interest groups in the market: the producer interest, the consumer interest, and the public interest (represented by independent scientists, academia, regulators, citizen groups). This is a sustained engagement process of these interest groups to review new information and data and revise consensus documents periodically but not later than 3-5 years. This consensus process has evolved in over a hundred years of interactions among these three groups in our democratic political and market-based economic system. The USGCRP interest to create “a network of scientific, decision-maker, and user communities for extended dialogue and engagement regarding climate change” would benefit from the experience of stakeholders having done that for the built environment. The climate change mitigation and adaptation are new concerns for all in our democratic political and market based economic system. The NCA’s sustained assessment process would have to ensure that no stakeholders are left out of the process for the public’s acceptance of the national plan of action on climate. A persistent and valid criticism of our global economy is that it is unfair or socially inequitable across the board in each nation and globally. This criticism predates by over a century the recent concern in American economy on income inequality. Climate change mitigation is a global issue impacting the global economy. As a result, American national plan of action on climate would have to be acceptable not only to the American public but appeal to the people of all nations in the world so that they can follow the basic principles of the American plan. In addition to the principle of setting targets and timeframes for GHG reduction, any nation’s plan would also have to include the issue of social equity in the national and global economies. “The civil engineering profession recognizes the reality of limited natural resources, the desire for sustainable practices (including life-cycle analysis and sustainable design techniques) and the need for social equity in the consumption of					

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		resources." This quote from ASCE Policy Statement 418, The Role of the Civil Engineer in Sustainable Development1 links the issue of environmental sustainability with that of social equity. After WWII in the last century, the two issues of environment degradation and social inequity have been championed separately by environmental scientists and macroeconomists respectively. The two issues of social equity and environmental sustainability are linked in national and global economies for over two centuries of the ongoing technological revolution. It is essential that the USGCRP support a collaborative process of scientists, engineers, and economists for developing a national plan of action to transition our $15 trillion economy to become environmentally sustainable and socially equitable by a date certain. The NCA process would also have to ensure that all existing climate related issues being discussed today are addressed in the national plan of action on climate emerging from the sustained assessment process. Social and environment conflicts have recently emerged in the American economy related to the new fossil fuel sources of hydrofracked natural gas/oil and tar sands oil. Thousands of comments are received during the public comment periods of the state and federal agency attempts to write regulations for safe extracting of frack gas/oil and tar sands oil. It is unrealistic for any regulatory agency to resolve conflicts on social and environmental impacts of new technologies without consensus opinion of scientists, engineers, and economists. The public needs to know what limited short-term role these fuels would have in a broader long-term plan of action on climate. It is suggested that the USGCRP address this divisive issue directly impacting the climate change issue, in developing the national plan of action to transition our economy to become environmentally sustainable and socially equitable by a date certain. References:1. ASCE Policy Statement 418, The Role of the Civil Engineer in Sustainable Development: Promote reduction of vulnerability to natural, accidental, and willful hazards to be part of sustainable development. http://www.asce.org/Public-Policies-and-Priorities/Public-Policy-Statements/Policy-Statement-418---The-Role-of-the-Civil-Engineer-in-Sustainable-Development/.2. ASCE Policy Statement 488, Greenhouse Gases: The American Society of Civil Engineers (ASCE) supports the following public and private sector strategies and efforts to achieve significant reductions in greenhouse gas emissions from existing and future infrastructure systems -----. http://www.asce.org/Public-Policies-and-Priorities/Public-Policy-Statements/Policy-Statement-488---Greenhouse-Gases/.3. ASCE Policy Statement 360, Impacts of Climate Change: The American Society of Civil Engineers (ASCE) supports government policies that encourage anticipation of and preparation for possible impacts of climate change on the built environment. http://www.asce.org/Public-Policies-and-Priorities/Public-Policy-Statements/Policy-Statement-360---Impact-of-Climate-Change/.My Additional Comments:As an engineer I am concerned about the lack of a comprehensive national plan of action for reduction of greenhouse gas emissions to a specific target and time frame. I suggest that USGCRP support a national level effort, to be jointly undertaken by scientists, engineers, and economists in a consensus process, to develop a comprehensive national plan of action to reduce total U.S. emissions of greenhouse gases to a level consistent with the B1 scenario by 2040 or sooner.Such a plan of action for reduction of greenhouse gas emissions to a specific target and time frame is called for by the American Society of Civil Engineers in its Policy Statement 488, Greenhouse Gases.The American conversation on climate that started in earnest in 2007 is likely to expand in 2013 at all levels – national, private and public sectors, local colleges and communities - in view of many ongoing activities at these levels and also because of the lack of global level action at the UN. The American public is more ahead on the issue of climate than the climate experts and politicians debating the issue realize. They are ready for action on climate change mitigation and adaptation. In a recent poll, 4 out of every 5 Americans said climate change will be a serious problem for the United States if nothing is done about it. Voices of business-as-usual (BAU) insiders and independent outsiders, for and against, on the issue					

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		of climate have been heard enough. What the American public needs now, is to hear the collective voice of our nation's scientists, economists, and engineers on a plan of action to usher in a clean energy economy, phase out dirty energy by a date certain, and adapt to climate changes already underway. This effort to develop and implement a plan of action would also comply with the US Congress's request in 2009 to the National Academies of Sciences and Engineering for actionable recommendations. It would also be responsive to President Obama's call in 2011 to America's scientists and engineers that if they assemble teams of the best minds in their fields, and focus on the hardest problems in clean energy, "...we'll fund the Apollo projects of our time".A bottom-up process of taking action on climate neutrality has already started in the campus climate-neutrality commitment of 663 educational institutions. Through a common monitoring program, local engineers work with the colleges to start them on their way to climate neutrality. The college teams can provide input to local engineers and together they can incrementally test and implement on ground the plan of action in a continuous interaction between the top/down national and bottom/up local processes. The involvement of the younger generation in making campuses and local communities climate-neutral would lead in time to broader acceptance by the American public that climate neutrality of American economy as a whole by a date certain is feasible. Clean energy technologies are decentralized as is the energy market. So conceptually it makes sense that clean energy technologies are the best system for providing for our needs. And decentralizing our current infrastructure shouldn't be hard to do. The transformation of our existing centralized energy industry into a decentralized user and community owned energy systems connected by smart grids fits with our rapidly unfolding digital revolution. Also, this decentralization is a compatible approach to the ongoing decentralized energy conservation work of users and communities.I envision that this economic transformation will occur gradually in a period of over 15-35 years during the ongoing digital advances and could be called the third technological revolution of the global civilization. It would deal at the same time with the issues of social inequity and environmental unsustainability in national and global economies that have accumulated over the last two centuries during the first and the second technological revolutions. It would bring to an end the notion that new technologies necessarily create winners and losers in an economy. No longer will gross social inequity and harmful environmental degradation in our global community have to be a natural side effect of the pursuit of material well-being.Note to the NCA Review Team:A more detailed rationale for the above comments is provided in my following two papers pasted below my comments on Chapter 27, Mitigation: 1. Engineers and the Public Good (2 Pages) 2. Searching for A Plan of Action on Climate Change (15 pages)Title: Engineers and the Public Good March 2013"This article appeared in the March 2013 issue of STRUCTURE magazine, published by the National Council of Structural Engineers Associations (NCSEA), and is reprinted with permission." "The civil engineering profession recognizes the reality of limited natural resources, the desire for sustainable practices (including life-cycle analysis and sustainable design techniques), and the need for social equity in the consumption of resources." This quote from ASCE Policy Statement 418, The Role of the Civil Engineer in Sustainable Development, links the issue of environmental sustainability with that of social equity. These two concerns are not easily tackled separately from each other or by one nation independently of the rest of the world. Yet that is exactly what is happening today: scientists addressing the long-term issue of environmental sustainability without simultaneously recognizing its					

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		short-term impact on the economy, and economists addressing the short-term issue of unemployment without simultaneously recognizing the long-term need for an environmentally sustainable global economy. Thomas Brooks, writing in this space (August 2012), sees the global link of economies as follows: “American businesses outsourcing and offshoring jobs to India and China” so as “to remain competitive” is one reason “hindering a full recovery” of the American economy. The less restrictive labor and environmental laws abroad constitute the primary reason for outsourcing American jobs. It is a short-sighted solution that creates social inequity across the board, causing unemployment in the United States and facilitating slave shops in Asian countries, as well as environmental degradation across the board, as rich and poor alike in Asia choke in pollution that eventually drifts to the U.S. West Coast. “So what’s the solution?” asks the editor of Modern Steel Construction (October 2011). He adds, “I believe that we need to start taking responsibility for the products we purchase. However, the solution can’t rest on the actions of individuals as that would unfairly penalize those who try to do the right thing. Instead, we need a national policy that imposes tariffs on imported products that do not meet our environmental and labor regulations.” The global macro-economists who support free movement of capital across national boundaries would regard this as too nationalistic and protectionist; it would likely result in trade wars and hurt both economies. Fortunately, after the near-collapse of Wall Street in 2008, economists have undergone soul-searching about the fundamental assumptions of their discipline. They now recognize that in addition to capital resources, two other key inputs also deserve their attention: labor, including skilled labor and technologies, and natural resources. Labor injects the social equity issue into the economy, and natural resources inject the environmental sustainability issue. Recently, there has emerged a new international group of economists focusing on these two issues. They held their first annual conference in 2008 in Paris, and the most recent one in 2012 in Montreal. Climate scientists and environmentalists approach sustainability with a global perspective, but generally do not get involved in the social equity issue, choosing to remain close to their field. Engineers, on the other hand, need to be concerned about social equity as they work directly with manual and skilled labor. Much has been written on the topic of the differences between scientists and engineers in their approaches to problem-solving. Henry Petroski, in his book, The Essential Engineer: Why Science Alone Will Not Solve Our Global Problems, invokes C. P. Snow's reference long ago to the cultural divide between the humanities and sciences, then explains as follows a similar cultural divide between scientists and engineers:"If the two cultures of a half century ago were the sciences and the humanities, are the two cultures of today the sciences and engineering? Do scientists understand engineering, and vice versa? ... But the overall cultures of the sciences and engineering can be as disparate as those that Snow observed between the sciences and humanities. While there are scientists who look down on engineering and engineers who dismiss science as of no practical value, in an age of apparent climate change and other global issues, it is incumbent upon both cultures to see the importance of the other in defining and solving the problems of the planet ... We all should strive to be of one culture ... There can be little doubt that these are not times for the global scientific, engineering, economic, political, and public policy communities to separate themselves into competing cultures. They can best unite when they understand each other's disciplines and their essential roles in contributing to the whole."After a century of technological progress and rationalization of markets, we now have three cultures - scientists, economists, and engineers - that interact in making decisions about global economic issues involving science and technology. In his bimonthly InFocus columns in this publication, Jon Schmidt has written extensively on social captivities of the engineering profession and is now developing virtue ethics concepts that could help engineers deal with the moral issue of the public good. For example, his column on					

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		"Knowledge, Rationality, and Judgment" (July 2012) explains the three traits that are all too often pursued singly by scientists, economists, and engineers, respectively, when what is needed is a fusion of these dispositions. In the meantime, social equity and environmental sustainability are addressed in ASCE Policy 418, which states that “ASCE will work on a global scale” for engineers to “have a role in planning, designing, building and ensuring a sustainable future. Engineers provide the bridge between science and society. In this role, engineers must actively promote and participate in multidisciplinary teams with other professionals, such as ecologists, economists, and sociologists to effectively address the issues and challenges of sustainable development.”Title: Searching for A Plan of Action on Climate Change (April 2013) This paper is written for the specific purpose of submittal to the NCA review team in support of my above comments.The Table of Contents Page1. Purpose 12. The Two-Level Global Conversation on Climate 22.1 The Successful Technical Level Global Conversation on Climate 2.2 The Stalled Political Level Global Conversation on Climate 2.3 The Future of Global Conversation on Climate3. The Emerging American National Conversation on Climate 43.1 The U.S. Global Change Research Program (USGCRP) 3.2 The American Public and Private Sector Initiatives on the Environment and Climate 3.3 The American University and College Campus Climate Commitment 3.4 President Obama’s Call for Action on Climate4. From Conversation to Timely Action 64.1 The Role of Engineers to Develop a Plan of Action on Climate Change 4.2 Clean Energy Global Economy with Social Equity and Environmental Sustainability 4.3 The Voluntary Consensus Process of Decision-making Defined 4.4 From the Business as Usual Energy Economy to a Clean Energy Economy5. Conclusions 136. References 141. PurposeThe longstanding global and American conversations on climate change have produced a robust knowledge base and created public awareness on the issue, but they have not offered a plan of action for mitigation, creating an impression among the public that none is possible in the foreseeable future. The purpose of this paper is to review the state of the global and national conversations on climate in order to explore how best to arrive at a plan for timely action to transition the business-as-usual (BAU) economy to a clean energy economy by a date certain that would also result in the global economy becoming socially equitable and environmentally sustainable. 2. The Two-Level Global Conversation on ClimateClimate change is a global issue. The initiative for global action on climate change was started at the UN in 1988 with participation of all nations. However climate change is also a technical issue requiring participation of scientists and engineers. Thus the global conversation on climate began at two levels at the UN in 1988 – the political and technical levels. The state of this two-level global conversation on climate is reviewed below.2.1 The Successful Technical Level Global					

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		Conversation on ClimateThe UN formed the Intergovernmental Panel on Climate Change (IPCC) in 1988 to assess the scientific, technical and socioeconomic information relevant for the understanding of the risk of human-induced climate change. The UN IPCC is where global conversation at the technical level occurs. Over 2,000 scientists and engineers voluntarily participate in a consensus process in the IPCC representing all nations that wish to participate. The UN IPCC has developed a valuable scientific and technological knowledge base on climate change, its mitigation and on adaptation to effects of climate change already underway. This knowledge is well documented and disseminated in hundreds of papers and reports found on the IPCC web site. The UN IPCC's scientifically authentic work has created global awareness of climate change. In 2007, the UN IPCC was awarded the Nobel Peace Prize jointly with American ex-Vice President Albert Gore "for their efforts to build up and disseminate greater knowledge about man-made climate change, and to lay the foundations for the measures that are needed to counteract such change."1The consensus required for approval of IPCC's documents is very rigorous – it's almost a line by line consensus approval by all national representatives at the UN. The success of the IPCC consensus process to deal with highly scientific and technological issue in a global political setting has made the IPCC process a model to follow in other such issues at the UN.2.2 The Stalled Political Level Global Conversation on ClimateThe political level conversation on climate began at the UN after the first IPCC report. This UN initiative is called the United Nations Framework Convention on Climate Change2 (UNFCCC). The first UNFCCC conference was held in Rio in 1992 called the Earth Summit, the first agreement called the Kyoto Protocol for Greenhouse Gas (GHG) reductions was adopted in 1997, and annual conferences are held since 1997 for continuing negotiations on climate change. In contrast to the success of the technical level global conversation culminating with the Nobel Peace Prize, the political level global conversation is stalled. The 2012 UNFCCC conference ended on December 08, 2012 in Doha, Qatar amidst reports that the global conversation on climate at the UN is stalled because it has not been effective in generating global action to reduce greenhouse gas (GHG) emissions. A news report3 on December 31, 2012 said: "The controversial and ineffective Kyoto Protocol's first stage comes to an end today, leaving the world with 58 per cent more greenhouse gases than in 1990, as opposed to the five per cent reduction its signatories sought." The UNFCCC political process failed to lay the foundations for the measures that are needed to counteract such change for which scientific and technical work was done by the IPCC. Why this UNFCCC political process failed in spite of the success of the UN IPCC's technical process remains to be examined by the UN. One likely explanation is that the UN process on climate didn't address the entwined issue of global poverty because the UN process on global poverty with the participation of social scientists and economists is separate and independent of the UN IPCC process on climate. Many social and environmental activists around the world concerned about global poverty and global warming both, recognize the historical link between social inequity in the global economy and its environmental unsustainability to support over 7 billion people in the world. This historical link between social inequity and environmental unsustainability has developed and persisted over 200 years of technological revolution. These activists see the UNFCCC as a top down government run process not responsive to the needs of the environment and the poor. The UNFCCC conferences attract civic protests, often angry and violent, from these groups. At the 2011 conference one activist courting an arrest said: "I took this action today because I believe this process is corrupt, this process is bankrupt, and this process is controlled by the One Percent … If meaningful action on climate change is to happen, it will need to happen from the bottom up … The action I took today was to remind us all of the power of taking action into our own hands. With the failure of states to provide human leadership, and the corporate capture of the United Nations process, direct action by the ninety-nine percent is the only avenue we have left." 4Clearly, the					

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		UN political process on climate is stalled because it lacks the credibility today for politicians of each nation to take climate action at the national level based on agreements made at the global level. 2.3 The Future of Global Conversation on ClimateThe 2012 UNFCCC conference ended with the recognition that: • The negotiations at the global level alone “were necessary, but were not sufficient. We won’t get an international agreement until enough domestic legislation and action are in place to begin to have an effect. … Governments have to find ways in which action on ground can be accelerated and taken to a higher level, because that is absolutely needed.” 5 • “It has long been evident that the United Nations talks were at best a partial solution to the planetary climate change problem, and at worst an expensive sideshow. The most effective actions to date have been taken at the national, state and local levels, with a number of countries adopting aggressive emissions reductions programs and using cap-and-trade programs or other means to help finance them.” 63. The Emerging American National Conversation on ClimateThe stalled global political conversation on climate in 2012 means that starting in 2013 the American conversation on climate will be guided by the American public’s interest in taking action on climate and not necessarily responding to the UN’s call for action that often had counterproductive effect with the American public. It is now up to the American public to advance the American conversation on climate to take action and influence the actions of other nations. Although climate conversation is ongoing in many private and public sector initiatives, a serious American national conversation has yet to emerge. In addition, the US government has not ratified the various global agreements that have been made at the UN. This lack of a national level conversation and the lack of political acceptance of the UN’s agreements together have created a public perception that the US government is in climate denial, not interested in either cooperating with the UN’s climate initiative or undertaking an American national climate initiative. Far from being in climate denial, the US government has taken the constitutionally mandated steps to participate in the UN process, and it proactively supports the UN process. There is also a long history in the US of environmental and social activism. Starting in 2007, American academic institutions, now numbering over 600, committed to becoming climate neutral as soon as possible. These three distinct conversations described in more detail below have the potential to unify into a national conversation retaining its bottom-up origin but benefitting from the top down flow of resources of expert advice and funds. 3.1 The U.S. Global Change Research Program (USGCRP)It is important for the American public to know that American experts have participated constructively at the UN through the U.S. Global Change Research Program (USGCRP) which started in the same timeframe as the UN IPCC and the UNFCCC as explained by USGCRP.7 The USGCRP began as a presidential initiative in 1989 and was mandated by Congress in the Global Change Research Act of 1990 (P.L. 101-606), which called for "a comprehensive and integrated United States research program which will assist the Nation and the world to understand, assess, predict, and respond to human-induced and natural processes of global change."During the past two decades, the United States, through the USGCRP, has made the world's largest scientific investment in the areas of climate change and global change research. Since its inception, the USGCRP has supported research and observational activities in collaboration with several other national and international science programs.The lack of confidence in the UN’s UNFCCC political process to lay the foundations for the measures that are needed to counteract such change is a more likely explanation for the US government not signing the various UN agreements. Whatever the global political state of the climate debate, the USGCRP has					

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		continuously worked since 1989 issuing periodic reports called the National Climate Assessment (NCA). The draft 2013 NCA was issued on January 14, 2013 and is now available for public comment closing on April 12, 2013. This draft NCA includes for the first time chapters on Adaptation, Mitigation, and Decision Support. The draft NCA is seeking to improve collaborative decision processes working with stakeholders, looking to increasing support through the USGCRP for research to develop decision support tools, and is interested to create a network of scientific, decision-maker, and user communities for extended dialogue and engagement regarding climate. The NCA process provides an opportunity for American public, the media, and the stakeholders in energy market to engage in a unifying national conversation with nation's expert scientists, engineers, and economists to seek timely action on climate change adaptation and mitigation. 3.2 The American Public and Private Sector Initiatives on the Environment and ClimateDuring the past five decades American environmental organizations have created public awareness of environmental impacts of our high material-intensity economy. The first Earth Day was proclaimed in April 1970. The Environmental Protection Agency (EPA) was formed in December 1970 to consolidate in one agency a variety of federal research, monitoring, standard-setting and enforcement activities to protect the environment. The EPA has enacted many regulations over the years to implement legislation such as the Clean Water Act in 1972 whose origin dates back to the Federal Water Pollution Control Act of 1948.In this respect, the American conversation on climate may be seen as a continuation of the American conversation on the environmental sustainability of the American economy. The American public and private sectors have been active in energy conservation and clean energy research and commercialization since the creation of the Department of Energy in 1977. Action at local municipal levels of recycling of solid wastes dates back to early 1980s. The American conversation on climate has picked up its pace since 2007 by engaging the nation's top scientists and engineers. In 2009, the US Congress requested the National Research Council (NRC) to offer advice on climate change. The NRC is the operating arm of National Academies of Sciences and Engineering. The leaders of America's scientists and engineers in the two Academies have completed a peer-reviewed report on climate change requested by the US Congress. In May 2011, the NRC issued the first three of five reports based on five studies known as America's Climate Choices with the remaining two issued later in 2011. Although the US Congress requested NRC to offer "action-oriented advice" the NRC reports contained no specific action plans in its three reports but offered stark warnings, recommendations, and policy advice for legislation. The second report, Limiting the Magnitude of Future Climate Change, acknowledges the global nature of limiting emissions and suggests that "the U.S. could establish itself as a leader in developing and deploying the technologies necessary to limit and adapt to climate change." 8 Going beyond carbon pricing, this NRC report seeks "rapid progress in key areas such as: increasing energy efficiency; accelerating the development of renewable energy sources; advancing full-scale development of new-generation nuclear power and carbon capture and storage systems; and retrofitting, retiring, or replacing existing emissions-intensive energy infrastructure." The draft NCA mentions these findings of the NRC on climate. The two national academies will review the draft NCA thus establishing a link between two initiatives of the US Congress. 3.3 The American University and College Campus Climate Commitment Another important voice on climate is of a national organization started in 2007 called the American University and College Presidents Climate Commitment. The commitment signed by over 600 educational institutions is to "Initiate the development of a comprehensive plan to achieve climate neutrality as soon as possible." 9Climate neutrality in this program "can be achieved by increasing energy efficiency and improving energy conservation, as well as by using renewable energy either through on-site generation or the purchase of renewable energy credits." Independent evaluation of campus and endowment					

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		sustainability activities at colleges and universities in the United States and Canada is being conducted by The College Sustainability Report Card10. An article titled Tracking a campus-wide green facilities initiative reporting on Pomona College campus "as one of seven schools to receive a grade of 'A' for campus sustainability initiatives"11 explains how Pomona College worked with outside experts to improve its sustainability initiatives. This program offers local engineers an opportunity to work with local academic institutions to start a bottom-up process of taking action on campus climate neutrality. Many local engineers would be members of local sections of engineering societies. The college teams and local engineers together can incrementally test and implement on ground the comprehensive national plan of action in a continuous interaction between the top/down national policy level work and bottom/up local implementation work. The local engineers would also be instrumental in working with other voluntary efforts of local and state governments.The involvement of the younger generation in making campuses and local communities climate-neutral would lead in time to a broader acceptance by the American public that climate neutrality of American economy as a whole by a date certain is feasible. 3.4 President Obama's Call for Action on ClimateWith the NRC report seeking rapid progress, the NCA seeking to improve collaborative decision processes working with stakeholders, the UN urging the national governments "to find ways in which action on ground can be accelerated and taken to a higher level," and the campus climate neutrality commitment of academic institutions, the many voices of American conversation on climate are poised to unify into a national conversation in 2013 towards taking action on climate.President Obama has gone even further in his State of the Union address on January 25, 2011 and issued a specific challenge: "We're telling America's scientists and engineers that if they assemble teams of the best minds in their fields, and focus on the hardest problems in clean energy, we'll fund the Apollo projects of our time." 4. From Conversation to Timely ActionA recent poll found 4 out of every 5 Americans said climate change will be a serious problem for the United States if nothing is done about it. Upon reelection, President Obama said that what's been done thus far on climate has been inadequate and that a national conversation on the topic was needed. The voices in American conversation on climate are poised to intensify in 2013. The following four steps can help unify the various growing voices on climate into a national conversation to formulate timely action.The successful technical process at the UN IPCC had participation of scientists AND engineers from all nations able to participate. The first step is for engineers to participate with scientists to define properly the role of each discipline to formulate timely action. This is further discussed below in Section 4.1, The Role of Engineers to Develop a Plan of Action for Climate Change.The two separate UN processes, one on climate and an independent one on poverty, is the likely reason for lack of credibility of the UN climate process with stakeholders in the UN poverty process. The second step is for economists to join scientists and engineers to develop a plan of action to transition the American economy by a date certain to a clean energy economy that is socially equitable and environmentally sustainable so that the public may then take political action. This is further discussed below in Section 4.2, Clean Energy Global Economy with Social Equity and Environmental Sustainability.On policies involving science and technology, the American public relies on a consensus of expert opinion more than on political ideologies. The UN IPCC technical level process gained its credibility around the world because the IPCC team operated with well established rules for consensus approval of its technical documents. American engineers have over a hundred years of experience in developing technical standards to protect the safety, health, and welfare of the public in a well-established consensus process. The third step therefore is for engineers to introduce this well-tested consensus process in their joint efforts with the scientists and economists to advance the American conversation on climate to action. Such a team conversation could occur at an institution with experience in providing					

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		secretariat support to consensus building. This is further discussed below in Section 4.3, The Voluntary Consensus Process of Decision-making Defined. Finally, the American national conversation on climate needs to bring under one consensus process all ongoing conversations impacting climate that have become contentious. Recently the issue of unconventional fossil fuels (natural gas and oil from hydrofractured shale rock and oil from tar sands) has consumed the time and energy of the fossil fuel industry, environment and climate scientists, and regulators at the three levels of the government but remains unresolved. The fourth step is to bring into the consensus process the ongoing conversation on unconventional fossil fuels in order to determine climate impact of these fuels as part of the American conversation on climate. Their short-term role needs to be examined in the long term plan of action to transition the American economy by a date certain to a clean energy economy that is socially equitable and environmentally sustainable. This is further discussed below in Section 4.4, From the Business as Usual Energy Economy to a Clean Energy Economy.The above four steps to advance the American conversation on climate to action are further discussed below in the following four sub-sections:4.1 The Role of Engineers to Develop a Plan of Action for Climate Change 4.2 Clean Energy Global Economy with Social Equity and Environmental Sustainability 4.3 The Voluntary Consensus Process of Decision-making Defined 4.4 From the Business as Usual Energy Economy to a Clean Energy Economy4.1 The Role of Engineers to Develop a Plan of Action for Climate ChangeAmerican architects actively joined the American climate conversation in 1994 with their green building rating program that has found appeal in other countries also. The role of engineers in the American climate conversation has not yet prominently emerged. This is recognized in the 2013 draft NCA in the following paragraph from Chapter 26, Decision Support. "Steps to improve collaborative decision processes could include training more 'science translators' to help bridge science and decision-making; integrating development of decision support tools into fundamental scientific research; improving reward structures and institutional recognition for those who work at the boundary of science and decision-making; increasing support through the USGCRP for research to develop decision support tools; and incorporating assessment of decision support resources for sectors and regions into the ongoing National Climate Assessment (NCA) process."Instead of creating a new discipline of “science translators” the NCA experts would do well to work with American engineers who are well trained for their role “to help bridge science and decision making” by the “collaborative decision processes” stated in the above paragraph. For example, the American Society of Civil Engineers (ASCE) state in a policy position: “Engineers have a leading role in planning, designing, building and ensuring a sustainable future. Engineers provide the bridge between science and society. In this role, engineers must actively promote and participate in multidisciplinary teams with other professionals, such as ecologists, economists, and sociologists to effectively address the issues and challenges of sustainable development.” 12 American engineers, though not as vociferous as scientists and economists, began their own internal conversation long ago, first on the issue of sustainable economic development and later on the climate issue. Seven major engineering societies have made sustainability part of their code of ethics for almost two decades. On climate change adaptation, an ASCE policy first approved in 1993 states that the ASCE “supports government policies that encourage anticipation of and preparation for possible impacts of climate change on the built environment.”13On the issue of greenhouse gas (GHG) reductions, the ASCE has called for establishing “clear and reasonable targets and time frames for the reduction of greenhouse gas emissions,” 14					

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		among several other strategies on climate change mitigation. This long-held policy position of ASCE is now supplied with “targets and time frames” in the 2013 draft NCA in The Key Message 2 on p. 24 which says: “To meet the rapid emissions reduction (B1) scenario used in this assessment, global mitigation actions would, within the next 25 years, need to limit global greenhouse gas emissions to a peak of around 44 billion tons of carbon dioxide per year."Clearly any entity wishing to develop a comprehensive national greenhouse gas policy would have to do so in coordination with other countries to limit global GHG emissions to a specified peak value. This is anticipated in ASCE policy position14 which supports encouraging “actions by other countries to reduce their greenhouse gas emissions.” An earlier ASCE policy on sustainable development asserts that “ASCE will work on a global scale to promote public recognition and understanding of the needs and opportunities for sustainable development.” 12 Engineers would welcome “increasing support through the USGCRP” to develop a plan of action by multi-discipline teams to transition our $15 trillion economy to clean energy economy with social equity and environmental sustainability by a date certain.4.2 Clean Energy Global Economy with Social Equity and Environmental SustainabilityThe American national conversation on climate action is likely to influence climate action in other nations in the emerging digitally connected global economy. This will create a path for coordinated global action on climate. A coordinated global action on climate would be possible only if all nations also address the other long-standing global economic issues of social inequity that exists in all nations and across the global economic divide. The ASCE recognizes “the reality of limited natural resources, the desire for sustainable practices (including life-cycle analysis and sustainable design techniques), and the need for social equity in the consumption of resources.” 12 Thus the issue of social equity in our economy is directly linked by ASCE to the issue of environmental sustainability. The global economy today is both socially inequitable and environmentally unsustainable. These two issues have been historically linked in our global economy since the beginning of the technological revolution over 200 years ago. One cannot be dealt with without simultaneously dealing with the other. Yet the two issues of environmental degradation and global poverty continue to be dealt with separately.The extent or the depth and breadth of social inequities and environmental unsustainability in the global economy increased gradually over the first 100 years of steam-driven technological revolution. They intensified to the present intolerable levels during the past 100 years of fossil-fueled technological revolution also referred to as the industrial revolution. During this period they became inextricably linked as well in a cycle with the rich getting richer and the poor getting poorer, with intensifying degradation of the environment. Global warming is the ultimate environmental degradation and global poverty the ultimate social injustice. During this 200-year long technological revolution the three disciplines of science, engineering, and economics made significant progress in theory and practice to become highly complex disciplines affecting all civil societies and creating economic growth. However, this economic growth has largely been inequitable around the world often causing social, political and military conflicts. Most economists have realized though that only equitable economic growth can minimize conflicts and provide true social progress in a civil society in terms of individual freedoms, gender and ethnic equality, access to education, democratic governance, public services such as clean water, sanitation, roads and transportation and so on. For example, in 2008, a new international group of ecological economists is formed to promote social equity and environmental sustainability in global economy. Fortunately, the three disciplines of science, engineering, and economics have together moved forward the technological revolution to the next or the third phase of technological revolution commonly referred to as the digital revolution. In less than two decades, the digital revolution has created a positive impact on the economy of all nations because it empowers individual citizens to take action at both individual and collective levels					

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		for their individual and collective well-being. This ongoing digital revolution creates an opportune time for taking coordinated global action on climate. If America takes the first steps to transition the American economy by a date certain to a clean energy economy that is socially equitable and environmentally sustainable, the American national conversation would serve as a model for other nations to develop and implement their own plans of action on climate. Another reason the American national conversation would serve as a model for other nations is that for the first time since the Great Depression, the issue of social equity has become important again in America as a result of the Great Recession that began in 2008. Columbia University's Nobel Laureate professor of economics Joseph Stiglitz addresses this issue of social equity in his new book The Price of Inequality – How Today's Divided Society Endangers our Future. In examining this income inequality in America, Prof. Stiglitz looks back only 30 years to propose regulations to not repeat that history. That is a welcome move. But looking back only 30 years is not sufficient unless it is done as part of looking back 200 years to understand the two wrongs of the global economy - social inequity and environmental unsustainability – so as not to repeat that history in newly developing economies of other countries. Unfortunately, during the past two decades, with the end of cold war, the business-as-usual (BAU) global process of economic growth that also creates economic inequality and environmental degradation has taken roots in major developing countries such as Brazil, Russia, India, South Africa, and China (abbreviated BRISC countries). They have put to work their own large number of capable scientists, engineers, and economists, to pursue export-driven local economy in the larger BAU global economy. These scientists, engineers, and economists are well connected with their counterparts in the BAU global economy. Though it seems there is strong economic growth in BRISC countries, it is only benefitting those able to participate in the export driven economy thus increasing economic inequality there. In addition, this BAU economic growth in BRISC countries is increasing their share of greenhouse gas (GHG) emissions and further degrading the local environment of the respective countries (as well as the world's). China today is the largest GHG emitter surpassing America and the Chinese air pollution drifts all the way to the American West Coast. This BAU global economic process that makes prosperous only 20% of the global population cannot be sustained to raise the income of the remaining 80% of the people. In view of this global economic integration of all major BAU economies, Prof. Stiglitz's prescriptions for reducing economic inequality in America by focusing only on regulating the capital in America is unlikely to work. The social and environmental impacts of the BAU global economy in developing countries also need to be taken into account. Prof. Stiglitz does mention in passing the globalization issue in a section of the last chapter titled Tempering globalization: creating a more level playing field and ending the race to the bottom where he writes:In reshaping globalization, we have to realize that there has occurred a race to the bottom from which we have all suffered. The United States is in the best position to stop this (if its politics would allow it); it can fight for better worker rights and conditions, better financial regulations, better environmental conditions. But other countries, working together, can also fight against the race to the bottom.Based on the state of global politics during and after cold war, Prof. Stiglitz makes a valid point above that the US is in the best position to influence global economy but it would have to be through a different process than the BAU process in place today. Meaningful action on climate and social equity first requires a consensus of scientists, economists, and engineers nationally and globally on how to transition the BAU economy into a clean energy economy before meaningful debates can occur on these issues at the national and global political levels. The inclusion of social equity issue in the climate conversation makes participation of economists in the climate conversation as essential as participation of scientists and engineers in multi-disciplinary teams as recognized by ASCE and in collaborative process sought in the NCA. 4.3 The					

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		Voluntary Consensus Process of Decision-making DefinedFor the public to support political action on climate, the public needs to know the consensus opinion of scientists, engineers, and economists on a plan of action on climate. In the absence of such a consensus opinion the space between science and the public is being filled by journalists, bloggers, non-profits, lawyers, and non-expert policy wonks with piecemeal developed, incomplete, and misunderstood information confusing the public and politicizing the issue. The UN IPCC technical level process gained its credibility around the world because the IPCC team operated with well established rules for approval of its technical documents. Most engineering journals published by technical committees of engineering societies follow a well-established peer review and approval process for accepting papers for publication. In contrast, the standards engineers implement in actual engineering practice are developed in a more stringent consensus approval process for protecting public safety, health, and welfare. This consensus process, well known to American engineers but not to scientists and economists or the general public, is defined in this section.This consensus process is a rigorous well-defined process with rules of committee balance, rules of evidence, rules for reaching a consensus by a formal balloting process, rules on public comments, and rules on resolution of objections. Any industry or government agency can form its own consensus standards process managed by an independent secretariat accredited by the American National Standards Institute (ANSI). The ANSI “has served in its capacity as administrator and coordinator of the Unites States private sector voluntary standardization system for more than 90 years.” 15 There is something to be learned from the consensus process engineers follow in developing their consensus standards for building construction. For example, there is no building safety department in Washington, DC or in State capitals. Building regulations are developed by architects and engineers in a well-established and tried voluntary consensus process for incorporation in legislation by local building departments. Because these consensus building regulations represent the consensus of the three interests in the market: the producer interest, the consumer interest, and the public interest, the regulations are rarely challenged in the legislative process and are always relied on by the courts in litigations involving malpractice suits against industry and professionals.The effectiveness of this private sector consensus process for developing standards to protect the public interest has gotten the attention of the US Congress and the Office of Management and Budget (OMB) in the Executive Branch. The US Congress mandated in 1995 that federal agencies “shall use technical standards that are developed or adopted by voluntary consensus standards bodies.” 16 In 1998, the OMB, following on Congress’ mandate, issued a document that defines the goal for agency use of consensus standards as follows: “When properly conducted, standards development can increase productivity and efficiency in Government and industry, expand opportunities for international trade, conserve resources, improve health and safety, and protect the environment.” 17 In the private sector new consensus standards organizations or groups are emerging to fill the need for stakeholders to reach consensus decisions on sustainability issues such as energy and resource conservation. Among the stakeholders are those who benefit as producers, those who benefit as consumers, and those who look out for the public interest. In each of the three interests there is diversity of stakeholders often with conflicting or competing interests. For example, the producer interest includes the capital and labor with internally conflicting interests between them. The consumer interest includes the chain of middlemen between the point of production to the point of consumption with internally conflicting interests. The public interest includes those who pay the social costs looking for just compensation, those who oppose the environmental costs looking to protect the environment, and those who seek to protect the public safety, health, and welfare including regulators at all levels of the government.On the climate issue a consensus process of decision making by the stakeholders has not emerged. We have experts in two					

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		key disciplines pursuing their own concerns in two separate tracks both looking for systemic changes in the BAU economy. The climate scientists would like to phase out over time existing and new fossil fuels and transition the BAU energy economy to a clean energy economy. The macroeconomists would like to make the BAU economy socially more equitable. Independently and separately they both reach out to the general public to influence the policy to address their concerns. This approach invariably politicizes their legitimate concerns in the absence of reliable information on a plan of action to address their concerns directly at a political level. Their concerns are best discussed jointly with engineers in a voluntary consensus process engineers follow to engage all the stakeholders in making consensus decisions for public safety, health, and welfare. Climate change is a more serious issue of public safety, health and welfare than, say, the issue of building safety during a hurricane or earthquake. So, climate change deserves to have similar consensus of experts in science, engineering, and economics in decision making. The scientists, engineers, and economists would work together to gain the confidence of the public on a plan of action to usher in clean energy economy with social equity and environmental sustainability, phase out dirty energy by a date certain, and adapt to climate changes already underway. The purpose of this voluntarily developed consensus information on climate action is meant only to inform the public so as to help the public to take whatever political action deemed fit for the digital age. Hopefully, with greater rationalization of global energy markets that exists today the consumers and the markets themselves would move voluntarily too to take action on climate based on this consensus information not requiring any legislative mandate thus speeding up the implementation. 4.4 From the Business as Usual Energy Economy to A Clean Energy EconomyAt a time when the American public is demanding action on climate change, the following three headlines18 sum up the business-as-usual (BAU) global energy scenario:• With China and India Ravenous for Energy, Coal's Future Seems Assured – Accords on global warming have had little impact on coal. • Shell Bets on a Colossal Floating Liquefied Natural Gas Factory off Australia – Moving onshore processing to a remote ocean field. • U.S. Is Forecast to be No.1 Oil Producer – by 2017 and a net oil exporter by 2030 says an IEA report which “confirms that, given the current policies, we will blow past every safe target for emissions.”Complicating the American conversation on climate are the two new sources of unconventional fossil fuels – the tar sands oil and hydrofracked oil and natural gas – in potentially vast quantities. They are being pursued by the BAU energy industry which is now on steroids with existing and new fossil energy sources overcoming the “peak oil” fear of just five years ago. The BAU energy interest is again in control of the global and national conversations on energy in the absence of credible progress on ground on clean energy and by projecting the new sources of fossil fuels as the transition fuels to clean energy economy that would provide much-needed jobs during the ongoing recession and much-desired energy independence. The opposition in the country to these two new sources of fossil fuels is growing. With regard to the Canadian tar sands oil pipeline known as the Keystone pipeline, the prominent climate scientist Dr. James Hansen said19 "If Canada proceeds, and we do nothing, it will be game over for the climate." Dr. Hansen explained: “The concentration of carbon dioxide in the atmosphere has risen from 280 parts per million to 393 p.p.m. over the last 150 years. The tar sands contain enough carbon — 240 gigatons — to add 120 p.p.m. Tar shale, a close cousin of tar sands found mainly in the United States, contains at least an additional 300 gigatons of carbon.”Similarly, if the US					

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		N-E states proceed with hydrofracking for Marcellus shale gas on a large scale, it too would be “game over for the climate” because frack gas has the potential for methane leakage from pipes and from the fractured rock in leakage rates (> 1%)20 that would make frack gas dirtier than coal, unsuitable as a transition fuel to clean energy economy, and far exceed the concern over the climate impact from the tar sands oil. There is strong indication in the near term that Canada would proceed with tar sands oil. BAU energy industry is already busy in North Dakota beginning to extract local shale oil. “As long as prices stay above $60 a barrel or so, oil will be a mainstay of the North Dakota economy for a generation or more.”21 Similarly, hundreds of frack gas wells are being drilled in some N-E states. Social and environmental impacts on ground are being felt that were not anticipated by local supporters of the BAU energy industry dividing the local civil society. Whether these new natural resources are actually a blessing or would prove to be a curse in the long run is being questioned now by local people apart from the climate and environmental concerns of outside activists. Protests against frack gas have resulted in two documentary films and many law suits. Protests against tar sands oil too would follow once the project proceeds along more than a thousand mile long pipeline. Thousands of comments are received during the public comment periods of the state and federal agency attempts to write regulations for safe extracting of frack oil/gas and tar sands oil. It is unrealistic for any regulatory agency to resolve conflicts on social and environmental impacts of new technologies without consensus opinion of scientists, engineers, and economists.Dr. James Hansen said19: "President Obama speaks of a 'planet in peril,' but he does not provide the leadership needed to change the world’s course. Our leaders must speak candidly to the public — which yearns for open, honest discussion — explaining that our continued technological leadership and economic well-being demand a reasoned change of our energy course. History has shown that the American public can rise to the challenge, but leadership is essential." It is true that the public yearns for open and honest discussion not only on these two new sources of fossil fuels but also on a plan of action on climate. But the public would need a lot more credible policy level information from President Obama than it now has to rise to the challenge of changing our energy course. Until then President Obama’s energy policy is likely to remain “all of the above” and the president has said “that a national conversation on the topic was needed.” Given the very short time the new fossil fuels have been part of the national energy scene and given how serious and contentious the implications are socially, economically, and environmentally, it is essential to include the new fossil fuels in the conversation on climate. The public needs to know the consensus opinion of scientists, engineers, and economists on what the social and environmental costs of extracting these resources are that are paid by the public and what are the lifecycle costs of alternative clean energies. This information will help the public to determine what limited short-term role these fuels would have in a broader long-term plan of action to usher in clean energy economy. Transition to a clean energy economy involves energy conservation and clean energy supply. Much of the ongoing energy conservation activities are valuable initiatives which, if pursued as part of a national plan of action, can reduce as much as 60% of American energy demand by 2030 in estimation of some. The balance of 40% energy we currently use would have to be provided by greening of our energy supply infrastructure itself. Consensus of scientists, engineers, and economists on clean energy science, technologies, and economics is lacking resulting in the current inaction in clean energy supply to replace fossil fuels. “It’s absolutely not true that we need natural gas, coal or oil — we think it’s a myth,” said Mark Z. Jacobson, a professor of civil and environmental engineering and the main author of the study, published in the journal Energy Policy. “You could power America with renewables from a technical and economic standpoint. The biggest obstacles are social and political — what you need is the will to do it.” 22In summary, to overcome the social and political obstacles and					

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		find “the will to do it,” the American public requires the consensus of scientists, engineers, and economists on a plan of action to phase out fossil fuel energy by a date certain to usher in clean energy economy with social equity and environmental sustainability, and adapt to climate changes already underway. 5. ConclusionsClimate change is a global issue. The global conversation on climate at the UN began in 1988 but is stalled at the political level seen now as merely a sideshow to climate initiatives at national levels. The technical level conversation at the UN by scientists and engineers has produced significant knowledge base for all nations to take action at national level to reduce greenhouse gas (GHG) emissions. The American conversation on climate led by American climate and environment scientists is the most advanced of all nations although it has not coalesced into a national conversation. One of the reasons for stalled global conversation on climate at the UN is that the global conversation on global poverty occurs separately at the UN and is not linked with climate conversation. This is true for all nations where macroeconomists lead the conversation on income inequality independently of the work of their scientists and engineers on climate at home and at the UN. Historically the two issues of social inequity and environmental unsustainability are linked in the global economy during the past 200 years of technological revolution that brought prosperity to only 20% of the global population deepening poverty of the rest and creating intolerable environment degradations. The business-as-usual economy fueled by fossil fuels must be transitioned to clean energy economy by a date certain to become socially equitable and environmentally sustainable. Consensus of scientists, engineers, and economists on clean energy science, technologies, and economics is lacking resulting in the current inaction in clean energy supply to replace fossil fuels by a date certain. American engineers are an untapped resource for taking action on climate change. They have separately conducted their own conversation on the issue of sustainability of our high-tech and resource-intensive global economy and on the need to make global economy both environmentally sustainable and socially equitable. American engineers have recognized also the need for multi-discipline team of scientists, engineers and economists to address both social equity and environmental sustainability of our global economy. American engineers have prior experience of over 100 years in developing consensus of three interests in the market – the producer, the consumer, and the public – to protect public safety, health, and welfare in our high-tech economy. Similar consensus decision making process on climate action is necessary with participation of scientists, engineers, and economists to develop a plan of action to transition to clean energy economy by a date certain that would also make the economy socially equitable and environmentally sustainable. Such a consensus plan of action is essential for American public to also address the issue of new unconventional fossil fuels and move forward the climate issue to a political action.American process on climate action is likely to become a model for other nations in the ongoing digital revolution to transition the global economy to clean energy economy by a date certain to also become socially equitable and environmentally sustainable. 6. References 1. The Nobel Peace Prize 2007, Intergovernmental Panel on Climate Change, Al Gore http://www.nobelprize.org/nobel_prizes/peace/laureates/2007/2. Gateway to the United Nations Systems Work on Climate Change http://www.un.org/wcm/content/site/climatechange/pages/gateway/the-negotiations3. Kyoto climate change treaty sputters to a sorry end, By Max Paris, Environment Unit, CBC News, December 31, 2012, http://www.cbc.ca/news/politics/story/2012/12/20/pol-kyoto-protocol-part-one-ends.html4. “Protesters Expelled From UN Climate Conference Hall”, Environment News Service, December 10, 2011, http://ens-newswire.com/2011/12/10/protesters-expelled-from-un-climate-conference-hall/5. “With Carbon Dioxide Emissions at Record High, Worries on How to Slow Warming,” By JUSTIN GILLIS						

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		and JOHN M. BRODER, The New York Times, December 2, 2012. 6. “Climate Talks Yield Commitment to Ambitious, but Unclear, Actions, By JOHN M. BRODER, The New York Times, December 8, 2012.7. United States Global Change Research Program - Integrating federal research on global change and climate change. http://assesment.globalchange.gov8. Limiting the Magnitude of Future Climate Change, 2010, The National Academies Press, 500 Fifth Street, NW, Washington, DC 20001. www.nap.edu.9. www.presidentsclimatecommitment.org10. http://www.greenreportcard.org/report-card-2011/schools/11. http://www.cenews.com/magazine-article-cenews.com-9-2012 tracking_a_campus_wide_green_facilities_initiative-9003.html.12. ASCE Policy Statement 418, The Role of the Civil Engineer in Sustainable Development: Promote reduction of vulnerability to natural, accidental, and willful hazards to be part of sustainable development. http://www.asce.org/Public-Policies-and-Priorities/Public-Policy-Statements/Policy-Statement-418---The-Role-of-the-Civil-Engineer-in-Sustainable-Development/.13. ASCE Policy Statement 360, Impacts of Climate Change: The American Society of Civil Engineers (ASCE) supports government policies that encourage anticipation of and preparation for possible impacts of climate change on the built environment. http://www.asce.org/Public-Policies-and-Priorities/Public-Policy-Statements/Policy-Statement-360---Impact-of-Climate-Change/ 14. ASCE Policy Statement 488, Greenhouse Gases: The American Society of Civil Engineers (ASCE) supports the following public and private sector strategies and efforts to achieve significant reductions in greenhouse gas emissions from existing and future infrastructure systems -----. http://www.asce.org/Public-Policies-and-Priorities/Public-Policy-Statements/Policy-Statement-488---Greenhouse-Gases/ 15. The American National Standards Institute www.ansi.org.16. The complete text of the National Technology Transfer and Advancement Act of 1995 is available at www.nal.usda.gov/ttic/faq/pl104113.htm.” In directing when and how federal agencies would meet that requirement, Congress stated, “Federal agencies and departments shall consult with voluntary, private sector consensus bodies and shall, when such participation is in the public interest and is compatible with agency and departmental missions, authorities, priorities, and budget resources, participate with such bodies in the development of technical standards.”17. Circular A-119 Federal Participation in the Development and Use of Voluntary Consensus Standards and in Conformity Assessment Activities. The complete text is available at www.whitehouse.gov/omb/circulars/a119/a119html. The OMB Circular A-119 further established policies related to consensus standards bodies, stating ”this Circular directs (federal) agencies to use voluntary consensus standards in lieu of government-unique standards except where inconsistent with law or otherwise impractical.”18. The business section of November 13, 2012 New York Times. 19. Game Over for the Climate , May 9, 2012 New York Times op-ed.20. The Conflagration Over Natural Gas, The EDF Newsletter Solutions, Summer 2012: “As the energy boom continues, EDF is working to make sure that it does not harm people or the environment. We need to ensure natural gas leakage is 1% or lower across the whole system. There are problems with hydraulic fracturing. The energy industry needs to admit that.” 21. North Dakota Went Boom, By Chip Brown, January 31, 2013 New York Times, 22. Life After Oil and Gas, By ELISABETH ROSENTHAL, March 23, 2013 New York Times,					
William	Schlesinger	The caption to this figure is not clear. First, it would be good to know the current usage or production capacity (MW) for each of the southwestern states. Then, it should be indicated whether the figure	20. Southwe	Fig. 20.3	692		We appreciate the suggestion, but space is limited. The author team has

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		listed for each state is the current or potential installed capacity of alternative energies, or what it would take to achieve 80% emissions reduction. And, is there any way to estimate what this would cost.	st				deliberated and agreed on the most important information/illustrations to include. The caption has been corrected to clarify that this is potential capacity, since the time for the reduction is 2050.
James	Adcock	Typo word "fo" should apparently be "of"	21. Northwest		748	21	The text has been revised to incorporate this suggestion.
Nancy	Cho	Wow, if this is what happens exactly, these predicaments are very unnerving. Although I am aware that the weather is in the grand scheme impossible to predict exactly, these predictions are still frightening.	17. Southeast and Caribbean				We greatly appreciate your positive comment about our report and hope that you find the content useful.
Randy	Moser	I enjoyed the bold statements of this page. Particularly that climate change is occurring and that the symptoms such as record high temperatures are likely to increase.	1. Executive Summary		3		Thank you for your comment.
Randy	Moser	It seems that mitigation and adaptation would be major components and the ultimate goal of this report. With their current placement on this page and in the chapter it seems like they could easily be overlooked. Perhaps having mitigation and adaptation appear earlier in this chapter, using formatting such as bolding them or creating a heading to highlight them more than just the quotes.	1. Executive Summary		6		Changes have been made to the structure of the Introduction to identify "framing issues" and point to where important topics are discussed in the report.
Randy	Moser	I found the confidence level diagram coordinated with the bolded text statements were very effect in communicating the message threat of sea level rise to the southeastern regions of the US.	17. Southeast and Caribbean		603		We greatly appreciate your positive comment about our report and hope that you find the content useful.
Dale	McCauley	Impact of human behavioral change (likely or unlikely) is not taken into account on this table. Most of the actions taken are focused on technological and emergency procedures - the results of human behavioral both in preventative and reactions are worth considering for further study.	4. Energy Supply and Use	4.2	178		Human behavioral change is implied in some of the adaptation actions in Table 4.2, but not directly stated. In response to this suggestion, we have revised the sentence in the Table 4.2 Caption to convey that human behavioral change by consumers can also promote resiliency.
Dale	McCauley	Discussion of energy needs and costs are excellent but do not describe the entire picture. These changes in demand are also likely to have an adverse impact on low-income communities and areas of energy poverty. This is both and economic and equity concern that should be addressed.	4. Energy Supply and Use		170		The topic of energy poverty is complex as it requires a multidimensional analysis of projected increases in cooling days and local energy costs, among many other things. It is beyond the scope of this chapter due to page length limitations.

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Matthew	Getchell	This chapter was written without significant contributions from non-economist social scientists, and as a result, the "human element" is lacking from this draft of this chapter. This chapter, and the report as a whole would benefit a great deal by emphasizing a mitigation approach FIRST, in addition to an adaptation approach SECOND. The priority to "Reduce Energy Demand" should be first and foremost, and should emphasize consumer change in behavior. The United States uses more energy per capita than most of the world, in large part due to the consumerism-driven culture of use-use-use. This has an enormous impact on energy usage and climate change-related emissions and should be targeted.Additionally, it would behoove the committee to take into account so-called "sanctuary areas" in the country which anticipate seeing a rise in population due to intra-country migration caused by climate change. Regions such as the Pacific Northwest are projected to continue to have comparatively mild climates as other regions in the country experience significant changes, so they will be more enticing to live in. This will have an impact on demand as well, and needs to be anticipated.Thank you for the good work.	4. Energy Supply and Use				The charter and focus of the National Climate Assessment (NCA) Report (including the scope of the energy chapter) is on impacts of climate change, rather than issues relating to mechanisms to reduce greenhouse gas emissions. Carbon emission reduction (mitigation) opportunities are primarily addressed in Chapter 27 - Mitigation. Note that improvements in efficiencies in energy, cooling, manufacturing, irrigation and water distribution/reuse are identified in Table 4.2 of this chapter as Adaptation Actions in the Energy Sector. Regarding the second comment, there are numerous factors that may cause migration within the U.S., including proven factors such as economic, demographic (retirement) and regulatory. While climate changes may be a factor in the future, credible studies establishing where and what those migration patterns will be were not submitted to the NCA.
Ricardo	Alvarez	No mention is made in this chapter of the natural causes that drive climate change. This may leave most of the general public with the impression that all climate change is caused by human activity, which is of course incorrect. I suggest adding a phrase to paragraph 1 to the effect that natural processes at work for million of years have caused the Earth's climate to cycle between warmer periods and ice ages, but that the current period of warming has been getting warmer at an accelerated pace under the effect of human activity. This would give a more balanced and correct picture of what is driving climate change.	Introduction: Letter to the American People				This is a good suggestion and changes have been made in response. There have been warming periods in the past, but the only explanation for warming observed now is human activities. Since the Eocene, the Earth has been cooling, but human activity has reversed this trend.
Ricardo	Alvarez	Ref: page 4, lines 33,34: the reference to five million Americans living within four feet of the local high-tide level is confusing. Is this a reference to four feet in elevation OR four feet in horizontal distance to the farthest landward reach of the water line at high-tide? Depending on which it is, the five-million figure may be significantly different.	1. Executive Summary				A change has been made to the language to clarify this.
Ricardo	Alvarez	Ref: page 5, line 6"...cost, benefits and risk of available response options.."This section could be made stronger by referring to either "adaptation" or "preparedness" options, which imply actions taken now or soon to prepare or adapt to future changes before they happen, instead of responding, which	1. Executive Summary				The authors believe the current language adequately communicates their intent - mitigation is also a

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		implies doing something after change has taken place.					response option, but it is not reactive.
Ricardo	Alvarez	Ref: page 6, lines 8 - 10....adaptation to better respond to new conditions..."Again the impression here is of doing something after the fact....By definition adaptation consists of measures taken to reduce the potential for damage from future impacts.	1. Executive Summary				The authors believe the current language adequately communicates their intent - mitigation is also a response option, but it is not reactive.
Ricardo	Alvarez	Ref: page 6, lines 10-11...mitigation and adaptation are linked, in that effective mitigation reduces the need for adaptation...This is the wrong message to send, and it is something that has carried from previous reports.Mitigation and adaptation become effective under vastly different timelines. Mitigation measures such as emissions' reduction may produce meaningful results over hundreds if not thousands of years. On the other hand, adaptation measures taken today of in a year's time become effectively immediately in reducing the potential for damage from expected future impacts. The reference to a reduction in the need for adaptation is the wrong message to send, it does not add to the value of the assessment and, in my opinion, it should be deleted.	1. Executive Summary				This language has been amended and a new section has been added to the Executive Summary on topics for future National Climate Assessments. This section addresses the need for more knowledge on the topic of interactions between adaptation and mitigation.
Ricardo	Alvarez	Ref: page 6, lines 35, 36".....building codes will likely need to be updated..."This comments ignores the fact that building codes, and not all communities have them, are about establishing minimum requirements for building design and construction. Also most codes, including the most stringent, do not even address issues of sea level rise, storm surge A much stronger and needed message would be that building codes will need to be radically changed in order to catch-up with the science and to emphasize building performance, rather than minimum requirements under expected impacts.	1. Executive Summary				The point made here is that building codes and land use planning decisions do need to be amended to enhance preparedness.
Ricardo	Alvarez	Ref: page 9, lines 6,7"....are already resulting in damage.."this gives the impression that this is a recent development, when in fact we have seen damage to coastal infrastructure and built-environment from storm surge for hundred of years, or at the very least for the 150+ years since we have kept records of land-falling hurricanes. The correct message is that damage caused by storm surge and wave impact on the coastal built environment is being exacerbated, and more rapidly so in recent years, by sea level rise driven by climate change.	1. Executive Summary				This is a good point, and changes have been made to the language.
Ricardo	Alvarez	Reg: page 10, lines 25 - 28This would be a lot stronger and clearer if we add words to the effect that..... "..reduce the potential for damage to the built-environment and supporting infrastructure"After all, almost the totality of human activity is sheltered in components of the built environment and it also requires a functioning infrastructure.	1. Executive Summary				There is a report finding on infrastructure that emphasizes your point…based on several chapters in the report.
Ricardo	Alvarez	Ref: page 11, "COAST"there is a reference to "water supply infrastructure"This would be clearer and stronger if the following language is added: "....water supply, water management, and waste water treatment infrastructure, are increasingly..."This refers to how water management infrastructure designed for flood control is losing its effectiveness as sea level rises . Also waste water treatment plants in coastal location, which are gravity dependent for influent are becoming much more vulnerable and less effective because of sea level rise	1. Executive Summary				This summary statement needs to be kept short, but the point is made clearly in the water chapter and the infrastructure report finding.
Ricardo	Alvarez	Ref: page 16m lines 33,34"....more effective mitigation measures can reduce the amount of climate change and therefore the need for adaptation in the future"Please see my comments to page 6, lines 10-11This is an incorrect statement and the wrong message to send to the public. The timelines for adaptation and mitigation measures to become effective are separated by several orders of magnitude. An adaptation measure implemented today becomes effective immediately against an anticipated impact, but it may take hundreds or even thousands of years before the reduction of GHG emissions actually result in a reduction in the rate of global warming and even longer for that to reduce the rate	1. Executive Summary				A new section has been added to the Executive Summary on topics for future National Climate Assessments. This section addresses the need for more knowledge on the topic of interactions between adaptation and mitigation and mentions the different

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		of SLR. This message actually weakens the assessment report and should be deleted.					timelines.
norman	holy	The entire report fails to address the most important issue of all. That is the stresses added as a result of the growing global population. Climate change is simply a manifestation of population. With the UN predicting a 10 billion population by 2100 under a "replacement" scenario, the fact of 3 billion more people will prove catastrophic.	2. Our Changing Climate				A statement about the basis for the scenarios used in the assessment has been added to the chapter (in the box describing the models used in the assessment).
norman	holy	In comments about the future corn crops, there is no mention of Hertel's work and the potential movement of the corn belt to near the Canadian border. Hertel also discussed the need for seed tolerant of 6 F higher temps. These views should be part of the report.	18. Midwest				Although the comment suggests a good specific example, the authors feel the existing examples are appropriate and adequate.
Jordan	Arriazol a	The executive summary hits on every environmental front, not just heating of the earth, which really will convince skeptics the true damage of global warming. However simply stating this fact is not convincing enough, we need more solid numbers and in the summary there was only two graphs that show climate scenarios. The summary should have multiple graphs that shows spikes in recent history of natural disasters linked to climate, actual graph in ice recession all of these and more alongside predictions for climate in the future. All the summary really needs to make a steel solid argument is more concrete numbers along with the already powerfully convincing statements.	1. Executive Summary				This is a good point, an additional paragraph about evidence and some new figures have been added to the Executive Summary.
Jordan	Arriazol a	The chapter over Southeast and Caribbean is extremely convincing, there are so many irrefutable graphs used in just the first few pictures of this chapter its scary. There is so much data observed that simply cannot be ignored by skeptics of climate change, and not only the graphs but the actual satellite images of Louisiana over the years which I cannot comprehend how others can ignore this. Extremely solid chapter, i wouldn't change anything except keep hitting people with hard data even more.	17. Southeast and Caribbean				We greatly appreciate your positive comment about our report and hope that you find the content useful.
brentt	kasmiski e	I should star off by saying that I'm a student doing this for an assignment. I'm by no means an expert in climate change. However, I am not totally ignorant of climate change either. I should also say that I have only read this one chapter, the executive summary. I've also never done a comment like this before, so I'm not sure what to write about.From what I have learned in my class on this topic, everything I have read here seems to go along with it and be about the same as what we have been reading from IPCC reports and our books, as well as other reports the teacher finds. Congratulations on what you've got so far, I can't even imagine working with a group of over 240 people. Also, in Crosscutting Themes and Issues section 4, Thresholds..., the second sentence starts with "Same changes..." I think this may be a typo and it should be "Some changes...".	1. Executive Summary				Thanks very much for your comments!
Brianna	Buchana n	I thoroughly enjoyed this section in particular as I am a resident of this region. And while its quite sobering to read, it was very insightful. If people do not fully know of the problems we are facing, it makes it very difficult to solve them or learn to adapt to them. I found the part detailing how, "Ground-level ozone is projected to increase in the 19 largest urban areas of 17 the Southeast, leading to an increase in deaths (Chang et al. 2010). A rise in hospital admissions 18 due to respiratory illnesses, emergency room visits for asthma, and lost school days is expected" very unsettling. This is something that I had not yet considered when imagining the future possibilities of climate change. Yet, it makes perfect sense. I am leery how this will pan out with the new addition to mandated healthcare and there already being such a strain on the healthcare system. As mentioned in the article, a good majority of the people affected the greatest by climate change are the poor, it makes me wonder how a poor population flooding hospitals even more than they do now, will effect our healthcare system.	17. Southeast and Caribbean				We greatly appreciate your positive comment about our report and hope that you find the content useful.

First Name	Last Name	Comment	Chapter	Figure/ Table Number	Start Page	Start Line	Response
Nicholas	Colarossi	With respect to figure 18.1, I notice that there are two higher variances just prior to 1935. Assuming that these spikes could be contributing factors to the dust bowl, is there a potential that despite improved farming techniques there could be a repeat disaster in the future? Is it possible to calculate the length of time it would take at consistently increasing temperature, coupled with decreasing water supplies before a dramatically dry region's dirt begins to loosen substantially?	18. Midwest				This is a good suggestion, but outside the scope of the report which assesses available literature. Such a study could be conducted for the next report in 2017, in which case, it could be reported upon.
James	Parten	Unless we do something, humans are going to negatively affect the climate so severely that human health will be a prominent issue. There will be an increased risk of heat stress, the lack of clean air will cause lung problems. Not to mention the water diseases. Food security will also be threatened. We need global action on a large scale to reverse this problem.	1. Executive Summary				Thanks very much for your comments. Many of these topics are included in this report, but this is a scientific asseessment, not a policy document.
Winston	Tieu	First off, I am pleased with the level of analysis in this chapter and thank the authors for their time.Texas is a massive state that has varying regions. Should the classification of states be further divided by the local climate of the regions in the state? For example, couldn't west Texas be part of the Southwest, the panhandle under the Great Plains, and East Texas and the coast be under the Southeast?	19. Great Plains				We greatly appreciate your positive comment about our report and hope that you find the content useful. Such a split of the great state of Texas occurred in the 2009 report, but stakeholder comments prior to the current assessment process were clear that we should follow geopolitical boundaries rather than regional climate. We attempted to capture the noted distinctions within the text where possible, given space constraints.
Kerensa	Schantz	I would like to see more information in this section on how sociological impacts of climate change will affect energy supply and use. For example, increased energy needed to irrigate fields would lead to inflated food prices. How will this affect those in developing countries? How will inflated food prices in combination with inflated energy prices, increased infrastructure damage because of extreme weather events, need to improve resiliency to infrastructure, increased health problems including lung cancer from indoor cooking, and other impacts, affect energy supply and demand? Will these things lead to a decrease in overall productivity in developing countries, so a decrease in energy supply and demand, or will these things lead to an increase in demand as they try to cope with these problems? Will these problems lead to a decrease in the rate of population growth or will having less money to spend on education lead to an increase in the rate of population growth? How will these things affect the expected life span of different populations, thus the energy demand. How will increasing poverty due to multiple sociological impacts affect the overall efficiency of energy systems? Will more poverty lead to increased dependence on traditional biomass? How will forest degradation further affect the climate/energy prices/ecosystem health/energy supply and demand? Although sociological impacts are difficult to study and interpret, they will, without doubt, have an astronomical effect on our energy supply and use. Sociology is so relevant to this chapter, that it does not make sense that we would leave it out. Even though predicting how people will behave is complicated, I think that attempting to answer some of these questions would lead to more long-term, effective solutions to the problems we are facing.	4. Energy Supply and Use				The charter and focus of the National Climate Assessment (NCA) Report (including the scope of the energy chapter) is on impacts of climate change, rather than issues relating to mechanisms to reduce greenhouse gas emissions. Carbon emission reduction (mitigation) opportunities are primarily addressed in Chapter 27 - Mitigation. Note that improvements in efficiencies in energy, cooling, manufacturing, irrigation and water distribution/reuse are identified in Table 4.2 of this chapter as Adaptation Actions in the Energy Sector. The cost of energy is influenced by numerous factors – as discussed in the “Future Energy Systems” section of the chapter. A detailed assessment of the role that increased energy use due to climate change impacts alone –

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							separate from simultaneous changes such as the availability of lower cost natural gas or solar energy - is complex and beyond the scope of this chapter. Finally, a deep assessment of impacts to countries outside of the U.S. is not included in the NCA.
Sophie	Slater	Being a student at the University of Texas at Dallas, I have a small amount of knowledge when addressing climate change. As I read through this Executive Summary, many new facts became clear to me and increased my interest and knowledge in the world's climate. This is a great primary effect of the paper, since spreading awareness of the climate and all its influencing factors is imperative if humans are to succeed in reducing their effect on the environment. The summary has near-perfect organization; finding what I wanted to know was easier than expected. Each point is introduced, then given its own section of emphasis further in the assessment. Nearly all the points are clear and explained effectively. The Executive Summary, in itself, provides sufficient information for the common person to understand the climate's current and future situation. I only have one or two suggestions in possibly improving the summary. While addressing human adaption to climate change, "insects that spread disease" are mentioned. Given that seemingly no information is provided about how infected insects are related to climate change, perhaps it would be in the writers' favor to explain a little more. Are insects going to be a problem regardless of climate, or is the climate change increasing the chances of the spreading of disease through insects? And if the climate change is affecting insects, how and to what extent is the effect taking place? I understand this is merely a summary, and this point may be explained in its appropriate chapter. However, since most points in the summary are explained, it may be best to explain this as well. My only other suggestion has less to do with the Executive Summary, and more to do with the evidence behind the assessment. I live in north Texas, and in my experience, Texas has not only gotten hotter, but colder. In addition, Texas has been having snowier Decembers and Januarys, which was unthinkable 10 years ago. I cannot say I know why this is happening, but it may be profitable for such a change to be addressed somewhat in the Climate Assessment Report.Thank you for your time, and I hope I helped!	1. Executive Summary				It is great to hear from you, and likely you will find more information related to your comments in the health chapter and in the Great Plains chapter of the NCA.
Kirk	Brus	Somewhere in this paragraph, under subsection titled, Biogeochemistry, Climate and Interaction with Other Factors, or under Chapter 15 - Biogechemical Cycles, recommend adding the following statement, ""Ozone is also a secondary pollutant formed by complex photochemical reactions of nitrogen oxides (NOx), Volatile Organic Compounds (VOCs), and carbon monoxide (CO) in the presence of sunlight.	15. Interactions of Climate Change and Biogeochemical Cycles		528	24	Thank you for your comment. The text has been edited in regards to this suggestion.
kaitlyn	stacey	After reviewing the public assesment report, there is one suggestion I have to make. The draft lacks indepth evidence on why the Federal Advisory Committee believes that recent climate changes are anthropogenic induced. It would be helpful if there was more data and if the draft included more information on the sources of data used. (For example, where the data was recorded, what organization collected this data, why is data reliable/trusworthy?, etc)					Thank you for your comment. Additional explanation of the attribution of climate change has been added to the report.

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		Overall, however, the draft was very informative and covered a broad range of important topics, especially the aspect of adaptation, which I believe is too critical at this stage to overlook.					
Kerry	Mitchell	I feel that we cannot keep approaching this the way we have in the past and expect different reactions. We must teach and the key word is teach the public and private sectors what causes climate change. I think you are assuming they know about water conservation, they do not. You see, scientists have admitted these are complex issues. Governments and businesses cannot internalize this. They must be taught in bite size pieces about what causes droughts and soil erosion. You just can't say climate chnage. Years ago, if you used the term global warming, people backed away- They are still doing this. A paradigm shift needs to have an education component and have INTERNAL TRAINING IN THE ADULT SECTORS on all issues explaining what causes climate change.. This is sorely needed. We need to work education and training in these issues into the corporate and government structures. They are so risk management oriented. So let's take a different approach. We need to address and train in the ROI across the board on what sustainability and bringing in why ecosystems working together is key. In the corporate and governments culture employees and all of management must take courses on line such as sexual harassment in the workplace, ADOBE training, how to deal with difficult co-workers, etc. We must incorporate these topics into CEU's for all professional licenses- EX: Accounting people need to know about carbon accounting, and environmental accountability- WHAT IF you inserted an e-learning platfrom that taught, on a very rudimentary level all that contributes to climate change.:Sustainability and Energy Planning Planning Policies for Government and Business Social Responsibility It's Definition and Benefits Guidelines for Transparency for Stakeholders Basic Training of Renewable Energy Leadership and Administration Green Building / Systems/Materials Green Building and Renovations Defined Energy Efficient Systems Driving Forces for Change Risks and Benefits of Green Construction Green Construction Risk Assessments	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				In the revised text, we have included some discussion of communication but the issues of education, training, and teaching are outside of the scope of the Decision Support Chapter.

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		Green Certification and Standards Green Certifications and Standards Energy Ratings and Audits Defined Certifications and Energy Standard Case Studies Green Building Adding to the Bottom Line Green Supply Chain Management Leadership, Assessment, and Life Cycle Analysis Environmental Costs and Benefits Guiding Your Company's Plan Waste Management Waste Concepts are a Part of History Tracking and Transporting Waste Solid Waste Principles Soil Erosion Issues What Can Be Recycled? A Plan to Begin Managing Waste Transportation / Green Fleet Management Introduction to Green Fleet Concepts Alternative Fuel Overview Green Fleet Case Studies Green Transportation Saves on the Bottom Line Sustainable Purchasing Practices Concepts in Green Purchasing					

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		Involve Purchasing Departments Greener Cleaning Practices Becoming Familiar with Green Cleaning Concepts Changing Cleaning Practices Water Conservation Efficient Use of Water Resources Water Filtering Options and Storage Preventing Stormwater Pollution Environmental Accounting General Environmental Management System Guidance International Standards for ISO Environmental Management System Implementation Planning for Environmental Accountability Tracking Carbon Emissions Waste and Recycling in Food Service Greener Food Service Practices Renewable Energy Basics Introduction Renewable Energy to Government and Business Identifying Localized Renewable Resources Waste to Energy Saves Money!All of this contributes to lowering greenhouse gasses. These are examples of bite size topics. This could be expanded but this is a start-So, wouldn't this type of internal training help to effect change, catapult the forming of internal committees and cause departments to change business practices? I think it would. This is available now and courses include core competency testing, narration and are of high quality. Place these on corporate and government websites globally, and make them part of compliance internal training programs then the wider public can make better					

First Name	Last Name	Comment	Chapter	Figure/ Table Number	Start Page	Start Line	Response
		and more "informed" business decisions.					
Gabriella	Kaminski	Very thorough and explicative. The concepts of mitigation and adaptation were explained, however, I would have liked it if some examples of each were given in the summary.	Introduction: Letter to the American People		5		Thanks for your suggestion, but we think the current text is sufficient. Mitigation options were not documented in the report. Adaptation options were presented, but not analyzed in the same way that other scientific topics were addressed. There is more information on adaptation and mitigation in the Executive Summary.
tammy	reiss	Subject: Comment #3 - National Climate Assessment Report & Hydrofracking NATIONAL CLIMATE ASSESSMENT REPORT & HYDROFRACKING February 18th more than 35,000 people converged on Washington D.C. for the largest climate rally in U.S. history. Governments worldwide as well as our own locally elected officials owe their citizens a clear plan of action to reduce the greenhouse gas emissions fueling rising global temperatures. The heavy industrialized mining process for natural gas known as Hydrofracking or fracking is NOT climate friendly. Methane is a powerful greenhouse gas that leaks from failed wells, fractured rock and pipelines. Researchers with the National Oceanic and Atmospheric Administration (NOAA) have confirmed findings of high rates of methane leakage from natural gas fields. Ranging from 4% in Colorado to 9% in Utah. When these findings are replicated elsewhere, they would utterly vitiate the climate benefit of natural gas, even when used to switch off coal. • Steel production is responsible for several billion tones of CO2 emissions per year. Apart from the refining of metals, the next most important source of carbon dioxide is cement production. These materials are used in large quantities in the containment and protection of fracking fluids from contaminating underground aquifers and furthermore, large quantities of cement is used to plug unproductive gas wells.Steel used in this manner is unrecoverable and can not be recycled. To replenish what the oil and gas industry has consumed, the steel industry will emit even more CO2 emissions by mining ore for the manufacturing of more virgin steel. It needs to be mentioned here that the steel industry has started financing the drilling of fracked wells. Natural gas wells require enormous amounts of steel for miles of gathering lines and transmission pipes to get the product to market. • Product water or Flowback and other by-products from the fracking process produce large quantities of volatile organic compounds (VOCs) during the entail frack of a well and react with nitrogen oxide and sunlight to form ozone. • In addition to tones of trucked materials: sand, chemicals, water, cement, steel and heavy machinery used in the initial start up of each well large quantities of other carbon, methane and VOCs and nitrogen oxide emissions are also produced from not only diesel trucks but from diesel generators, drill rigs, transfer stations, condensation tanks and the flaring process of combustible gases at the well. WE CAN CHANGE THE FUTURE Our elected officials and the public need to agree on spending cuts, tax increases (carbon tax: the U.S. on a federal level only charges $6.00 per metric ton of carbon emissions compared to Switzerland's $141.00 p.m.t) and new investments in renewable energy that would be phased in as the economy improves as well as higher efficiency standards for power plants, buildings, appliances and affordable electrical vehicles. Building a sustainable society is the greatest challenge that the world has ever faced. Society has now reached a peak in consumption of materials and the high living standards of current generations in developed countries have been partly achieved by borrowing from the future and ignoring the impacts on the environment and generations yet to come. American communities scared by centuries of industrial pollution and corporate domination as the					Thank you for your comment, however policy issues are beyond the defined scope of the National Climate Assessment, a scientific document that provides the basis for decision making, but does not address policy.

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		leading cause for climate change need to take bake the control of our destiny. Please except these comments for the National Climate Assessment Report. Thank you. Mrs. Tammy Reiss and family 181 Wilbur Hill Road Unadilla, NY 13849					
Felix	Deguilla, Jr.	If we are talking about emission-free, clean energy that is continuous and capable of supplanting fossil fuels, then the singular solution, in one word, is nuclear. If we want to seriously put a dent on greenhouse gas emissions and halt global climate change, again the singular solution, in one word, is nuclear.Not the same uranium-based, water-cooled nuclear technology that we grew up and continue to live with, but a newer, safer, does-not-need-to-sit-by-a-river power plant. You mean a nuclear reactor that can be viable in the middle of a bone-dry desert? How can that be? Is that magic? What is this “new” reactor design? It is called a thorium reactor, or more accurately, a liquid-fluoride thorium reactor (LFTR, reads as “lifter”), and it was invented here in the U.S. Here are two links:1) http://youtu.be/bbyr7jZOlll?t=30m16s2) http://www.youtube.com/watch?v=N2vzotsvvkw&feature=share&list=PL9p3Ws-jomR7zQTPXQGksLFNBhMnAtmPUA tablespoon of thorium has the equivalent energy of a house-size volume of gasoline. The nice thing about LFTR is that LFTR requires:1. No nine-inch thick steel pressure vessel; 2. No concrete containment building; 3. No fuel fabrication; 4. No active safety systems; 5. No water for cooling.Wind and solar energy are not exactly clean. They require vast acres of land and long, land-grabbing transmission lines to bring to utilization. And when there's no wind and there's no sun, the lights go out. Even with vast government subsidies, wind and solar are adjuncts at best.“The world desperately needs sustainable, low-carbon energy to address climate change while lifting people out of poverty. Thorium-based reactors, such as those designed by the late Alvin Weinberg, could radically change perceptions of nuclear power leading to widespread deployment.” — Baroness Worthington					Thank you for your comment, however policy issues are beyond the defined scope of the National Climate Assessment, a scientific document that provides the basis for decision making, but does not address policy.
Marcus	Petz	I read through the chapter and I think that there should be some clear recommendations from it. This is actually mandated by the Charter for NCADAC and EO 13514, which both actually call for "recommendations".With this in mind the recommendations that I think should be made on the basis of this Chapter are by implication:forest product use for bioenergy - so more investment in bio-energy SO THIS COULD BE to set energy wood standards (as we have in some places in Europe). I think this is especially important say with something like wood pellets ? briquettes. As this allows high environmental processing and burn standards. Such an American standard would help guard jobs and frame a growing new industry. STARTER Tarrifs may also be possible for this too, which makes an export industry for American	7. Forestry				This is a useful policy concept. We will pass it on.

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		workers.better access to practical and timely information for managers SO THIS requires some kind of management standards and education systems. I guess you have better ideas as to what might work culturally for you there, but I believe that some thing should be recommended for this. Here in Austria we have identified several hundred stand types and these are used to inform through software on management regimes etc. Here in the Forest Engineering dept of BOKU we also developed an energy-wood supply software to help make decsions. Such DSSes coudl also be provided with investment for forest owners etc.regulatory requirements may penalize adaptive or innovative management in the face of climate change - so policy / legal change to be proactive to climate change not BAU SO THIS lack of standards in the forestry sector and worse bad standards should recommend a legal advisory committee for forestry to carry out a legal review. I would recommend this should include the Canadian and European representation to identify improvements and international standards that can update and codify factors effecting forestry.I hope these suggestions are useful to you. Of course other things could be recommended, such as more research into plants that cope with drier conditions or alternative techniques for moisture retention, but I think the 3 above are the most pertinent to the direction already investigated.					
Tanja	Smith	After reading the report on the Great Plains, I found that there was not enough coverage on the lack of recharge of the Ogallala aquifer and the consequences of irrigation associated with this water source. Stress on this deposit of ancient water will affect farming communities sooner rather than later and development of alternative economies must be stressed. Higher penalties for overuse of this vital resource should be enacted to force farmers to look for other ways to sustain themselves.	19. Great Plains				The text has been revised to incorporate this suggestion.
Michelle	Oswald	The current text includes the discussion that "Climate data desired by transportation planners may be different than the projections generated by regional climate models". This is useful and can be expanded to discuss the need for planning tools and models that bridge this gap such as the CCATT Framework published in Public Works and Management Policy (Oswald and McNeil, Dec. 2012). Planning tools and models can present a step-by-step process for connecting the risk of impact with specific planning strategies such as assessing the vulnerability of existing and proposed infrastructure and then identifying key adaptation practices to address the risk. Identifying recent examples of these tools/models would be valuable.	5. Transportation		217		The text found under the Key Message 1, “New information and remaining uncertainties” section in the Traceable Account addresses this comment. However, given that there are several frameworks available for adaptation planning, we do not have the space to identify tools and methods. We refer to those interested in a deeper treatment of adaptation to Chapter 28 of this report on Adaptation.
Frank	Muller-Karger	This comment is general and applies to the whole report, therefore it is included here as these issues should be included in the Exec. Summary:1) Education (early life as well as continuing) as a required process in climate assessment, adaptation and mitigation, is effectively invisible in the report - and yet it is a problem underlying many of the present issues. Education is buried in CH 29 (Research Agenda) starting page 1041. This should be close to the beginning and listed as a high priority finding in the assessment. Climate, in many ways, is in the way we think of it - and this can only improve with education.2) The summary and report miss emphasis on the combined, synergistic impacts of climate change and human activities on coastal and estuarine water quality. There is talk of sea level, and the example of the Mississippi River 'dead zone' (a horrible misnomer) is used a few times. HOwever, there are people living in estuaries large and small and along the entire coastline, and impacts on coastal					Thank you for your comments. 1) Since this is an assessment of the state of knowledge related to climate change, an assessment of climate literacy is one topic that could have been chosen for inclusion. However, it was not possible to cover every topic in this report due to space constraints. Fortunately, many of the topics you suggest have been addressed by many

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		ecology and water quality are not addressed properly. I think it is easy to highlight this problem in existing sections.Congratulations to the committee on a very comprehensive report. It is clear that this has taken an enormous and serious effort.					recent publications and programs. The NCA should serve as an excellent foundation for educational efforts in schools, and the electronic delivery format is expected to encourage broad access to the information through web-based capacity and tools. 2) Authors across the report have, within existing space limitations, attempted to include description of the importance of synergistic impacts of climate change and other stressors. A number of edits were made throughout the report related to this suggestion.
Nedal	Katbehbader	It is important to indicate the impact of climate change on respiratory system.	1. Executive Summary		5	21	More detail on this topic is available in the health chapter… but this level of detail is acceptable in the Exec Summary.
Nedal	Katbehbader	to add after rich array of: of services and benefits.	1. Executive Summary		5	23	This is a good suggestion, language has been modified.
Nedal	Katbehbader	to add after drinking water: storage and filtration.	1. Executive Summary		5	24	This is a good suggestion, but there is limited space to add this level of detail.
Nedal	Katbehbader	to indicate after local: The Territorial Approach for Climate Change (TACC).	1. Executive Summary		7	1	It is not clear what change is being recommended here.
Bill	Zachmann	Comment related to both Figure 3.2 and the "Caption": My interpretation of both seems that in particular for "Columbia River at Grand Coulee" then with the 'Caption' text it is misleading or at best partial information. The Grand Coulee site represents only about 1/3 to 1/2 of the basin as outlined in yellow in the figure. Several sub-basins within Washington state on the east slopes of the Cascade Mtns. are below Grand Coulee. Their years-of-record flow data when coupled with anticipated climate trends and predictions made by the Univ. of Washington's Climate Impacts Group for these predominantly snow-melt influenced hydrographs, are not part of the Columbia River predicitive information at Grand Coulee. I recall the predictions for the Wenatchee, Entiat, Methow and maybe even the Yakima sub-basins are: there will be climate influenced, negative (in terms of water delivery needs) changes to these basin hydrographs. Additionally, the very large Snake River sub-basin, as well as snow-melt influenced basins in Oregaon, also within the yellow Columbia Basin watershed in Figure 2, are not represented by predictions at Grand Coulee. Instead, I think the chart for this basin and the predictions should be on the mid-Columbia, at the 'bottom' of the basin outline, in this case it looks like The Dalles. The same may be said for other representative basins	3. Water Resources	3.2	112		Following the reviewer comment, the figure was revised to indicate the drainage basins corresponding to the location of the referenced projections.

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		in the figure when and where the reference gage/site is not at the 'bottom' of the watershed, the lowest outlet, etc. Or, make the 'yellow' of the Columbia Basin, only represent all contributing basins above the Grand Coulee site. You pick! Thanks for opportunity to comment.					
Caleb	Marsh	• Over all, the paper is a bit too technical. It would benefit from using less technical language and also by being more concise. • While 100-year floods are mentioned repeatedly, a description of these is not given and the effects of climate change on such flooding is not elaborated on. Page 557 line 24 • Many numeric statistics are used, which is good for backing up facts, but is confusing to read. The paper should probably have less numeric statistics. Page 557 line 16 and 17 (redundant, too many numbers). • An effect of climate change not discussed in this section that should be mentioned is the increased spread of diseases, particularly in high-population urban areas. Insect-borne diseases are of particular concern and should be mentioned in this section. • The graphics are inconsistent and not always clear. Figure 16.5 needs more explanation. Figure 16.1 is clear and does an excellent job of elucidating the various impacts of climate change. • This section focused on human effects, which is an excellent way of ensuring people realize the severity of the situation. However, despite mentioning potential economic impacts, economics were not elaborated on further in this section, which was a bit confusing. • Despite a graphic used to describe the urban heat island effect, this phenomenon is not described further and adds to the confusion of the section rather than making things clearer. Further explanation on the urban heat island effect should be given, particularly if the graphic is being used. • This section focused primarily on NYC and New Jersey. While these regions are excellent case studies for the effects of climate change on large urban/coastal areas, other cities in the Northeast should be mentioned. What are the effects in other areas? Focus more on inland cities than just coastal. • Consistent data from consistent locations should be used in this paper. Again, NYC is mentioned again and again. However, was data collected from anywhere else? If it was not, data should be brought in from other places to build the case for this climate change. • The messages are not organized clearly and seem to skip around a bit- bolded headings would be very helpful. For example craft key messages according to each specific section. • There should be a table of contents to make navigation easier in this section.	16. Northeast		549	1	1. Thank you for your comments. We will continue to work with the science editor to strike the right balances for this audience. 2. The text has been revised to incorporate this suggestion. 3. After consideration of this point, we still feel the existing text is clear and accurate. We have struck a balance between quantitative and non-quantitative information; especially given the topic's importance, this information is sure to be helpful to some who prefer quantitative information. 4. The text has been revised to incorporate this suggestion by adding some additional description of changing disease risk. 5. The figure has been revised to incorporate this suggestion. 6. Space was too limiting, and analyses to draw on too few, to do more than point readers to other reports. 7. The text has been revised to incorporate this suggestion. 8. Additional information has been added to increase coverage of other areas in the region. 9. Additional information has been added to increase coverage of other areas in the region. 10. This was in fact our attention; hopefully it will be clearer in the revised version. 11. Use of a TOC was not permitted in the standard chapter template - each chapter is small enough to be read in its entirety without needing one.
Lauren	Gibbs	I am writing to address the Northeast Region Draft, and in specific, the Key Message 4.	16. Northeas				The table is focused on coastal infrastructure and so needs to be

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		The document was very well written. It was very clear that it is written for a lay audience. The end of the document was when the fourth message started, but during the main part of the report, there seemed to be very little talk about what we are doing today, and its importance in the actual document. The end seems kind of tacked on to the document. They do a very good job, however of making it clear that they don't know what the effectiveness of the plans will be. Also, there is no Key Message variance used at the end of the fourth message which was disappointing. Also, there was no explanation of what people, as individuals, can do to fight climate change. There was no sense of urgency at the end with the Key Messages boxes. It also may have been more interesting to compare the Northeast and the other sections of the US. There was a really good amount of pertinent research in the report which lends credibility to the document. They ultimately try and find issues in the document and address them to defuse the situation before the issues come out. There was a definite feeling of the system not being able to keep up with the urgency. The images need to be more applicable to the messages and text around them. A better way to organize it would have been to have the table at the beginning and the rest of document after that then a more prospective conclusion.	t				located near the Key Message on that topic rather than at the head of the chapter. Given the limited space, too much comparison to other regions was not a choice. Providing recommendations for individuals is policy and so not the purview of this assessment, and this chapter would not be the locale for it anyway.
Lauren	Trutschel	To Whom It May Concern:Upon review of key element three in the National Climate Assessment, we found several aspects that both work well in the document and could use improvement. To begin, we appreciated the document being broken into four key elements. This was helpful to separate the messages and make the reading more manageable. However, it would be helpful if each message were initially written with corresponding page numbers to direct the reader to their section of interest. Content according to the message being labeled more clearly is important. This association would help with organization and comprehension.In each section, it would also be helpful having a key takeaway in the subsection. This would aid in simplifying the National Climate Assessment as a whole. It would give the audience exact points to understand and give some direction to the document. Also, bullet pointing where possible would be important to add some simplicity.Lines 8-10, about perennials, on page 561 were good at explaining what the problem is, but need to tell why this is a problem. Lines 12-14, about the deer population did a good job explaining what the problem was and why it is a problem. It was helpful having the format of detailing the problem and explaining why it is a problem. Being consistent with this model and execution of explanations through the whole document would be a good improvement.The part about Chesapeake Bay is seemingly unrelated. How does this connect back to key message three? A case study for an example would be great, but it needs to be relevant. This would enable the reader to understand what is trying to be done. Answering the questions how and why is vitally important.More appropriate pictures would also add to the value of the document and enhance the comprehension. The current pictures are confusing. Graphs that are relevant and show correlation between data would also be helpful to paint a clearer picture. Also, the captions under pictures are too long.Charts are a great way to break down information and make it more manageable for the audience to read, although arranging them can sometimes be difficult. If the chart at the end were broken up into more clear sections, and moved to corresponding key points it could greatly improve the digestibility of the content.Sections based on regional agriculture would enhance local audiences understanding of the problems and possible solutions related to climate change. Localized support would also help any changes that need to be made in the area. Thank you for your time, and we hope our response has provided some helpful feedback from an outsider’s perspective.	16. Northeast				1. This draft PDF was not designed as the final product, but the report in its e-book format will have the capacity to link the KM's to their descriptive text section. 2. Our hope was that the KM itself was the takeaway. 3. The text in the section on perennials has been change to incorporate the suggestion. 4. We are replacing this graphic as suggested. 5. The new version includes several changes to the graphics. For example, a photo of workshop participants was removed and the sea level rise graphic improved. Captions have been revised to clarify their message. 6. We plan to implement this suggestion in the e-book format, but chose to keep the chart as is for this pdf. 7. We have tried to provide both local and region-wide examples, but given the space constraints it is challenging to add more local examples.
Bethany	Holbroo	The draft report was really well-written, and easy to understand. There were a few areas within the	16.				1. With respect to 'capital

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	k	report that could have been clarified, including:Line 12 of pg 564: Don't attempt to place a positive spin on a negative concept (eg., capital improvement cycles). This term does not explicitly state what it means; it's implied that this will happen when it is most economically feasible, and could be stopped at any time. Incorporate more information about inland areas. There is a lot of emphasis on coastal areas.Figure 16. 9: Use different color coding for vulnerability index. Include a Table of Contents so reader can navigate the text to particular pieces of information or specific topics.Don't be too dramatic with examples (pg 555: between 20,000 and 100,000 families lost their homes). Use averages instead of ranges.New York Times as a source doesn't seem credible. Where did the New York Times receive that information and cite that instead.Lines 10-11. Reword the sentence to say something like, "Based on early research, we predicted events like Superstorm Sandy to have a large impact on the Northeast region due to their large coastline."Elaborate on the socioeconomic factors referenced in line 29-32 on page 556."Stressed Infrastructure" paragraph on page 558: The paragraph uses a lot of numbers that can get confusing. Perhaps supplement these numbers with a comparison example. (ex. 212 miles of roads is equivalent to the distance across "x" state)Provide more mitigation strategies in addition to adaptation strategies. Give people ways to start working on this issue now.There were a number of aspects of the report that stood out and made the report applicable to the general public:Explicitly states costs of inaction, which is good for the public to understand the expenses climate change will bringGraphs/ pictures were a great way to supplement all the text in the document (easier and quicker to read)Great use of visual rhetoric (use of images to persuade audience)Predictions of future trends aid in ethosNumbered lines made it easy to comment Overall, great job. This is a great tool for the public to understand the confusion of climate change.Sincerely, Bethany Holbrook Samantha Brooks Yocasta Pichardo Liane DeRosa Nory Mitchell (SUNY ESF Environmental Communication Workshop students)	Northeast				improvement cycles', the sentence does not put a spin on the concept, but merely suggests using the such existing decision mechanisms to make iterative adaptations. 2. We felt that at this point in time, the coastal impacts of CC are the most imminent and obvious. As new reports are prepared every 4 years, other impacts will become more obvious and be featured. 3. This figure has been reconfigured and no longer uses the vulnerability index, but the color palette and caption of the remaining elements have been altered to be clearer. 4. More navigation aids will be added to the final PDF that could not be applied in this draft version. 5. The examples have been updated from an official NOAA report (Blake et al 2013). 6. NYT citations have been updated from an official NOAA report (Blake et al 2013). 7. This section was rewritten. 8. This section was rewritten. 9. This section was rewritten. 10. Unfortunately there are few mitigation activities that we can assess, and this assessment cannot make policy recommendations 11. Thanks for your positive response.
Neil	Maizlish	Comments on National Climate Assessment – Chapter 9- Human Health (v 11 Jan 2013)I would like to commend the authors for creating a cogent synthesis of the scientific literature on the health impacts of climate change. The document is highly readable and has a very good balance of text and visuals (graphs, maps, illustrations) to maintain reader engagement.However, there is one area that needs strengthening to bring it in line with the scientific evidence: the role that active transport plays in both generating health cobenefits and greenhouse gas reductions. The current emphasis of the section Responses Have Multiple Benefits (page 354, lines 23-41 to page 355, lines 1-18) is focused on air pollution. There is now a critical mass of consistent studies (1-5) that show that the substitution of personal passenger vehicle miles by active transport yields an enormous health co-benefit, overwhelmingly contributed by physical activity. In comparison, air pollution reduction from substitution of vehicle miles by active transport or even electrification of a large segment of the	9. Human Health		354	23	We have added citations in response to this comment.

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		automobile fleet makes very modest contributions in health cobenefits. Concerns have been raised and allayed that the health co-benefits of active transport will be negated by harms of air pollution by placing large numbers of pedestrians and bicyclists near busy roadways. Several studies have demonstrated with increases in active transport (and assuming no mitigations) that there may be small subpopulations with increased risks, but the overall population gains in health cobenefits remain overwhelming.(6-7) The other findings of note are that the magnitude of greenhouse gas reduction from active transport may be as significant as that from the electrification of the automobile fleet and other low-carbon driving strategies. Both in Woodcock et al (2009) and Maizlish et al (2013), ambitious but achievable levels of active transport yielded as large reductions in greenhouse gases as low carbon driving, but with very different levels of health co-benefits. Both the electrification of the auto fleet and increasing the mode share of active transport both face daunting challenges. However, compared to low carbon driving, the observation that active transport is an efficacious means to reduce greenhouse gas emissions in the transportation sector has not garnered as sufficient attention.References 1. Woodcock J, Givoni M, Morgan AS. Health impact modelling of active travel visions for England and Wales Using an integrated transport and health impact modelling tool (ITHIM). PLoS ONE 2013; 8(1): e51462. doi:10.1371/journal.pone.0051462.2. Maizlish N, Woodcock J, Co S, Ostro B, Fanai A, Fairley D. Health cobenefits and transportation-related reductions in greenhouse gas emissions in the San Francisco Bay Area. Am J Public Health. Published online ahead of print February 14, 2013: e1–e7.doi:10.2105/AJPH.2012.300939. 3. Woodcock J, Edwards P, Tonne C, Armstrong BG, Ashiru O, Banister D, et al. Public health benefits of strategies to reduce greenhouse-gas emissions: urban land transport. Lancet. 2009;374:1930-1943.4. Grabow ML, Spak SN, Holloway T, Stone B, Mednick AC, Patz JA. Air quality and exercise-related health benefits from reduced car travel in the Midwestern United States. Environ Health Persp. 2011; http://dx.doi.org/10.1289/ehp.1103440.5. Rojas-Rueda D, de Nazelle A, Tainio M, Nieuwenhuijsen MJ. The risks and benefits of cycling in urban environments compared with car use: health impact assessment study. Br Med J. 2011;343: d4521 doi 10.1136/bmj.d4521.6. de Hartog JJ, Boogaard H, Nijland H, Hoek G. Do the health benefits of cycling outweigh the risks? Environ Health Persp. 2010;118:1109–1116.7. Rabl A, de Nazelle. Benefits of shift from car to active transport. Transport Pol. 2012;19:121-131.					
Jeff	Cobb	"Climate change is already affecting the American people." PERFECT! COULD NOT HAVE A MUCH BETTER BEGINNING!!! Unless you added something like a time frame, or how badly affected with examples.	1. Executive Summary		3	2	Thank you for your comment; the additional topics suggested are covered in subsequent paragraphs.
Jeff	Cobb	"The current U.S. contribution to global emissions is about 20%." Annually? Historically?! C'mon, you can do better than that! ;) We need both figures, annual by year chart, and historical total. Supposedly China is going to surpass everyone combined on an annual basis. This would be a good comparison point for total gobal context of climate change and GHG emissions.	1. Executive Summary		6	21	Changes have been made to this language.
Michael	Arney	I recently heard a talk by Dr. Amanda Staudt of the National Wildlife Federation, and I was impressed to learn of the high quality work and diverse stakeholder input that went into this Assessment. I'm especially happy to see the significant discussion of mitigation in the report -- it is still not too late to avert the worst of the tragedies we seem to be headed for! Thank you all for your work on this report. I will do what I can to understand it (at a high level anyway) and get this information out to people in my area.					We greatly appreciate your positive comment and hope you find the content of the report useful.
rik	wannink hof	It is not appropriate to refer to America, American People, American people when discussion a part of America (the United States of America). Use terminology such as "our nation"	Introduction:				We appreciate the suggestion, but the authors still consider it reasonable to

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			Letter to the American People				refer to the people of the U.S. as Americans – this is in fact the way they refer to themselves
rik	wanninkhof	Include a footnote on the compositon emissions and their radiative forcing potential. There is mention of "emission of greenhouse gases", "emission of heat trapping gases", and mostly just "emissions". It leaves the reader confused	Introduction: Letter to the American People				This topic is not appropriate for the Letter, but changes have been made in the climate science chapter related to this comment.
rik	wanninkhof	This document is thorough and comprehensive but it has a fundamental flaw that will decrease its utility in that it uses non-conventional scientific units, feet and Fahrenheit. It might be appropriate to list them parenthesis (and possibly as a second axis label for select figures). All of the data and figures in this report must have been changed from the original contributions. Several of the chapter figures and text appear to have incorrect magnitudes of change because of errors in conversion. There will be very few readers that will undertand the text and graphics but not be familiar with the proper units. All schools in the USA have taught metric units for the past 5 decades.	Introduction: Letter to the American People				We are communicating to the American public, hence the use of F vs C; the conversions have been carefully calculated.
rik	wanninkhof	Y-axis COe should be CO2	15. Interactions of Climate Change and Biogeochemical Cycles	15.3	525		Thank you for your comment; the text has been revised to reflect this suggestion.
rik	wanninkhof	Mention of the coastal oceans as an essential component of the USA ecosystems would be appropriate.Units should be made consistent. I spotted Mt C (million tons carbon) ; Tg CO2 (terra grams carbon dioxide); and Tg CO2 equivalent."Key messages 1. Human activities have increased CO2 by more than 30% over background levels and more than doubled the amount of nitrogen available to ecosystems"I assume the reference is to atmospheric CO2, rather than to ecossystems. This should be 40 % (from 280 ppm to 390 ppm) as mentioned in chapter 24	15. Interactions of Climate Change and Biogeochemical Cycles				Thank you for your comment. We opted to stop our analysis at the land border of the US. Most work on oceanic carbon sinks considers more pelagic areas.
rik	wanninkhof	"Numerous references demonstrate the declining acidity around the world (Feely et al. 2008; NRC 2010b)"Declining acidity should be either increasing acidity or decreasing pH.	24. Oceans and Marine Resources		851	2	The text has been revised to incorporate this suggestion.
Chris	Potter	The Key message #2/5 "Climate change combined with other stressors is overwhelming the capacity of	8.		308	1	No change. We think and hope that we

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		ecosystems to buffer the impacts from extreme events like fires, floods, and storms" is not supported by empirical evidence of any kind. In fact, the phrase "overwhelming the capacity of ecosystems to buffer the impacts" is not scientifically testable -- It is rather a value judgement that is completely subjective and nonsensical. What is overwhleming and what is the capacity of any ecosystem and what is a buffer? Moreover, the change factors that are cited in the "Description of evidence base" here are mainly attributable to direct human management - i.e. fuels management, fire suppression, coastal development, that have no causation from climate change at all. This entire Key message #2/5 should be deleted from the Chapter -- It is some of the worst science I have read in quite some time.	Ecosystems, Biodiversity, and Ecosystem Services				have made a strong case that ecosystems play an important role in “buffering” the effects of extreme climate conditions (floods, wildfires, tornados, hurricanes) on the movements of materials and the flow of energy. Climate change and human modifications of ecosystems and landscapes often increase their vulnerability of ecosystems and landscapes to damage from extreme events while at the same time reducing their natural capacity to modulate the impacts of such events.
Mariza	Costa-Cabral	Key message 1 (which appears on page 721 lines 14-16 and elsewhere) reads:"Changes in the timing of streamflow related to changing snowmelt are already observed and will continue (...)"I suggest this be changed to:"Trends in the timing of the streamflow hydrograph, resulting from trends toward earlier snowmelt and towards a larger fraction of precipitation falling as rain rather than snow, have already been observed at many locations and are expected to continue (...)"	21. Northwest				We make this point in the text, but this is too detailed for a key message.
Mariza	Costa-Cabral	Key message 2 (page 721, lines 17-18 and elsewhere).I suggest the words "sea level rise" should appear in this key message. Perhaps even the following phrase: "sea level rise, compounded by land subsidence in the populous Puget Sound region".	21. Northwest		721	17	The text has been revised to incorporate the suggestion regarding sea level rise. Additional information about land subsidence would be too detailed for a key message.
Mariza	Costa-Cabral	Even though it is said in this chapter that much of the Northwest Coast has been experiencing uplift, it is not said that the Puget Sound region, home to a large fraction of the northwest's population, has been subsiding. In the context of discussing relative sea level rise, this appears as a major omission.	21. Northwest				The text has been revised to incorporate this suggestion.
Mariza	Costa-Cabral	Key message 3 (page 721, lines 19-22 and elsewhere), where it says "diseases" it probably should say "tree diseases".	21. Northwest		721	19	The text has been revised to incorporate this suggestion.
Mariza	Costa-Cabral	Under the heading "Observed Climate Change" (page 722, lines 11-21), the assertion that "precipitation has generally increased, especially in spring" is made without citing any studies. Additionally, the statement that "extreme precipitation (heavy downpours) increased somewhat in the Northwest" is also not a well-founded conclusion derivable from any of the three literature sources cited. Also note that in Chapter 3, page 108 lines 36-37, the Northwest is cited as one of three U.S. regions which have not experienced (so far) increases in heavy precipitation (top 1% or greater). Although no literature references are given there to back up that assertion, either.	21. Northwest		722	11	The text has been revised to incorporate this suggestion.
Mariza	Costa-Cabral	On page 723, lines 6-13, I note that the observed changes cover an interval that includes 0% (no change). Doesn't that mean that the null hypothesis of no statistically significant trend cannot be rejected with any appreciable degree of confidence?	21. Northwest		723	6	The text doesn't not discuss a trend or significance, so no change was made.
Mariza	Costa-Cabral	On page 724, lines 12-13, it is written "This increase in heavy downpours could increase future flood risk in transient and rain-dominant basins." I don't recall reading in this chapter (did I miss it) reference	21. Northwe		724	12	The text has been revised to incorporate this suggestion. We have

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		to what might increase future flood risk in snow-dominated and some transient watersheds: because of earlier snowmelt, the risk of having the snowmelt peak overlap with a rainstorm hydrograph peak becomes much higher than historical. Historically on the west coast, the wet season ends or tapers off in March, while snowmelt peaks in the late spring and summer, with little likelihood of overlap. Not so if snowmelt arrives several weeks earlier than historically.(Plus a detail: In the sentence cited at the very top, I suggest that the words "and urban areas" be added at the end.)	st				not revised the text to explain the mechanism for warming-related increased flood risk in transient basins. Mechanisms like this are included in the modeling studies cited, but space precludes a discussion of the exact mechanisms.
Mariza	Costa-Cabral	In Figure 2.12 (page 724) instead of "Future Shift in Timing of Stream Flows" I suggest "Simulated Future Shift in Timing of Streamflows Under the A1B Scenario of Greenhouse Gas Emissions"	21. Northwest	2.12	724		All suggested information is already in the caption.
Mariza	Costa-Cabral	On page 725, line 25, reference is made to "iconic" salmon species. I suggest replacing "iconic" with "threatened and endangered", although I admit that salmon's iconic status may be more powerful than ESA regulations.	21. Northwest		725	25	Iconic is an accurate description of salmon, but not all salmon species and stocks are listed as threatened or endangered.
Mariza	Costa-Cabral	Figure 21.3 (page 727). There is a typo: instead of "A1F1" it should be "A1Fi" (Letter i instead of number 1). Also, in the figure caption the word "Relative" should probably precede the words "Sea Level Rise".	21. Northwest	21.3	727		The text has been revised to incorporate this suggestion.
Mariza	Costa-Cabral	In the discussion of ocean acidification, no mention is made of its potentially devastating effects on the shellfish industry (so important in the Puget Sound) or on the main oceanic food source of salmon: the tiny shelled organisms called pteropods. Both seem like major omissions.Also, please consider mentioning the particular vulnerability of the Lummi Nation in this chapter. Even though there is a chapter dedicated to impacts on indian tribes and nations, it may be appropriate to include this mention in the Northwest chapter (21). The Lummi Nation will see part of its small reservation land submerged by sea level rise and, perhaps even before that, may lose two of its major subsistence sources, due to ocean acidification: a) shellfish cultivation, and b) salmon capture. A principal source food of salmon, pteropods, are small shelled animals which, like all shelled animals, are endangered by acidification.	21. Northwest				The section titled Coastal Vulnerabilities does specifically point to oysters and salmon as being affected, and provide several references that detail these impacts. Given the small space allowed for this chapter, we were not able to highlight all of the vulnerabilities, such as the Lummi Nation.
Mariza	Costa-Cabral	The discussion of adapting agriculture seems entirely inadequate, i.e., little more than the most basic of considerations lacking in meaningful detail. Perhaps it should include a statement on the great need for region-specific studies on this topic.	21. Northwest				The text has been revised to incorporate this suggestion.
Mariza	Costa-Cabral	The figure presents an annual time series, from the late 1960s through present, showing great inter-annual variability (although less than at first sight, if we consider that the y axis starts at 130, not at zero).Through the cloud of points we see a sloping line, presumably a linear regression line.No statistical test results are presented to tell us with what degree of confidence we can reject the null hypothesis that the time series has no long-time linear trend (i.e., reject slope = zero). A Mann-Kendall test should be run to determine this (this can be done very quickly). But there are additional questions. Presumably, if there is a long-term positive linear trend in this time series, we are expected to conclude that atmospheric warming is the culprit, causing warming of the late water, hence this trend is expected to continue. But there are other possible explanations. Perhaps the years with the largest snowpack produce the largest amounts of cold volumes inputted from the incoming streams, generating deeper insertion of this stream water into the lake, having a larger effect than air temperature. Also the sediment content of the streamflow inputs affects the insertion depth (see Sahoo et al., 2012, a paper cited in this chapter). And can we rule out the possibility that it is the	3. Water Resources	3.4	116		We have clarified what drivers have influenced stratification and added additional figures on Lake Superior.

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		sunniest years, with least cloud cover in certain seasons, which produce the greatest radiative cooling powered by riparian vegetation? In conclusion, not enough information is given about the statistical significance of the line's slope, or of the factors that generate the differences from year to year. Presenting this sloping line without such information can be misleading.					
Mariza	Costa-Cabral	There was a study performed at higher resolution (at the county level rather than watershed scale, shown here), and that considers up to the time horizon 2040-2059, that I would suggest you include in this chapter:Roy SB, Chen L, Girvets EH, Maurer EP, Mills WB, Grieb TM (2012) Projecting water withdrawal and supply for future decades in the U.S. under climate change scenarios, Environmental Science and Technology 46:2545-2556. DOI: 10.1021/es2030774	3. Water Resources	3.7	121		Thank you for your suggestion. We reviewed the reference and felt that it makes very tentative assumptions regarding future projections. Thus, we prefer to base this discussion on the references we have cited. We have revised this section to include more detailed information and a new figure on water withdrawal distributions regionally and by sector.
Mariza	Costa-Cabral	Stream temperature is indeed rising at many locations, but is this the direct result of atmospheric warming?The recent study by Arismendi et al (2012) made me doubt this. Arismendi et al (2012) looked at streams minimally perturbed by human activities and found little association between air and stream temperature trends (see Fig. 3 in Arismendi et al, 2012). They found both warming and cooling trends for locations with long records (starting 1950). For the most recent period (starting 1983), at sites with little human influence, about one-third of the sites had cooling trends in mean and minimum daily water temperature, roughly the same as those with warming trends in this period. They found that streams with greater riparian vegetation cover and higher baseflow indices were less likely to show warming trends and more likely to show cooling trends, although those factors have not been shown to fully account for the observed cooling. During spring and autumn, cooling trends were reported for at least 1 out of 4 of the streams studied. They emphasize the importance of long-term stream temperature records for proper evaluation and interpretation of trends, because these trends can vary and change from one multi-year period to another; and they emphasize the need for more widespread sensors to document spatial variability in trends.Arismendi I, Johnson SL, Dunham JB, Haggerty R, Hockman-Wert D (2012) The paradox of cooling streams in a warming world: regional climate trends do not parallel variable local trends in stream temperature in the pacific continental United States. Geophys Res Lett 39(L10401). doi:10.1029/ 2012GL051448	3. Water Resources		116	12	This reference has been added and some additional clarifications have been provided with respect to the observed trends and projections.
Felix	Landerer	Chapter 2 - Sea Level RiseThe section on 'Sea Level Rise' discusses past and projected future changes, but does not (neither in the text nor in the figure captions) mention any reference time-periods relative to which these sea level changes can be referenced. This should be revised, so that the discussed sea level change numbers can be put in context, and also updated. Not having reference time periods makes it impossible to properly cite and trace the presented sea level change values. I suggest that the same reference time period as in the forthcoming IPCC-AR5 is used to avoid confusion.Felix Landerer	2. Our Changing Climate		63	1	Plots were re-made such that the decade from 2000 to 2010 was set to zero; this is now noted in the text.

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		(JPL)					
EVERETT	NICKERSON	COMMENTS ON NCADAC DRAFT REPORT 7 March 2013 Comments are directed primarily at figures displaying data for the peninsula of Baja California.The spatial resolution of global model simulations is inadequate for the depiction of precipitation over the Baja peninsula. Eastern Pacific hurricanes that form in the Gulf of Tehuantepec and then move northward yield significant rainfall over the Western coast of Mexico and the Baja Peninsula. And those storms don't always approach the southern tip of the peninsula directly, but sometimes move westward and then curve eastward to hit the peninsula near Puerto San Carlos. Moreover, those storms leave in their wake conditions for severe thunderstorms and associated heavy rainfall. Precipitation amounts over Baja shown in Figure 2.13 are therefore misleading at best. The report should not give credence to such unjustifiable data. Moreover, since ocean temperatures have a major impact on hurricane development and movement, increases in surface temperature over the Eastern Pacific (Figure 24.1) would seem to foretell an increase in hurricane events and ancillary precipitation amounts. even though it may be desirabl to include those images of Baja. I believe it would be better to omit misleading information. Surface temperatures over the Baja peninsula are greatly moderated by the diurnal land-sea breeze and mountain-valley wind regimes, local process that will most likely never be incorporated into global model simulations. Larger scal model temperature regimes that might be appropriate for Arizona are simply not suitable for depicting future impacts on tourism in Baja as shown in Figure 14.4. Moving away now from Baja, my understanding is that model results used to arrive at ocean acidification (Figure 23.4) do not include E-P (with resulting impacts on surface salinity), which could result in significant modifications to presented acidity results. ITCZ convective precipitation and ocean-wide evaporation modeled on the appropriate spatial and temporal scales would lend more credence to ocean acidification predictions. Everett Nickerson La Paz, Mexico Retired from ERL/Boulder in 1996.					Thank you for the comment. Additional discussion has been added to the Executive Summary, the Climate Science chapter, and the Introduction to Regions to better explain the way the authors have addressed uncertainty in regional models and depictions of precipitation.
U.S.	Environmental Protection Agency	There is no mention or consideration in the Chapter of the existence of several interstate, regional adaptation networks (sector-focused and general) extant in New England and the Northeast. This should be remedied. There is no indication that the authors considered the statewide adaptation plans for CT, MA, ME, NH, and VT and associated primary sources and data sets. These plans form the fundamental basis of state and local actions to implement adaptation strategies.	16. Northeast				While the comment suggests a good specific example, the authors feel the existing examples are appropriate and adequate. Key Message #4 does mention & consider such networks such as RGGI, and indeed the first line of that section calls out that 11 of 12 states have plans.
U.S.	Environ	Insert "storm surge" or "coastal storm surge". See Pg. 550 ln.7 and elsewhere in text.	16.		549	14	This comment is inconsistent with the

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	mental Protection Agency		Northeast				current state of the science on this topic. The text has been clarified to sharpen the message.
U.S.	Environmental Protection Agency	"adaptations" as a noun is awkward. May be better phrased as "adaptive measures" or "adaptation measures".	16. Northeast		549	23	After consideration of this point, we still feel the existing text is clear and accurate.
U.S.	Environmental Protection Agency	Change "several" modifying "municipalities" to "numerous" or "a rapidly growing number". Examples are many, particularly in New England with Keene, NH; Portland, ME communities; NH seacoast towns; northshore of MA; cities of Boston and Cambridge, MA; York, ME; Groton, CT; the 101 communities that constitute the Boston Metropolitan Planning Council; NH regional planning councils; Cape Cod communities; etc.	16. Northeast		549	25	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Would it make sense to include "the nation's capital" here - the chapter mentions "the world's financial center" - why not the national capital?	16. Northeast		549	32	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	The values on lines 4 and 13 should be consistent, and should be presented over consistent time frames unless there are clear differences in total SLR. Is there a real difference between "1 foot since 1900" (line 4) and "Over 100 years, sea level increased 1.2 feet" (line 13)? Is the second reference to 1912-2012, for instance, or 1900-2000 as might be commonly presumed?See also the reference to a 1.5 ft SLR on p. 558, lines 20-21. These need to be consistent or explain why there are differences.	16. Northeast		551		We thank the reviewer for the helpful suggestion, but the figure has been replaced, although there was no inconsistency as the values referred to a specific tide gauge and an average value along a swath of coast.
U.S.	Environmental Protection Agency	The phrase "Observed sea level at the Battery" should be "Observed sea level rise at the Battery"	16. Northeast		551	11	That phrase has been replaced with "Sea level is Rising" and the locale shifted to Philadelphia.
U.S.	Environmental Protection Agency	Need to define "very heavy events," "heavy downpour," and "heat wave" as used in the chapter. Are these definitions consistent with what is used in other chapters?	16. Northeast				After consideration of this point, we still feel the existing text is consistent across the report. The Executive Summary discusses this issue and was used by authors across the chapters.
U.S.	Environmental Protection Agency	Need to provide reader with information on what the "A2 scenario" means.	16. Northeast				It is defined in many places such as caption to figure 16.3 with language consistent across the report.
U.S.	Environmental	Reader may ask "how many days over 95 F do we experience now in the Northeast?" Would be better to give a sense of change compared to today.	16. Northeas	16.3	552		We thank the reviewer for the helpful suggestion, which has been

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	Protection Agency		t				incorporated into a new figure.
U.S.	Environmental Protection Agency	Does figure 16.3 and text beneath agree with the projections in, e.g. Massachusetts' Adaptation Plan ? The Norhteast Climate Iimpact Assessment, 20-07 datasets ? See http://www.climatechoices.org/assets/documents/climatechoices/confrinting-climate-change-in-the-u-s-northeast.pdf and the chapter end notes of same, in particular http://www.northeast climatedata.org/welcome_home.php?userID=38. This may well be peer-reviewed data.	16. Northeast	16.3	552		We appreciate the suggestion, but the figure data were reviewed by the state climatologists and the Regional Climate Centers, who are familiar with those earlier studies.
U.S.	Environmental Protection Agency	No indication of time frame for additional 15 days. Is this in 2050? 2070?	16. Northeast		552	18	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	What are the existing and evolving plans? Need to cite. How is "efficacy" of those plans evaluated?	16. Northeast		553	27	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Provide the dates of Sandy, as has been done for Irene - parallel construction	16. Northeast		553	3	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Is there documentation of other important (to many lay people) problems of mold, allergy, pollen potency and phenology, flooded basements, failing septic tanks and sewer system back flows ? Exposure to mold during demolition and removal. And - financial cost of rebuilding flood-damaged homes. There is likely documentation of issues such as these that are important from the perspective of having lay people understand their vulnerabilities in their back yards.	16. Northeast		554	10	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	"lost electricity" and "lost their homes" where ? It's unclear -NYC ? The Region ? NY and NJ ? CT?	16. Northeast		555	4	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	"The observed vulnerability was not a surprise in New York" This may be true for people who are thinking about climate and emergency response, but it was likely a surprise to many people and residents. Although experts were well aware of the previously cited studies, most people (by far) have not seen documentation of sea level rise as early as 2000.	16. Northeast		555	10	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection	"follow-on activities" needs clarification. Follow-on to what? What were the activities (meetings, technical consultations, etc.).	16. Northeast		555	12	The text has been revised to incorporate this suggestion.

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	Agency						
U.S.	Environmental Protection Agency	Awkward word choice and sentence construction. For example, can a tool be "formulated"? And when was the formulation developed?	16. Northeast		555	12	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	"new channels can form that leads to permanent flooding" should read "new channels can form that lead to permanent flooding" (lead, not leads)	16. Northeast	6	556		The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Insert "storm surge" or "coastal storm surge". See Pg. 550 ln.7 and elsewhere in text.	16. Northeast		556	13	This comment is inconsistent with the current state of the science on this topic. There is not sufficient evidence that storm surge will increase, only coastal flooding, which depends on sea level rise whereas storm surge does not.
U.S.	Environmental Protection Agency	The key message discusses disadvantaged populations, but the subsequent text does not mention the term (disadvantaged). There is some discussion of "socioeconomic factors," which may be understood by some, but should be addressed in some additional details, perhaps with parenthetical notes (income, neighborhood, etc.). In general, the message and the text should use equivalent terms where possible - vulnerable, disadvantaged, or other terms may mean the same things to those "in the know" but can be confusing for other audiences.	16. Northeast		556	13	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	"In New York alone," - is this New York City, New York State, the NY metro area?	16. Northeast		558	23	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	"A 1.5 foot rise in sea level (1 to 4 feet are projected by 2100; Ch. 2: Our Changing Climate, Key Message 9) would expose"Needs to be consistent with SLR values and times cited on p. 551, or clearly explain why there are differences in the values (preferably the former).	16. Northeast		558	20	After consideration of this point, we still feel the existing text is clear and accurate. The Lenton et al value of 1.5 ft is consistent with the NCA values as indicated in the parentheses.
U.S.	Environmental Protection Agency	The term "Nor'easter" may not be well understood outside of the Northeast. Suggest using a different term.	16. Northeast		558	5	After consideration of this point, we still feel the existing term is clear and accurate since it is iconic for the region.
U.S.	Environmental Protecti	Suggest rephrasing "drainage basins between the mountains." The specific areas being discussed may be well understood by the authors, but they are not necessarily recognized by a broader audience.	16. Northeast		558	15	The text has been revised to incorporate this suggestion.

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	on Agency						
U.S.	Environmental Protection Agency	This sentence is somewhat awkward. Suggest "The New York City Panel on Climate Change highlights a broader range of climate impacts across economic sectors. Although developed specifically for New York City, these impacts are applicable throughout the region. Responding to the aftermath of Hurricane Sandy illustrates the current reality of these impacts and those likely to be faced in the future."	16. Northeast		558	31	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Add septic systems to impacts on water and waste. Add direct damage to bridges and approaches to impacts on infrastructure. Add impacts to fuel delivery systems to impacts on energy.	16. Northeast	16.1	559		While the comment suggests a good specific example, the authors feel the existing examples are appropriate and adequate. The table is meant to be illustrative rather than exhaustive, and reflects the results expressed during interactions with NYC infrastructure stakeholders.
U.S.	Environmental Protection Agency	Would be better to explicitly note commuter rail as well as Amtrack given the extensive local rail networks in the NE.	16. Northeast		560	2	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Suggest changing "highly diverse climate" to "diverse climate." Climate regimes in the Northwest, for instance, range from arid in eastern Washington and Oregon to rain forest in NW Washington and high altitude conditions in the Cascades. Similarly, the Southwest also has much greater range of climate conditions in comparison to the NE.	16. Northeast		550	9	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	The Groisman citation should be replaced or at least augmented with more recent citations. There needs to be consistency with the heavy precipitation data reported in Chapter 2 (NOAA NCDC/CICS-NC; Karl et al. 2009).	16. Northeast		560	19	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Is there documentation of additional impacts on public health such as more potent pollens and changed phenology ? More potent poison ivy ? What about changing growing seasons and planting zone changes - again lay people can relate to "measures" like these. There is likely documentation for these impacts. Ditto increased risks posed by disease vectors sucha as ticks carrying Lyme bacteria, mosquitos and EEE, West Nile fever. Ticks and morbidity and mortality - decline in moose populations in Maine.	16. Northeast		561		Additional text has been inserted to expand the discussion of public health.
U.S.	Environmental Protection Agency	Reference to "loss of over 93% of tidal marshes and swamps" - It's not clear what geographical areas is being described here. Substitute "wetlands" for "swamps".	16. Northeast		561	32	The text has been revised to incorporate this suggestion.
U.S.	Environ	Define ICLEI.	16.		563	13	After consideration of this point, we

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	mental Protection Agency		Northeast				still feel the existing text is clear and accurate. The official name is just ICLEI Local Governments for Sustainability, so there is nothing to define.
U.S.	Environmental Protection Agency	Would be good to note here that the Cape Cod Commission has drafted model ordinance to help communities incorporate climate into zoning decision making. There are good reasons to highlight the efforts of NYC, but need to be careful not to lose sight of efforts in other communities.	16. Northeast		563	13	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	"One well-known adaptation-planning tool is the eight-step iterative approach developed by the 5 New York City Panel on Climate Change"This presumes that most readers will be (or implies they should be) familiar with the tool. It may be well known to the authors, but not necessarily to the broader audience of the chapter. Perhaps "widely-used" would be more appropriate.	16. Northeast		564	5	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	The "Northeast Hotspot" for accelerated SLR north of Cape Hatteras should be addressed here, or at a minimum noted. It is unclear whether this has been taken into account in the presented values for expected SLR (or if it should be). See Sallenger et al. 2012.	16. Northeast		553	18	We have added the suggested citation in our chapter assessment.
Sidney	Oldberg	March 28, 2013Comments on the current draft of the Federal Advisory Committee Climate Assessment Report (FACCAR)by Terry Oldberg, M.S.E., M.S.E.E., P.E. Engineer-Scientist, Citizen of the U.S.Summary and Introduction No statistical population underlies the models by which climatologists project the amount, if any, of global warming from greenhouse gas emissions that the people of the United States will have to endure in the future. For the people of the United States, the absence of a statistical population has dire consequences. They include: • The inability of the models to provide policy makers with information about the outcomes from their policy decisions, • The insusceptibility of the models to being statistically validated and, • The inability of the government to control the climate through regulation of greenhouse gas emissions.Notwithstanding its inability to control the climate, our government continues to enact legislation and spend money in attempts at controlling the climate. Evidently the government continues to labor under one or more misapprehensions. To relieve the government of these misapprehensions is a task that the authors of the FACCAR should do. Currently, the FACCAR reveals neither the absence of a statistical population nor the consequences					This comment is inconsistent with the author team's thorough assessment of the science, and does not seem to raise any question or suggest any revision. However, additional description of model uncertainty has been added to the introductory materials and Climate Science chapter, which the reviewer may find useful.

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		from this absence. Rather than describe global warming climatology warts and all, the FACCAR obscures its unsavory features through repeated applications of a deceptive argument. Philosophers call this argument the equivocation fallacy (Wikipedia: “Equivocation.”) . In the course of the following remarks, I show how the Advisory Committee can, if it wishes, expose and eliminate instances of this fallacy in the version of the FACCAR that eventually is published. Elimination of all instances of the fallacy would reveal to public view that the publicly supported investigation of the global warming phenomenon has failed. Retention of the fallacy would conceal this failure from public view. The Equivocation Fallacy Currently the failure of global warming research is concealed by multiple instances of the equivocation fallacy (EF). An example of an EF follows (Jumonville, 2003):Major premise: A plane is a carpenter’s tool. Minor premise: A Boeing 737 is a plane. Conclusion: A Boeing 737 is a carpenter’s tool.Like the argument which is called a “syllogism,” (Wikipedia: “Syllogism.”) the example has a major premise, a minor premise and a conclusion. Like a syllogism, the example has three terms; they are “plane,” “carpenter’s tool” and “Boeing 737.” Thus, it would be easy for one to mistake the example of an EF for a syllogism. However, there is a significant difference between the example and a syllogism: the conclusion of a syllogism is true but the conclusion of the example, that “a Boeing 737 is a carpenter’s tool,” is false. What is it about the example that makes its conclusion false when the conclusion of a syllogism is true? A pathological feature of the example can be exposed by replacement of the first instance of “plane” by “carpenter’s plane” and by replacement of the second instance of “plane” by “airplane.” The example then reads:Major premise: A carpenter’s plane is a carpenter’s tool. Minor premise: A Boeing 737 is an airplane. Conclusion: A Boeing 737 is a carpenter’s tool.While being like a syllogism in certain respects, the reworded example has four terms while a syllogism has three of them; the four terms are “carpenter’s plane,” “carpenter’s tool,” “airplane” and “Boeing 737.” Rather than being an example of a syllogism, the reworded example is a four term fallacy (Wikipedia, “Fallacy of Four Terms”) . That there are four terms has the consequence that the reworded example does not have the three terms that are a property of a syllogism. It is no surprise, then, that the conclusion of the example is false.The technique that I used in exposing the fallaciousness of the example is suitable for general use. The technique is to disambiguate all of the terms in the language in which an argument is made. Prior to my rewording of the example, the term “plane” had two meanings; one was “carpenter’s plane”; the other was “airplane.” A term that has several meanings is said to be “polysemic.” Disambiguation of the language in which an argument is made eliminates the polysemic terms from this argument. It is the presence of polysemic terms that can lead a person to mistake an EF for a syllogism. The source of the term “equivocation fallacy” is as follows. An “equivocation” is an argument in which a term changes meanings in the middle of this argument. By logical rule, a proper conclusion cannot be drawn from an equivocation (Hall, “Proper inferences avoid equivocation.”). To draw a conclusion					

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		from an equivocation is the “equivocation fallacy.”Polysemic terms in climatology In making arguments regarding the methodologies of their studies, global warming climatologists use polysemic terms. Some of these terms are words. Others are word pairs. The two words of a word pair sound alike and while they have different meanings climatologists treat the two words as though they were synonyms in making arguments. The following terms are polysemic and are used by climatologists in making methodological arguments (Oldberg, 2011):model scientific project-predict projection-prediction validate-evaluate validation-evaluationAn example A post to the blog Real Climate offers an example of an EF in the methodological argument of a global warming climatologist. Under the heading “Is Climate Modeling Science?,” the global warming climatologist Gavin Schmidt attacks an opponent’s claim that climate models are not scientific. His argument, though, draws an improper conclusion from an equivocation thus being an example of an EF.Were climate models of the past built under the scientific method of inquiry? Schmidt argues that: At first glance this seems like a strange question. Isn’t science precisely the quantification of observations into a theory or model and then using that to make predictions? Yes. And are those predictions in different cases then tested against observations again and again to either validate those models or generate ideas for potential improvements? Yes, again. So the fact that climate modeling was recently singled out as being somehow non-scientific seems absurd (Schmidt, 2005).Reduced to the form of major premise, minor premise and conclusion, Dr. Schmidt’s argument seems to be:Major premise: All scientific models are built by a process in which the predictions of these models are validated. Minor premise: All climate models are built by a process in which the predictions of these models are validated. Conclusion: All climate models are scientific models.Upon superficial examination, this argument seems to be an example of a syllogism. As the conclusion of a syllogism is true, the conclusion of Dr. Schmidt’s argument also seems to be true. However, with the help of the list of polysemic terms provided earlier, it can be seen that this argument contains the polysemic terms “model,” “scientific,” “prediction” and “validate.” Dr. Schmidt’s argument, then, draws its conclusion from an equivocation. By logical rule, this conclusion is improper.Need for disambiguation					

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		One can avoid reaching improper conclusions about the methodologies of climatological studies by disambiguating terms in the language of the associated arguments. In the course of the following remarks, I disambiguate these terms. Disambiguating “model” In the language in which global warming climatologists make methodological arguments, the word “model” is polysemic. The word means: a) a kind of algorithm that makes a predictive inference and b) a kind of algorithm that makes no predictive inference. That a “model” makes and does not make a predictive inference is of logical significance, for logic contains rules that discriminate correct from incorrect predictive inferences. Without a predictive inference, these rules are inoperative. Thus, going forward I’ll disambiguate the language of the methodological arguments of global warming climatology through elimination of the polysemic term “model.” I’ll accomplish this task by reserving the word “model” for reference to the kind of algorithm that makes a predictive inference. For reference to the kind of algorithm that makes no predictive inference, I’ll reserve the French word modèle. As I’ll soon show, models and modèles have remarkably different characteristics. To fail to distinguish between a model and a modèle is to obscure these differences.Disambiguating predict-project and prediction-projection To “predict” is to do something different than to “project” yet most global warming climatologists use the two terms synonymously (Green and Armstrong, 2007). In doing so, they create the polysemic term predict-project and the polysemic term prediction-projection. I shall disambiguate the two polysemic terms by drawing a distinction between: a) predict and project and b) prediction and projection.The idea of a “prediction” is closely related to the idea of a “predictive inference.” This relationship follows from the fact that a predictive inference is a conditional prediction. An example of one is provided by the following two statements:Given that it is cloudy: the probability of rain in the next 24 hours is thirty percent.Given that it is not cloudy: the probability of rain in the next 24 hours is ten percent.A “prediction” is an unconditional predictive inference. It is like a predictive inference but with the exception that one of the conditions has a probability of 1 because this condition has been observed. Suppose cloudy has a probability of 1 because it has been observed. Then the prediction that is a product of the predictive inference referenced immediately above is The probability of rain in the next 24 hours is thirty percent.Thirty percent is the probability of rain, given that it is cloudy in the associated predictive inference.To make a prediction, one needs a predictive inference. A predictive inference is made by a model. A predictive inference is not made by a modèle. Thus, while predictions are made by a model, a modèle is incapable of making predictions.On the other hand, a modèle is capable of making projections while a model is incapable of making them. The “projection” of global warming climatology is a mathematical function that maps the time to the projected global average surface air temperature.Related to the idea of a “predictive inference” is the idea of the independent events in a statistical population. Each such event is associated with a state of nature that is called a “condition” and a state of nature that is called an “outcome.” In the above example, an event has one of two possible conditions; they are “cloudy” and “not-cloudy.” Also, an event has one of two possible outcomes; they are “rain in the next 24 hours” and “no rain in the next 24 hours.” The statistical population of a model is said to “underlie” this model. A modèle has no underlying statistical population.The statistical population of a model has properties called “relative frequencies.” The non-existent statistical population of a modèle has no such					

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		properties. A consequence is for probability theory to be inapplicable to a modèle. A further consequence is for it to be impossible for the builder of a modèle to express incomplete information.Disambiguating validate-evaluate and validation-evaluation Validate-evaluate and validation-evaluation are polysemic terms that were created by the IPCC. As the long time IPCC expert reviewer Vincent Gray tells the story (Gray, 2008, pp 8-9), many years ago he complained to IPCC management that the IPCC assessment reports of the day were claiming the IPCC modèles to have been validated when these modèles were insusceptible to being validated.After tacitly admitting to Dr. Gray's charge, the IPCC established a policy of changing the term "validate" to the similar sounding term "evaluate" and the term "validation" to the similar sounding term "evaluation." Thereafter, many climatologists fell into the habit of treating the words in each word-pair as if they were synonyms. A consequence was for the two polysemic terms validate-evaluate and validation-evaluation to be created. These terms may be disambiguated through recognition of the fact that the meanings of the words in each word-pair differ.A model is said to be "validated" when the predicted relative frequencies of the outcomes of events are compared to the observed relative frequencies in a sample that is randomly drawn from the underlying statistical population, without a significant difference being found between them. As it has no underlying statistical population, a modèle is insusceptible to being validated. However, it is susceptible to being "evaluated." In an evaluation, projected global average surface air temperatures are compared to observed global average surface air temperatures in a selected time series. Disambiguating "scientific" According to Wikipedia (Wikipedia, "Scientific theory"), "A scientific theory is a well-substantiated explanation of some aspect of the natural world, based on a body of knowledge that has been repeatedly confirmed through observation and experiment." For a model, validation serves the purpose of confirming through observation and experiment. Does evaluation serve the same purpose for a modèle?No it does not. In an evaluation, projected temperatures are compared to observed temperatures but a judgment is not made in which claims made by a modèle are confirmed or denied. Thus, "scientific" cannot legitimately be used as a modifier of "modèle." On the other hand, under Wikipedia's definition of "scientific theory," "scientific" can legitimately be used as a modifier of "model."Translating Gavin Schmidt's argument With the help of the disambiguated terminology developed immediately above, Dr.Schmidt's argument can be translated into a form in which it is free from the potential for drawing a conclusion from an equivocation. With its polysemic terms removed and conclusion rewritten for consistency with its premises, this argument reads:Major premise: All scientific models are built by a process in which the predictions of these models are validated. Minor premise: All climate modèles are built by a process in which the projections of these modèles are evaluated. Conclusion: (none logically possible)No conclusion is logically possible from it because Dr. Schmidt's argument is not of the form of a syllogism. On the other hand, it appears to be of this form prior to disambiguation of polysemic terms in the language in which it is expressed.The conclusion that "All climate models are scientific models" is a consequence from drawing an improper conclusion from an equivocation. To draw such a conclusion is an example of an EF. Dr. Schmidt's conclusion is an					

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		EF.Contrasting a model and a modèle Disambiguation of terms in the language in which climatologists make methodological arguments reveals that there a contrast between a model and a modèle. This contrast is illustrated in the table immediately below model: modèle: makes predictive inference makes no predictive inference makes predictions makes no predictions underlying statistical population no underlying statistical population makes no projections makes projections susceptible to validation insusceptible to validation insusceptible to evaluation susceptible to evaluation product of scientific method not product of scientific method conveys information to user conveys no information to user makes climate controllable does not make climate controllableThe last two lines of the above table deserve amplification. If there were any, predictions from a climate model would convey information to a policy maker about the outcomes from his or her policy decisions prior to these outcomes happening; the availability of this information might make the climate controllable. Currently, however, we have no climate models. We do have climate modèles but they make no predictions hence conveying no information to a policy maker.Thus, after decades of effort and the expenditure of several hundred billion U.S. dollars on global warming research, the climate remains uncontrollable. Nonetheless governments, including our federal government, persist in trying to control the climate. It is conceivable that climate models can be built. To try to build them offers the only hope for one day being able to control the climate.The “models” of AR4 Every entity which, in IPCC Assessment Report 4 (AR4), is referenced by the polysemic term “model” is an example of a modèle. Each modèle has traits lying on the right hand side of the contrast presented immediately above. These traits are:makes no predictive inference makes no predictions no underlying statistical population makes projections insusceptible to validation					

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		susceptible to evaluation not product of scientific method conveys no information to user does not make climate controllableIf the language of the methodological arguments that are made in the FACCAR were to be disambiguated, the authors of the FACCAR would be compelled to admit that the items in the above list are descriptive of the climate modèles that are currently being used in making policy on emissions of greenhouse gases by the federal government. If these admissions are not made, there will be continuing catastrophic waste of the capital of the people of the U.S. on: a) attempts at controlling the uncontrollable and b) foolishly framed, deceptively described global warming research. To make these admissions would require courage and integrity on the part of the Advisory Committee. Works cited Wikipedia: “Equivocation.” URL = http://en.wikipedia.org/wiki/Equivocation . Wikipedia: “Syllogism.” URL = http://en.wikipedia.org/wiki/Syllogism . Jumonville, D., 2003: “Fallacies in Argument.” URL = http://lionsden.tec.selu.edu/~djumonville/etec641/WebQuest/fallacy.htm . Wikipedia: “ “Fallacy of Four Terms:” URL = http://en.wikipedia.org/wiki/Fallacy_of_four_terms . Hall, James “Proper inferences avoid equivocation ”: Lecture 13 in the series of lectures entitled “Tools of Thinking: Understanding the World Through Experience and Reason.” This series is published on DVDs by The Teaching Company. Oldberg, T. 2011: “The Principles of Reasoning. Part III: Logic and Climatology.” URL = http://judithcurry.com/2011/02/15/the- principles-of-reasoning-part-iii-logic-and-climatology/ . Schmidt, Gavin 2005: “Is Climate Modelling Science?” URL = http://www.realclimate.org/index.php/archives/2005/01/is-climate- modelling-science/ . Gray, Vincent 2008: “The Intergovernmental Panel on Climate Change: Spinning the Climate.” URL = http://icecap.us/images/uploads/SPINNING_THE_CLIMATE08.pdf .					

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		Green, Kestin and J. Scott Armstrong: "Global Warming: Forecasts by Scientists vs. Scientific Forecasts," Energy and Environment, Vol 18, No. 7+8, 2007. URL = http://www.forecastingprinciples.com/files/WarmAudit31.pdf . Wikipedia, "Scientific theory, URL = http://en.wikipedia.org/wiki/Scientific_theory .					
U.S.	Environmental Protection Agency	Additional reference to the Urban Systems chapter is needed. There are numerous cascading events that relate to vulnerability and health not addressed in Chapter 16 (downed trees due to wind and snow, disruption of fuel delivery due to damaged infrastructure, impacts of losing electricity in cold weather - all of which may result in increased mortality and morbidity). Although these are not all addressed in either Ch 16 or Ch 11, connecting the two helps to provide greater understanding of the complexity of the problems. It would be appropriate to note that those impacts listed in the Chapter are not all-inclusive.	16. Northeast				The text has been revised to incorporate this suggestion.
Thomas	Webler	Comments on Chapter 14: Rural CommunitiesAdditional vulnerabilitiesPeople work outside a lot and are exposed to hotter weatherObesity rates are higher, which means people are more subject to heat stroke. They have higher rates of cigarette smoking.Rural town/county governments often have high dependency of tax revenue on one major employer. That economic dependency makes individuals vulnerable to income loss, but also makes the town vulnerable to tax revenue loss.Resilience and adaptive capacitiesRural people have technical skills that enable for them to cope when essential services are cut off. For instance, when electricity is cut, rural skills in machinery, engine repair, electricity, plumbing, welding, and so on allow people to invent or innovate ways to regain some of those essential services. • E.g. They may modify machinery for innovative functions, for instance, they can use a boat battery and small generator to install lighting in their home. • E.g. They can build a temporary woodstove out of a 55 gallon barrel in a few hours. • E.g. They may construct alternative sanitary facilities (e.g. outhouses or composting toilets) to allow them to live in their homes without running water.Rural people have knowledge bases that are valuable capital to inform resilience actions. • E.g. They know how to save seeds, which adds food security for the long-term. • E.g. They know how to can or preserve food (without freezing) that gives them food security over the winter. • Elderly rural people are often healthy because they have lived a life in which they have been constantly living and working out of doors.Rural people often have machinery and other infrastructure resources that enable them to cope. • if electricity or heating oil supplies are interrupted during the winter, rural people have wood stoves and chainsaws.	14. Rural Communities				We appreciate the input. We have considered the information in the comment. The comment appears to make a number of generalizations on a range of conditions which may apply to a greater or lesser degree depending on the specific place and time. The chapter authors reviewed the literature on demographic, social, and economic conditions in rural populations and reflected the strengths and weaknesses in these populations in adapting to extremes and change. The authors stand by the conclusion that factors including physical isolation, limited economic diversity, higher poverty rates, and aging population will increase the vulnerability of rural populations to climate change.

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		• they have often a ready supply of lumber, nails, tools, metal, machinery at home or in a shop, which they can use for numerous purposes. • they often have alternative modes of transportation (snowmobiles, horses, ATVs) which allow them to access hospitals or care for neighbors and family when normal automobiles are unusable due to impassable roads. • They often have an extra refrigerator or freezer to store foodThey also have access to resource bases that they can draw on as backup systems: • woodlands for firewood and game, • ponds, lakes and streams for fish, • natural springs for water.Most of all, rural people have social networks that add incredible resilience to rural communities. This was demonstrated in numerous ways during hurricane Irene in Vermont. • they know their neighbors and have a long standing tradition of caring and watching out for each other. • Voluntary forms of government mean that people rise to the occasion. When needed, people volunteer because there is a tradition of volunteering. • Voluntary government means that people have a great deal of knowledge in how to do various governmental jobs. Maybe people have served on multiple town committees and so there is a great deal of expertise in how to run town government. During a time when rural communities are isolated from state or federal government services, they cope just fine.					
Megan	Fisher	I really enjoyed reviewing the forestry sections of this report. It went into a lot of detail on how important the forest is everyday life and why we need to keep as many around as possible. Also the effects of climate change on the forest are strongly talked about which is good, but I feel as though the report talks more about the effects of climate change on the forest without making it clear that we, humans, are the ones causing this climate change. I feel as though it almost leads away from the notion that we are causing the change in climate and talks more about why we need to save the forest and due to the effects of climate change. When this all boils down to humans being the cause of climate change, I feel its more important to get across what we need to do to stop climate change not necessarily what we need to do to save the forest because if it weren't for us causing the change we wouldn't have these concerns of the forest.	7. Forestry				We greatly appreciate your positive comment. Chapters on climate discuss the influence of humans on climate change.
Christopher	Miller	Replace “smooth” by ”uniform or smooth”?	2. Our Changing Climate		25	25	The text has been revised to incorporate this suggestion.
Michael	Coffey	"potential increases" Increase in what?	2. Our Changing Climate		27	24	The text has been revised to incorporate this suggestion.

First Name	Last Name	Comment	Chapter	Figure/ Table Number	Start Page	Start Line	Response
Michael	Coffey	P28L12 tropopause height is usually between 10 and 16 km (which is 8-12 mi) If this is to be a serious scientific assessment then units should be expressed in the metric system throughout P28L19 The obvious reference for worldwide climate change is the series of IPCC reports. To not reference them here shows a lack of rigor in the NCA research or some political motive, either of which will diminish the creditability of the NCA report.	2. Our Changing Climate		28	12	The decision was made early on in the development of the National Climate Assessment that it would use units customarily used in the U.S., so that the NCA could be readily understood in the U.S.
Michael	Coffey	P28L33 Do not want to give the impression here that the stratosphere is warming	2. Our Changing Climate		28	33	The sentence has been revised to add additional information about the trends in the various parameters.
Michael	Coffey	P30L4 " and that show that " delete first thatP30L7 Regarding the reference to NOAA NCDC in this figure and in others: a reference should allow the reader to trace the origin or development of some idea or fact, to give simply the name of a data center may not be specific enough to trace the origin. Is there some person or publication responsible for this product?	2. Our Changing Climate		30	4	The section has been revised to incorporate this suggestion. A reference has been added.
Michael	Coffey	P31L13 CO2 subscript 2P33L6 and L8 This is the first introduction of SRES and RCP they should be defined or referenced here	2. Our Changing Climate		31	13	The text has been revised to clarify. The acronyms are explained the first time they are used in the assessment.
Michael	Coffey	P34L2 Is Figure 2.4 a map of the largest temperature increases over continents or is this a comment concerning the data shown on the maps?P38L1 Terms like "newer" or "older" (P37L1) are relative to some context that may not be evident in later reading of the documentP39L17 An entire federal agency as a reference is hard to traceP39L25 This all sounds very negative, are there no benefits to a longer growing seasonP57L1 The axes of Figure 2.21 should have labels. What does PDSI<-4.0 mean on the chart?P70L14 Correct Feel.y to Feely	2. Our Changing Climate		34	2	The figure caption has been revised to incorporate these suggestions on the impacts of a longer growing season. The reference is in the list of references, including a link to download the report. On the figure, we thank the reviewer for the helpful suggestion, which has been incorporated. The figure has been moved to the Appendix on Climate Science.
David	Corbin	There should be an effort to reference Healthy People 2020 environmental health objectives as they relate to climate change and to add climate change issues related to health as we move forward on Healthy People 2030.Currently the The Healthy People 2020 Environmental Health objectives focus on 6 themes, each of which highlights an element of environmental health. All of these should be cross referenced with the NCA report.Outdoor air quality Surface and ground water quality Toxic substances and hazardous wastes Homes and communities Infrastructure and surveillance	9. Human Health				Thank you for your suggestion, currently climate change is included in the Healthy People 2020 objectives, (http://healthypeople.gov/2020/topicsobjectives2020/overview.aspx?topicid=12). Due to space considerations, we are unable to cross reference each of these objectives of the Healthy People 2020 report.

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		Global environmental health					
Michael	Coffey	P1152L6 Remove extra ","P1153L7 It might be useful to mention here that these limitations on model grid size (and also time step) are due to the current capabilities of super computers.P1156L4 Good to see scientific unitsP1156L5 Source neededP1158L15 A useful source that might be referenced here is the National Academy Press "Reconciling Observations of Global Temperature Change", 2000.P1161L34 For what period or date are these projected water level reductions? Reductions of 1 or 2 feet here seem out of line with recent estimates (P1162L1) for 2021-2050 of 1 or 2 inches. P1164L16 Should the new climate normal be (1981-2010)	Appendix: The Science of Climate Change		1152	6	Fixed the punctuation error and added statement about supercomputer capacity limitations. Also added test on the other issues. We thank the reviewer.
Michael	Coffey	P1170L15 Replace "on a" by "of a"P1178L24 Add or delete a parenthesisP1185L7 This reference is listed twice	Appendix: The Science of Climate Change		1170	15	The text was revised to incorporate this suggestion.
Michael	Coffey	P1120L16 and L17 "first discovered in 1824" "in 1859" these need a referenceP1120L21 If this appendix is a Science of Climate Change then units should be in the metric systemP1122 Caption Eliminate redundant (in million metric tons)P1127L7 Warming or cooling due to changes in the sun are not included in this chart. Changes in albedo are a feature of the Earth's atmosphere. Radiative forcing due to increases in CO2, CH4 and N2O is 1.5 - 2 Wm-2; radiative forcing due to changes in solar irradiance since 1750 is about 0.1 Wm-2. (I would not express this as BTU per second per square foot.)	Appendix: The Science of Climate Change		1120	16	References have been added. The decision was made early on that only American units would be used in this assessment. Caption corrected. Radiative forcing figure corrected.
Michael	Coffey	P1135L13 Word(s) missing at end of sentenceP1137L5 I do not think that the red trend line in the period from 1998 to 2006 shows no upward trend as the caption states.	Appendix: The Science of Climate Change		1135	13	Corrections have been made in both instances.
Peter	Harlem	After looking at all the sections where sea level rise is discussed I find the entire document wanting because the subject only discusses the rise of the ocean not the affect of topography on the resulting impacts. To keep this discussion simple for the review there should be presented an understanding that depending on the topography (local effect) of an area the rate of land lost will vary dramatically. This variation will be both based on coastal slope(high slope - minor loss of area/low slope - major loss of area) and how that slope varies with elevation. For example, in South Florida the slopes are generally low meaning we will lose a lot of area to the ocean but the initial slope is steeper than the slope once plus 5 feet of SLR is reached. Once that level is reached most of the interior (former Everglades) will be lost in just a few inches of further increase. Similar profile variations occur on most coastlines so the rise may be linear from the ocean point of view, but the actual rise will be most damaging when the portion of the coast being acted upon is on a low slope toporgraphy. This idea should be discussed in several sections of the report as it better describes both what will happen and shows how the rate of land lost to the ocean will vary as sea level comes up. There will be bad decades and there will be worse ones even if the rise were linear through time. If someone wants more detail, I can show how					We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include. The regional differences in topography and subsidence are discussed in several parts of the report, and are covered in greater detail in the Sea Level Rise Scenarios report that was prepared as a technical input for the NCA.

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		this works here in South Florida but it also can be applied to almost any coastline to better define the future with sea level rise.PWH					
Clyde	Martin	The authors are to be congratulated for putting together an almost complete report. One issue that is not covered and is of considerable importance in what they discuss is hydraulic fracturing to increase oil and gas production. There are two aspects that are critically important. • Natural gas. Hydraulic fracturing of the shale has led to a huge increase in the availability of natural gas and in fact has the potential to make the US an energy exporting country. It also has the potential to delay by decades the criticality of wind farms. • Water Usage. Hydraulic fracturing uses a huge amount of water and there have been incidences of the contamination of ground water. If climate change results in a decrease in available water in reservoirs then hydraulic fracturing would be in competition with urban areas and farms for available water. Another issue that is not really mentioned is that high demand will increase the cost of electricity for cooling in the summer. This will invariably lead to lower usage. It is a rather delicate problem to try to decide where the price and demand for electricity might settle. A nice example of the effect of price increase is in the cotton fields of West Texas. The water level in the Oglala aquifer has dropped and hotter summers require more irrigation water. These two facts combined have led to an expected decrease of 25% in the acres planted to irrigated cotton for 2013. Over all the authors have written a very useful report.	4. Energy Supply and Use				Thank you for the accolade. Regarding hydraulic fracturing, that energy production technique is discussed in detail in Chapter 10: Water, Energy and Land Use. Regarding energy prices and use during peak summer demand periods, increased electricity costs are identified as an issue. The consequences, trade offs and business decisions (such as the one described in the comment) will be influenced by additional factors and made at the local level. A discussion of the range of local consequences is beyond the scope of this chapter due to page length limitations.
U.S.	Environmental Protection Agency	An overarching comment on the ES, as well as specifically regarding the “assessing confidence” and “assessing likelihood” sections on page 17, is that the ES generally does not convey the confidence or likelihood of the myriad impacts that are discussed. For a non-technical audience, too much use of confidence and likelihood labels can clutter the message. However, too little use of such labels can give the false impression that all impacts discussed are equally likely and are backed by equal scientific weight [for example, see our comment on key finding #5 (pg 8, lines 34-41 below)]. Since the ES is split into a narrative and Report Findings, the authors should seriously consider conveying the confidence and likelihood for the Report Findings.	1. Executive Summary				The confidence and likelihood components are in the traceable accounts portions of each chapter, and would not fit well in the Executive Summary as you noted.
U.S.	Environmental Protection Agency	"Recent" should be added as a modifier somewhere in this sentence (e.g., These changes are part of a pattern of global climate change which has recently been driven primarily by human activity) (bullet one of chapter 2 is also a better wording)	1. Executive Summary		3	5	Language has been modified slightly to address this comment.
U.S.	Environmental Protection Agency	Add a time-scale: eg, "relatively stable climate of the past several thousand years"	1. Executive Summary		3	12	Agree that providing more specificity to the concept of "the past" is a good idea; language has been changed accordingly.
U.S.	Environ	While the evidence for negative impacts outweighs the evidence for positive impacts (especially at	1.				There are positive effects mentioned

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	mental Protecti on Agency	larger climate changes), it would still be appropriate for the Executive Summary to note any positive impacts mentioned in the underlying chapters - such as a decrease in extreme cold, carbon fertilization, increases in growing seasons, etc., though it may be acknowledged that not even these are purely positive effects: reduced cold means not killing off pests, and longer growing seasons and carbon fertilization can augment invasives and allergen production. Currently, positive impacts are only mentioned in the Midwest regional sentence.	Executive Summary				in other parts of the Executive Summary; in most cases, the positive effects are not the ones that rise to the "highest order message" from each of the chapters, so it is hard to bring more forward into the Executive Summary.
U.S.	Environ mental Protecti on Agency	"Increasingly frequent extreme precipitation and associated flooding that can lead to injuries and increases in marine and freshwater-borne disease" - this sentence is not entirely consistent with the information presented in Ch.24, which does not present evidence of a link between extreme precip/flooding and marine disease. Marine disease should be given a separate clause in this sentence and discussed in terms of temperature--i.e., "rising sea surface temperatures have been linked with increasing levels and ranges of diseases" (from Ch. 24)	1. Executive Summary		5	12	A change in response to this comment has been made.
U.S.	Environ mental Protecti on Agency	“However, beyond the next few decades, the amount of climate change will still largely be determined by choices society makes about emissions.” - This is generally consistent with previous statements by IPCC on the timing of the effect of different emission scenarios. However, in light of the additional information and attention being paid to the role of black carbon (where effects due to emission changes can be immediate) and methane (where effects can occur on a decadal time scale after an emission change), should this statement be revised to reflect the potential for changes in so-called short-lived climate forcers to have some degree of climate impact over the next few decades?	1. Executive Summary		6	2	References have been added to short-lived climate forcers.
U.S.	Environ mental Protecti on Agency	Editorial: typo in "under way and have" - delete "and"	1. Executive Summary		6	24	This change has been made.
U.S.	Environ mental Protecti on Agency	Caution is needed in the use of the word 'avoid' in "necessary to avoid" since it is not clear either whether even B1 is 100% certain to avoid the worst impacts, or whether these impacts would be 100% certain under BAU. Suggest revising as follows: "Large reductions in global emissions, similar to the lower emissions scenario (B1) analyzed in this assessment, would reduce the risks of some of the worst impacts of climate change."	1. Executive Summary		6	18	A change has been made in response to this comment.
U.S.	Environ mental Protecti on Agency	In lines 19 and 29, replace "international agreements" with "international negotiations." There are no internationally agreed-upon targets.	1. Executive Summary		6	19	This change has been made.
U.S.	Environ mental Protecti on Agency	Please reword this sentence to be consistent with Chapter 27 Mitigation and the key finding reported on page 10--e.g., "While these represent positive steps, the level of current efforts is insufficient to avoid increasingly serious impacts of climate change that have large social, environmental, and economic consequences."	1. Executive Summary		6	28	A change has been made in response to this comment.
U.S.	Environ mental	The section "Report Findings" does not adequately discuss the timing of impacts. Overall, the ES does a good job of highlighting the fact that many impacts are indeed occurring now and this paints a	1. Executive		8	1	An analysis of references to the timing of impacts across the report has been

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	Protection Agency	compelling picture of how climate change has already been observed to affect a number of systems. However, aside from this section's discussion of projected impacts for agriculture, there is little attempt to discuss current understanding and limitations about how further impacts may trend over time.	Summary				completed. Most graphical projections in the report do contain information about time frames, but there are not many specific time-frame high level findings. Reference the climate science chapter.
U.S.	Environmental Protection Agency	Key Finding #5 is a good example of our overarching comment above about why it's problematic to list all projected health impacts in one sentence without including any information on confidence or likelihood. Without such additional info, it's easy to conclude that scientists understand climate change's effects on waterborne diseases or mental health just as well as they understand heat stress and decreased air quality. Obviously this is not the case, as the former have only Medium confidence reported in Chapter 9, while the latter have Very High confidence.	1. Executive Summary		8	37	The key findings in the report are the accumulated highlights from the report agreed to by the full author team.
U.S.	Environmental Protection Agency	"Reliability of water supplies…" The term 'reliability' here is not clear if it refers to water quantity, quality, or both. Please reword to be more specific.	1. Executive Summary		9	15	The authors are comfortable with the language as it stands. It is entirely consistent with the conclusions of the water chapter.
U.S.	Environmental Protection Agency	The key finding states, “Over the next 25 years or so, the agriculture sector is projected to be relatively resilient, even though…” Please check if the wording of this finding is indeed consistent with the key findings from the agricultural sector chapter, because it appears to be a bold and potentially over-optimistic projection that even over the next 25 years ag will be resilient, when there remain uncertainties about changing variability and potential for extreme events to become even more frequent.	1. Executive Summary		9	28	This conclusion refers to the agricultural sector over the whole of the US and is consistent with the findings of the agriculture chapter.
U.S.	Environmental Protection Agency	Insert new clause at beginning of this sentence: "While these represent positive steps, the level of current efforts is insufficient to avoid increasingly serious impacts of climate change that have large social, environmental, and economic consequences."	1. Executive Summary		10	23	This section has been modified.
U.S.	Environmental Protection Agency	Are there any health impacts at the regional levels, particularly from extreme heat, that can be included in this table?	1. Executive Summary	1.1	11		The table has been replaced with an infographic map containing information about key impacts to the regions. This information is intended to reflect some of the highest order findings from the regional chapters. Though health is mentioned in all of the regional chapters, it is not the one that appears to rise to highest order in any one of them.
U.S.	Environmental Protection Agency	The "Crosscutting Themes and Issues” section is not always clear if the information under this section is the result of the findings or simply additional information worth considering. If the information is stemming from the draft findings, then they might be considered key findings themselves if given more specificity. For example, the “Thresholds, Tipping Points, and Surprises” section is written so generally that it doesn’t appear to have any specific relationship to the rest of the report. If specific examples	1. Executive Summary		12	1	Major changes have been made to the "framing issues" within About this Report, Executive Summary, and Context and Background.

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		could be given from the report itself, this topic could be an appropriate finding under Report Findings.					
U.S.	Environmental Protection Agency	The date "July 31, 2012" may need to be revised since the authors are now considering newer literature submitted through the public comment process. In any case, the report should be very clear about what was considered.	1. Executive Summary		16	11	This language has been amended to April 12, 2013.
U.S.	Environmental Protection Agency	The section "Sources of Information" needs to include description of the report's approach to citing grey literature. It should indicate that in limited instances, some NCA chapters (e.g., Ch. 12) cite grey literature in order to convey key information not found in the peer-reviewed literature, but that these sources have been clearly identified as such. In addition, it should be noted that all information in the report, including that from grey literature, will have undergone formal peer review by the National Academy of Sciences in addition to review by experts in the public comment process.	1. Executive Summary		16	9	The authors have included only sources that meet Information Quality Act standards and an appendix has been added that describes the approach used to ensure this.
U.S.	Environmental Protection Agency	This sentence states that the report “underscores the effect of mitigation by comparing impacts resulting from higher versus lower emissions scenarios.” A few issues here: a) the ES does not appear to attempt to take advantage of the examples in the report where either climate outcomes or impacts can be compared between the lower vs. higher emission scenario; this could be an additional way of conveying key messages from the report; b) this statement (along with the description of the SRES B1 vs. A2 description) may need to be re-worded so that it doesn’t falsely imply that for each and every impact describes comparison betwee B1 vs. A2.	1. Executive Summary		16	35	The Traceable Accounts have all been reviewed and the authors have provided additional details in some cases.
U.S.	Environmental Protection Agency	The traceable accounts in most chapters do not include enough detail or explanation to meet the objectives outlined for them in this section of the ES. In particular, there is very little discussion about the quality of information used; it is left up to the reader to look at the references cited and draw their own conclusions. Strongly recommend that each chapter team revist their traceable accounts to ensure a commensurate level of detail/explanation across chapters and to clarify their rationale for choosing the confidence levels.	1. Executive Summary		17	27	The Traceable Accounts have all been reviewed and the authors have been asked to provided additional details in some cases.
U.S.	Environmental Protection Agency	For accuracy, please reword this sentence to read: "Three types of scenarios are applied in certain chapters of this assessment – emissions scenarios (including population and land use components), climate scenarios, and sea level rise scenarios."	1. Executive Summary		18	13	Modifications have been made to the language in this section.
U.S.	Environmental Protection Agency	In general the draft report says very little about the potential role of black carbon emissions in climate change. The lack of information on this topic stands out because there has been more recent scientific information on BC as well as increased attention by policy makers. Most recently, Bond et al. (2013) in JGR estimated a central estimate of globally averaged radiative forcing for black carbon (including direct, indirect cloud, and snow and ice effects) of 1.1 W/m2, which would make it the second most potent anthropogenic warming agent behind CO2. However, this “Bounding Report” by Bond et al. also points out the importance, in terms of mitigation considerations, of taking into account potential cooling effects due to emissions co-emitted with black carbon, and how the net effects can vary significantly by source. Information from Bond et al. (2013) and other sources on short-lived climate forcers could be reflected in the ES, Chapter 2, and Chapter 27.					The text has been revised in several chapters to incorporate this suggestion to include the importance of black carbon emissions.
U.S.	Environmental	Update to reference the latest EPA Climate Change Indicators in the United States, 2012 Report.	2. Our Changing		39	16	This has been updated to the more recent report.

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	Protection Agency		Climate				
U.S.	Environmental Protection Agency	The current version of Figure 2.12 seems to indicate that in summer the Northwest and South-Central regions may be considerably drier than current conditions - this may be worth elevating into the text in a more emphatic way than its current mention related to certainty on pg 45.	2. Our Changing Climate	2.12	44		The areas of high model agreement for decreases (the hatched areas) are relatively small compared to the large areas of increases to the north and decreases to the south in winter and spring. Therefore we think our current level of emphasis is about right.
U.S.	Environmental Protection Agency	"unprecedented" since when? Presumably since the start of good records - maybe 1880? But previously the paragraph describes 800-year tree records, so this would be helpful to clarify.	2. Our Changing Climate		52	6	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	The caption for the figure notes the use of the VIC hydrological model - what model(s) are the precipitation and temperature data coming from?	2. Our Changing Climate	2.22	58		We added a phrase noting that the temperature and precipitation data are downscaled data from 16 CMIP3 models.
U.S.	Environmental Protection Agency	Please cite the methodology used in constructing the precipitation map of high spatial resolutions. According to Microburst and Nielsen-Gammon, they are based on estimates and interpolation of historical datasets.	2. Our Changing Climate	2.11	42		The wrong citation was used in this figure caption -- i.e., this map is NOT based on the divisional dataset from McRoberts and Neilsen-Gammon (2011). Furthermore, no interpolation-based estimates for missing monthly precipitation totals were used in the construction of this map. Rather, the underlying data and methods are the same as in Peterson et al. (2013), which come from NOAA/NCDC. The figure caption has been revised accordingly.
U.S.	Environmental Protection Agency	This discussion would benefit by citing national-scale drought projection analyses published to date. For example, Strzepek et al. (2010) - see http://iopscience.iop.org/1748-9326/5/4/044012/fulltext/. This study applies both meteorological and hydrological (e.g., SPI, PDSI) indices to project the spatial and temporal patterns of drought risks across the 99 sub-basins of the contiguous 48 US states in the early, middle, and late 21st century. Consistent with the NCA approach, these projections are estimated under the B1, A1B, and A2 SRES scenarios using the full suite of 22 GCMs from IPCC AR4.	3. Water Resources		113	22	We have included citation of this reference, particularly with respect to the precipitation projected presented therein.
U.S.	Environmental Protection	The 'Power Plant Cooling' section omits an important/recent national-scale study on this vulnerability (van Vliet et al. 2012) - http://www.nature.com/nclimate/journal/v2/n9/full/nclimate1546.html. "We used a physically based hydrological and water temperature modelling framework to produce a multi-model ensemble of daily river flow and water temperature projections for the US over the twenty-first	3. Water Resources		122	1	The reference has been added.

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	Agency	century" (they use SRES B1 and A2 and multiple GCMS).					
U.S.	Environmental Protection Agency	This section on 'Flood Effects on People and Communities' does not describe empirical findings on how flooding impacts and damages are projected to change in the future - the current text focuses on how society may need to respond to those risks. It would be useful to set the context by describing some of the recent literature. One example is: Wobus, C., Lawson, M., Jones, R., Smith, J., and Martinich, J., (in press). Estimating monetary damages from flooding under a changing climate. Journal of Flood Risk Management (see attached PDF entitled 'Wobus et al. 2013 - JFRM Flooding Damages ACCEPTED.pdf).	3. Water Resources		126	1	The suggested reference has been added to the text
U.S.	Environmental Protection Agency	This passage / summary on precipitation change impacting stream flow and carrying capacity to water/wastewater management is less than complete. Please consider to revise for following reasons: 1. The positive / negative impacts on stream flow is too simplified. A better summary of the literature is needed. 2. The statement on positive effect of increasing precipitation to stream flow is flawed. The carrying capacity is in largely related to stream/river base flow, not peak flow. There is inadequate data suggesting the hydrologic caustic relationship. Base flow of river monitoring network by USGS should be used to derive the statement; nonetheless, the data are inclusive for this rather complex hydrological process. 3. The citation of Whiteheat et al (2009) for increased likelihood of combined sewer overflows is misleading. The authors only cited CSO as a potential consequence in general description of climate change effect in the Introduction section. Their data and future watershed simulation analysis have nothing to do with CSO.	3. Water Resources		124	38	Regarding the comment on the positive/negative impacts of stream flow, the text has been revised. After consideration of the carrying capacity comment, we still feel the existing text is clear and accurate. Regarding the citation, we have replaced the citation with a different source.
U.S.	Environmental Protection Agency	Can you be more specific on this important aspect of adaptation and institutional response? This is a generic statement as it is currently written, and only yields a perception that the US water laws and regulations are outdated, particularly with respect to climate change adaptation . It is unclear if there is a definite case that climate change impacts and hydrologic response have occurred to the degree to which current regulations become ineffective or inapplicable or a responsive adaptation requires policy/regulation changes. More specific discussion and description here would help clarify the message.	3. Water Resources		129	38	The text has been revised to incorporate the suggestion
U.S.	Environmental Protection Agency	Editorial: Update the reference to Ch. 11 with correct chapter title, "Urban Systems, Infrastructure, and Vulnerability"	4. Energy Supply and Use		168	29	Thank you. We have incorporated in the text the suggested editorial change to update the reference to Chapter 11.
U.S.	Environmental Protection Agency	Editorial: Missing a word? Suggest "...face some type of water sustainability issue (EPRI, 2011)."	4. Energy Supply and Use		176	8	Thank you. We have reworded the text and added the missing word, "issue."
U.S.	Environmental Protecti	Editorial: Should refer to "Table 4.3" rather than "Table 3".	4. Energy Supply and Use		180	6	Thank you. We have corrected the table reference.

First Name	Last Name	Comment	Chapter	Figure/ Table Number	Start Page	Start Line	Response
	on Agency						
U.S.	Environmental Protection Agency	Editorial: It would be helpful for Table 4.3 to be consistent with Table 4.1 in using color-coding of the words "Challenges" and "Opportunities" in the heading (color-coded in Table 4.1; white in Table 4.3).	4. Energy Supply and Use	4.3	181		Thank you. We have modified the tables to have consistent formatting.
Stephanie	Moore	Clarify "higher basins" - higher altitude vs higher latitude.	21. Northwest		724	8	The text has been revised to incorporate this suggestion.
Stephanie	Moore	Is a "transient" basin a mixed basin (as defined on line 7), or is it a basin that is projected to transition? e.g., from mixed to rain-dominated.	21. Northwest		724	13	The text has been revised to incorporate this suggestion.
Stephanie	Moore	In addition to increasing temperatures, ocean acidification can also affect toxin-producing harmful algal blooms (HABs). Sun et al. (2011) and Tatters et al. (2012) have found that increasing pCO2/decreasing pH can increase the amount of toxin produced per cell of some species of Pseudo-nitzschia. Pseudo-nitzschia is best known in the Pacific Northwest for blooming on the outer Washington coast and contaminating razor clams, causing up to $22 million in lost revenue (Dyson and Huppert 2010). There are also some incorrect references in this paragraph: 1. There are 2 issues with the Huppert et al. (2009) reference on line 26. First, it should be removed here because it is not applicable to PSP in Puget Sound. Second, it should be replaced with Dyson and Huppert 2010 (see full reference below), and should appear only when referencing the blooms of Pseudo-nitzschia (not blooms that cause PSP). For example, this reference could be used when highlighting the economic impacts associated with blooms of Pseudo-nitzschia that may increase in toxicity as a result of ocean acidification. 2. The Feely et al. (2010) reference on line 26 should also be removed - it does not show or reference linkages between climate, warmer temperatures, and harmful algal blooms in Puget Sound. 3. The Moore et al. 2008 reference on line 26 is incorrect and should be removed. Instead it should be Moore et al. (2009), Moore et al. (2010), and Moore et al. (2011). Sun, J., Hutchins, D. A., Feng, Y., Seubert, E. L., Caron, D. A., Fu, F. (2011). Effects of changing pCO2 and phosphate availability on domoic acid production and physiology of the marine harmful bloom diatom Pseudo-nitzschia multiseries. Limnology and Oceanography. Vol. 56 (3), pp. 829-840.Tatters, A. O., Fu, F., Hutchins, D. A. (2012). High CO2 and silicate limitation synergistically increase the toxicity of a harmful bloom diatom. PLoS ONE. Vol. 7 (2), pp. e32116.Dyson, K., Huppert, D.D., 2010. Regional economic impacts of razor clam beach closures due to harmful algal blooms (HABs) on the Pacific coast of Washington. Harmful Algae 9(3), 264-271, doi: 210.1016/j.hal.2009.1011.1003.Moore, S.K., Mantua, N.J., Trainer, V.L., Hickey, B.M., 2009. Recent trends in paralytic shellfish toxins in Puget Sound, relationships to climate, and capacity for prediction of toxic events. Harmful Algae 8(3), 463-477, doi:410.1016/j.hal.2008.1010.1003.Moore, S.K., Mantua, N.J., Hickey, B.M., Trainer, V.L., 2010. The relative influences of El Niño Southern Oscillation and Pacific Decadal Oscillation on paralytic shellfish	21. Northwest		728	14	The text has been revised to incorporate this suggestion. "Neurotoxic" has been changed to "paralytic" to be consistent with revised wording in expanded coastal chapter of the Northwest Climate Assessment Report. New references were added.

First Name	Last Name	Comment	Chapter	Figure/ Table Number	Start Page	Start Line	Response
		toxin accumulation in Pacific Northwest shellfish. Limnol Oceanogr 6(55), 2262-2274, doi: 2210.4319/lo.2010.2255.2266.2262.Moore, S.K., Mantua, N.J., Salathé Jr., E.P., 2011. Past trends and future scenarios for environmental conditions favoring the accumulation of paralytic shellfish toxins in Puget Sound shellfish. Harmful Algae 10(5), 521-529, doi:510.1016/j.hal.2011.1004.1004.					
U.S.	Environmental Protection Agency	As phrased, the sentence has not been established by the information in the chapter. That is, the chapter has not demonstrated that either the capacity or the reliability of the US transportation system is declining. Most likely, the authors really mean that climate change reduces capacity compared to what it would otherwise be, but without that qualifying language, the capacity has to actually be declining - and that decline documented - for the sentence to be true.	5. Transportation		195	14	We have revised the text of Key Message 1 to indicate that impacts from sea level rise and storm surge, extreme weather events, higher temperatures and heat waves, precipitation changes, Arctic warming, and other climatic conditions are affecting the reliability and capacity of the U.S. transportation systems.
U.S.	Environmental Protection Agency	Please inset "sidewalks" into the list of infrastructure.	5. Transportation		195	33	The list was not meant to be all-inclusive but we have listed “pedestrian/bicycle facilities.”
U.S.	Environmental Protection Agency	Please insert "bicycles" into this list.	5. Transportation		195	35	We added “pedestrian/bicycle facilities.”
U.S.	Environmental Protection Agency	Please add a citation to this sentence (re: economic and personal losses).	5. Transportation		195	29	Thank you for your comment. We added a reference.

U.S.	Environmental Protection Agency	The first sentence does not really relate to the rest of this paragraph. The point is important and relevant, but its relevance is not addressed in the paragraph.	5. Transportation		196	12	Thank you for the observation. The text has been edited to incorporate this perspective.
U.S.	Environmental Protection Agency	The text has not explicitly demonstrated that climate change has reduced either capacity or reliability to what it would be without climate change, so the first key message has not been demonstrated. Certainly the impacts discussed have the potential to reduce reliability and capacity, but other types of climate change can increase both (e.g. shorter ice free seasons and less snowfall), and the chapter never really establishes which effect dominates. Nor does it demonstrate that the systems have not been adapted to climate change sufficient to offset those effects. The conclusions are probably correct, but they should be demonstrated.Note that this applies to the key finding in the opening page of the chapter.	5. Transportation		197	2	We have revised the text of Key Message 1 to indicate that impacts from sea level rise and storm surge, extreme weather events, higher temperatures and heat waves, precipitation changes, Arctic warming, and other climatic conditions are affecting the reliability and capacity of the U.S. transportation systems.
U.S.	Environmental Protection Agency	Citations are needed for the statements describing impacts and effects.	5. Transportation		197	6	We added the corresponding references.
U.S.	Environmental Protection Agency	"such high temperatures" is a nonsequitur since the previous sentences did not say how high the temperatures would be, only what temperature changes are expected to be.	5. Transportation		197	18	Thank you for your comment. We have changed the wording.
U.S.	Environmental Protection Agency	This statement needs to be qualified. There are asphalt mixes designed for warmer temperatures, and roads are repaved every 10-15 years.	5. Transportation		197	19	Thank you. We have modified the text to incorporate your suggestion.
U.S.	Environmental Protection Agency	This sentence is so vague that either it should be cut, or the text should explain what these impacts are. A reference or two would be useful as well.	5. Transportation		197	25	We have edited the sentence to address this comment and added references.
U.S.	Environmental Protection Agency	Recommend finding appropriate citations within the peer-reviewed literature rather than citing a website. If these do not exist, consider whether the information is truly necessary for a scientific assessment and will meet information quality standards for this report.	5. Transportation		200	16	The Airnav LLC website is based on Federal Aviation Administration (FAA) data. We have changed the text to include the FAA source. The Airnav LLC web site, based on FAA data, was used specifically for runway elevations rather than the more generic airport information. This is a useful distinction because some of the other airport information on that web site could change from year to year, whereas runway elevations do not change very

							often.
U.S.	Environmental Protection Agency	The denominator is missing in "13 of the nation's largest…" and "two of the most important…"Suggest "13 of the nation's XX largest..." (15 largest? 100 largest?) Suggest "...two that handle XX% of the nation's port traffic..."	5. Transportation		200	15	We have added language that sets context.
U.S.	Environmental Protection Agency	This sentence reasonably explains a vulnerability created by something other than climate change, but it needs to be better linked to the point the paragraph is attempting to make.	5. Transportation		200	18	We have moved the sentence to better link to the intent of the paragraph.
U.S.	Environmental Protection Agency	This assessment should not be citing a web site for factual information without note clearly explaining why that web site is deemed reliable. See comment concerning p. 200, line 16.	5. Transportation	5.2	201		The source of data for the information found in airnav.com, an online database for pilots and aviation professionals, is the Federal Aviation Administration's National Flight Data Center Portal. We revised the text to cite this source information. The source meets the Guidance on Information Quality Assurance to Chapter Authors of the National Climate Assessment: Question Tools (2/21/2012), which is used by the NCADAC to assure for each source used in the NCA Report: (1) utility, (2) transparency and traceability, (3) objectivity, and (4) integrity and security.
U.S.	Environmental Protection Agency	This section appears to omit the types of disruptions that will decrease due to global warming, such as the longer ice-free shipping season and less snow in some areas. The reader has no way to evaluate whether the good or ill effects dominate.	5. Transportation		202	1	We appreciate your comment. We have discussed the positive aspects of climate change in other sections of our chapter assessment. Due to space limitations, we have decided to not repeat them in this section.
U.S.	Environmental Protection Agency	The legend box and caption can be misleading, by asserting that the highways themselves are at elevations below 4 feet (above what--NAVD?). In fact, most of the actual highways are at higher elevations than the surrounding terrain. Basically, the roadbeds have been elevated (or the highway is actually on a low bridge) though they run through very low land.	5. Transportation	5.3	203		We appreciate your comment, however after consideration of this point, we still feel the legend is accurate. The graphic is from a major study of the Gulf Coast.
Kayla	Craighead	The issue of global climate change is one that can no longer be ignored. With direct, irrefutable evidence supporting its existence and effects, policies and resource planning must be adapted to combat global climate change. I urge politicians for a unified front on this bipartisan issue. With irrefutable evidence it is necessary that our politicians work together to support policy planning to limit the effects of global climate change. This issue will not affect one single group of individuals, but the entirety of the global population. The issue calls for a unified front on policies both within our nation and between nations.	Introduction: Letter to the American People				Thank you for your comments.

U.S.	Environmental Protection Agency	Revise sentence to include food prices in the considerations for food security, such as "not only though changes in crop yields and food prices, but…"	6. Agriculture		227	32	We agree and have changed the text as suggested.
Stephanie	Moore	It is difficult to tell the difference between the colors on the map that show medium (i.e., 13") and high (i.e., 50") sea level rise estimates.	21. Northwest	21.4	729		The figure has been resized to incorporate this suggestion since we were unable to change the original palette.
U.S.	Environmental Protection Agency	Include extreme events in this description of crop and livestock threats, such as "direct impacts from changing climate conditions and extreme weather events on crop and livestock…".	6. Agriculture		227	36	We agree and have added the suggested wording to the sentence.
Stephanie	Moore	Not certain what is meant by "viability" here -- do the authors mean vulnerability?	21. Northwest		730	1	After consideration of this point, we still feel the existing text is clear and accurate.
U.S.	Environmental Protection Agency	Consider indicating that climate change not just has both positive and negative impacts at different spatial scales, but also at different temporal scales, and that impacts can switch from positive to negative over time (and vice versa perhaps)	6. Agriculture		228	5	We changed the sentence to include spatial patterns and spatial and temporal productivity.
U.S.	Environmental Protection Agency	These sentences need to be re-ordered and cited. Revise to something like: "US agriculture exists as part of the global economy and agricultural exports have outpaced imports as part of the overall balance of trade. Climate change will affect food prices, quantity and quality of produce available for export and import, and will also alter the stability of food supplies. These impacts will create new food security challenges for the US as the world seeks to feed nine billion people by 2050. ([citations])." Please provide appropriate, current citations in the opening section of this chapter.	6. Agriculture		228	6	After consideration of your suggestion, we have decided to leave the current text as is. The current flow of the sentences conveys the message of cause and effect.
U.S.	Environmental Protection Agency	This paragraph needs reworking. Revise to something like: "The cumulative impacts of climate change on agriculture will ultimately depend on changing global market conditions as well as responses to local climate stressors, which could include such actions as farmers adjusting... Adaptive actions in the areas of production, consumption, research, and education include seizing opportunities to avoid economic damages, and in some cases increase profitability, while minimizing risks." The phrase "increase profitability" sounds cold and the phrase "unfavorable conditions" sounds weak- revise to better convey the seriousness of these threats.	6. Agriculture		228	12	We have changed the sentence to incorporate these suggestions.
U.S.	Environmental Protection Agency	This paragraph is confusing and needs a lot of structural reworking. The first sentence (line 22-23) is awkward. It is very difficult to figure out what the pronouns between Lines 22 through 29 are referring to-- for example, please clarify what "These strategies" on line 25 and "such projections" on line 29 refer to. Reorder sentences to clarify and separate the subject of adaptation strategies versus the subject of projections. Please clarify if "changes in extremes are less well understood" on line 24 refers to the extremes being less known or the strategies to adapt to extremes being less known. Clarify if the phrase, "when temperature increases" on line 32 refers to average temperature. Please include more current citations.	6. Agriculture		228	22	We modified the wording and removed the sentence on future extremes.
U.S.	Environmental	For figure 6.1 it would be more insightful if actual percentages where given with pie chart.	6. Agricultu	6.1	229		Thank you for your suggestion. We have added dollar values to the pie

	Protection Agency		re				chart to provide more clarity on the size of each commodity type.
Stephanie	Moore	I found this paragraph a little confusing. The first few sentences describe an increasing trend for outbreaks of mountain pine beetle and state that this trend is projected to continue with ongoing warming (i.e., a linear increasing trend). Then the next few sentences say that suitable beetle habitat is projected to first increase and then decrease. Do outbreaks and suitable habitat not vary together? And why is the available area for beetles ultimately limited as stated in line 17? Is there a lower elevation/higher temperature that becomes too warm for them, and so they run out of mountain at higher altitudes?	21. Northwest		732	9	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	While it is understood that the 2007 Census of Agriculture is the most recent, it is desirable to have more recent data if it is available through other sources.	6. Agriculture	6.2	230		We have added the reference to the 2010 Census data.
Stephanie	Moore	Typo in reference.	21. Northwest		748	21	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Please clarify the text in lines 5 and 6 (Figure 6.2 caption). It is unclear whether the different effects are due to differences in response of commodities in a given area, or due to regional differences in climate impacts.	6. Agriculture	6.2	230		We have modified the text to provide more clarity.
U.S.	Environmental Protection Agency	Its not clear that this figure adds much to the story of climate change impacts on agriculture.The statement that "poor harvests in many nations in which climate was a factor" is questionable in this context. If it is to be used, it needs to be revised. As written, it suggests that the failures due to "climate" were caused by climate change. If that is true, it needs to be backed by at least one citation. If that cannot be verified, the statement should make clear that drought, heat, or other climate-related impacts are likely to occur more frequently and lead to poor harvests such as occurred in the past.	6. Agriculture	6.3	231		Thank you for your comment. After consideration of your suggestion, we still feel the figure is useful. The figure was inserted in response to earlier comments.
David	Klein	Suggestion: The (red) trend line for 1998-2006 appears to have nearly the same slope as the (black) overall trend line. The point of the caption might be better illustrated by choosing a different period of time, perhaps 2002-2009 so that the slopes are more visibly different.	Appendix: The Science of Climate Change	13	1137		The point of the figure is that the slopes are essentially the same, indicating that the warming of global temperature is the same in El Nino and La Nina years. Hence the net warming can be skewed by the relative frequencies of El Nino and La Nina years, but the background warming is nevertheless the same.
U.S.	Environmental Protection Agency	It would be helpful to have a subtitle here, such as "Plant Response to Climate Change" to differentiate from Animal Response to Climate Change (see p. 237)	6. Agriculture		231	10	We have added section headers to the text.
U.S.	Environmental	Replace the word "match" with something like "fall within"	6. Agricultu		231	14	We agree and have modified the text according to the suggestion.

	Protection Agency		re				
U.S.	Environmental Protection Agency	Suggest defining the dotted zero line similar to the A2 and B1 lines.	6. Agriculture	6.4	232		The dotted line is the zero line of no change. The intent of this line is for a reference point. As such, we feel that it does not warrant a definition in the text.
U.S.	Environmental Protection Agency	Clarify in the text that (if true) the phrase "only year to year variation across the whole period" means there is no significant trend over the period examined.	6. Agriculture		232	10	We have reworded the caption to indicate that yield response varies among crops with cotton, maize, wheat, and sunflower showing yield declines early in the period.
U.S.	Environmental Protection Agency	End the sentence at "Corn Belt. With the number…"	6. Agriculture		233	7	We have made the editorial change as indicated.
U.S.	Environmental Protection Agency	This figure title is not very descriptive. Revise to something like "Projected changes in key climate variables affecting agricultural productivity in 2100" .	6. Agriculture	6.5	234		Thank you for your comment. We have changed the figure title to be more descriptive. For consistency with the title lengths of all figures in the report, we are reserving most details for the caption.
U.S.	Environmental Protection Agency	Revise to include discussion of the lower left figure in the caption	6. Agriculture	6.5	234		A description of this graph is found in the surrounding main body of text. We have added a reference to the Figure following the description.
U.S.	Environmental Protection Agency	Revise to "Changes in some of the climate parameters". Clarify the baseline or starting year that these 2100 changes occur from.	6. Agriculture	6.5	234		We have modified the figure caption to indicate the baseline.
U.S.	Environmental Protection Agency	Benefits and disbenefits are unclear here. Clarify (as appropriate) that some changes will help and some will harm, but that overall changes by the end of the century will be harmful.	6. Agriculture		234	3	We have modified the text following this caption to incorporate this clarification. We have also changed the figure title to emphasize that the focus for this figure is on productivity. The caption as is indicates that changes are not identical everywhere and that some crops, such as cereals, would grow more quickly under warmer conditions, meaning less time for the grain itself to mature, reducing productivity.

U.S.	Environmental Protection Agency	Clarify the phrase "a similar response"- it sounds like it says animals have decreases in the length of grain-filling period. Revise this sentence and explain the effects of stress on animals (reduced milk productivity, slower growth etc.) Consider noting that this is further discussed in the next section.	6. Agriculture		235	7	We have revised the sentence to incorporate your suggestion.
U.S.	Environmental Protection Agency	Paragraph needs revising- include a topic sentence and separate disparate concepts. Include a topic sentence something like: Though changes in temperature, CO2 concentrations, and radiation may benefit plant growth rate, this doesn't necessarily equal more production, etc.	6. Agriculture		235	9	We agree and have added the suggested sentence.
U.S.	Environmental Protection Agency	Editorial: Revise to: "…mature more quickly. But because soil may not be able to supply nutrients at rates required for faster growing plants, plants may grow smaller, thereby reducing grain, forage, fruit, or fiber production."	6. Agriculture		235	9	We have modified the text as suggested.
U.S.	Environmental Protection Agency	Editorial: Revise to: "Reduction in solar radiation in agricultural areas over the last 60 years is projected to continue, which would slow plant growth and may partially offset the acceleration of plant growth due to higher temperature and CO2, depending on the crop."	6. Agriculture		235	12	We have modified the sentence as suggested.
U.S.	Environmental Protection Agency	This is not an adequate topic sentence. Revise to something like: its not just warming but the lack of cold that causes threats to agriculture…	6. Agriculture		235	21	We have modified the sentence to incorporate your suggestion.
U.S.	Environmental Protection Agency	CRITICAL COMMENT: Check for consistency throughout assessment with how "heat-trapping gas emissions" are characterized or defined and whether they are different than "greenhouse gases", which is a term that has been specifically defined in regulations. It may be helpful to define these terms once at the outset, and note whether they are considered as interchangeable or have meanings distinct from one another.					After careful consideration, the NCADAC concluded that both terms ("heat-trapping gases" and "greenhouse gases)" are acceptable in this report. "Heat-trapping" is preferred in some places for communication purposes, and "greenhouse" is used for in certain situations, such as for regulations. A mouse-over glossary in the final report will also be provided to help clarify definitions.
U.S.	Environmental Protection Agency	Editorial: Revise to: "viability is low. Projections show that chilling requirements for fruit and nut tress in California will not be…"	6. Agriculture		235	25	We have made this editorial change to the text.
U.S.	Environmental Protection	It would be helpful to clarify what crops (most?) have a 400 hour chilling requirement.	6. Agriculture		235	27	We have added names of plants.

	Agency						
U.S.	Environmental Protection Agency	Recommend finding an appropriate citation within the peer-reviewed literature. If one does not exist, consider whether a personal communication used in this context is truly necessary and will meet information quality standards for this report.	6. Agriculture		235	32	There is no citable reference at this time which meets the standards for this report. This current statement does show that these impacts are occurring and the personal communication meets the Guidance on Information Quality Assurance to Chapter Authors of the National Climate Assessment.
U.S.	Environmental Protection Agency	The text introduces this topic as "winter chilling", not "chilling" as shown in the caption. Revise caption to say "winter chilling"	6. Agriculture	6.6	236		We have modified the text to include the word "winter."
U.S.	Environmental Protection Agency	The term "fruit set" is specialized to the ag sector - clarify or revise to say "production" or use other phrasing as appropriate.	6. Agriculture		236	6	We have revised the sentence.
U.S.	Environmental Protection Agency	Revise caption to clarify what scenarios are being used, how they're being characterized (BAU = A2?), and their appropriate likelihood. The sentence on lines 14-16 can begin to be clarified by revising to: "These are very conservative estimates of the reduction in winter chilling hours because climate models project not just simple continuations of observed trends, but temperature trends rising at an increasing rate." ([citation]). More citations needed.	6. Agriculture		236	3	We have modified the sentence and added a citation.
U.S.	Environmental Protection Agency	Note that, while the sentence on lines 14-16 states that these are not "simple continuations" of observed trends, the sentence on lines 7 and 8 states, "One example of this change is shown here for California's Central Valley assuming that observed climate trends in that area continue through 2050 and 2090." The sentence on lines 7 and 8 implies (at least to many readers) that these are "simple continuations." It is unlikely that many readers will automatically consider anything beyond a straight-line trend form.These two statements need to be revised for clarity.	6. Agriculture		236	14	We have revised the text for clarity.
U.S.	Environmental Protection Agency	Clarify what chemical manipulation to induce chilling refers to, or omit.	6. Agriculture		236	18	We have revised the sentence to clarify the meaning.
U.S.	Environmental Protection Agency	Presumably the citation at the end of the caption (Luedeling et al. 2009) is the same for the immediately preceding data as well as for the figure. However, that is not clear. It would be helpful to include the citation in the figure title to clarify the figure source.	6. Agriculture	6.6	236		We have added text to clarify that the citation Luedeling et al 2009 is the source of the figure.
U.S.	Environmental Protection	The examples in this paragraph, after the topic sentence, are all negative, though the topic sentence says that impacts are mixed. Please revise to include positive impacts or change the "mixed" characterization.	6. Agriculture		237	1	The section has been revised in accordance with this and other comments.

	Agency						
U.S.	Environmental Protection Agency	Revise last sentence to: "The growth stimulation effect of increased atmospheric CO2 concentrations also has a disproportionately positive impact on several weed species, which will contribute to increased risk of crop loss due to weed pressure."	6. Agriculture		237	11	The sentence has been revised for clarity.
U.S.	Environmental Protection Agency	Change the word "precipitation" to "water supply"	6. Agriculture		237	15	We have reworded the sentence to incorporate this suggestion.
U.S.	Environmental Protection Agency	Move this paragraph under the subtitle "Animal Response"	6. Agriculture		237	19	We have added a subhead in front of this paragraph.
U.S.	Environmental Protection Agency	Editorial: Revise to: "…5F range; deviations from this range can cause animals to become stressed, which can disrupt performance, production, and fertility, limiting the animal's ability to produce meat, milk, or eggs."	6. Agriculture		237	26	We have modified this sentence to incorporate this editorial change.
U.S.	Environmental Protection Agency	Editorial: Revise title to: "Animal Response to Climate Change"	6. Agriculture		237	34	We have added a subheading in a different paragraph.
U.S.	Environmental Protection Agency	The phrase "causes problems" is too vague. Please clarify.	6. Agriculture		237	42	We have modified the wording for clarity.
U.S.	Environmental Protection Agency	If available, it would be better to have 2012 data on production losses.	6. Agriculture		238	2	These are the latest published data available to meet the guidelines of this report.
U.S.	Environmental Protection Agency	Revise to: "Several weed types benefit…"	6. Agriculture		238	14	Thank you. We have changed the text to “weed species.”
U.S.	Environmental Protection	Clarify whether higher humidity only occurs in wet years or omit "in wet years".	6. Agriculture		238	23	The text on higher humidity in wet years is no longer in the chapter.

	Agency						
U.S.	Environmental Protection Agency	Consider coupling this figure with a drought figure.	6. Agriculture	6.9	240		Drought is covered in the chapter where we mention that climate change projections suggest an increase in extreme heat, severe drought, and heavy precipitation (Peterson et al. 2012). Given that we are limited in space, we defer those interested in learning more about trends in drought to the Peterson et al. 2012 reference.
U.S.	Environmental Protection Agency	How are "rare" and "many" defined here? Years with more than 8 days in which more than 1.25 inches of rain fell are more frequent since 2000 than they were previously, but the term "rare" is subjective. Consider revising using "more frequent" or similar terms.Similarly, the statement that "many recent years having more than 8 days with such heavy rainfall" is also somewhat subjective. It appears from the figure that there were 4 years between 2000 and 2011 in which this occurred, and it appears that one could say that there were "only" 4 years since 1994 in which there were 8 days of 1.25"+ rainfalls. Consider revising in terms of relative frequency.	6. Agriculture		241	4	Recent frequent occurrences of such events at individual stations are consistent with the statistically significant upward trend of heavy precipitation events documented in the upper midwestern U.S. (USGCRP SAP 3.3, 2008). We have modified the sentence to clarify this point.
U.S.	Environmental Protection Agency	What is the relevance of 1.25 inches/day as the metric used for this figure? What would be the result if it were 1"/day or 1.5"/day? I.e., how robust are these results to changes in the rainfall amount?	6. Agriculture	6.9	240		As stated in the caption, 1.25" is an approximate threshold for creating runoff. Rain amounts exceeding about 1.25" leads to soil erosion, enhanced streamflow and flood potential, so this level is more agriculturally relevant than other arbitrary thresholds. Number of events over 1.25" has increased at a faster rate than total rainfall.
U.S.	Environmental Protection Agency	It is unclear why this sentence is separated- consider moving to a more appropriate location.	6. Agriculture		241	32	We moved and modified the sentence to address this comment.
U.S.	Environmental Protection Agency	Revise to: "will add to the existing risks"	6. Agriculture		242	37	We added the suggested word.
U.S.	Environmental Protection Agency	Revise "climate extremes and changes" to "climate change and changes in extreme events"	6. Agriculture		243	30	We have revised the text to address this comment.
U.S.	Environmental Protecti	Please clarify if "shocks" means "price shocks"	6. Agriculture		243	41	We have modified the text to clarify that it is price shocks.

	on Agency						
U.S.	Environmental Protection Agency	This figure seems out of place at this particular location. If this figure is to be retained, it needs to be placed at a location relevant to the topic.	6. Agriculture	6.10	244		The figure, "Herbicide Loses Effectiveness at Higher CO2" is no longer in the chapter.
U.S.	Environmental Protection Agency	Revise to: "…weather events occurring during corn pollination. Recent studies suggest that, with increased average temperature, higher temperatures and drier conditions will amplify future drought severity and temperature extremes."	6. Agriculture		241	28	We modified the sentence to incorporate this suggestion.
U.S.	Environmental Protection Agency	"CO2 emitted by fossil fuel burning" - this wording does not appear to be consistent with the cited study for this statistic, which does not differentiate the sources of CO2 emissions. Our understanding is that the 13% is not specific to fossil fuel burning only. Please correct this sentence and the corresponding sentences throughout the chapter. Consider replacing with "anthropogenic CO2 emissions".	7. Forestry		263	20	The text has been revised to incorporate this suggestion. Numbers from the recent EPA 2013 report are used.
U.S.	Environmental Protection Agency	The wording here is misleading. It implies that the specific CO2 emitted by fossil fuel combustion is absorbed by forests. The appropriate phrasing is "U.S. forests currently absorb the equivalent of about 13% of all carbon dioxide (CO2) emitted by fossil fuel burning in the U.S."	7. Forestry		263	19	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Consider revising image- the small boxes in this figure are hard to see, hard to discern what the picture is showing	7. Forestry	7.1	265		The chapter focused on broad trends for the topic. We refer those interested in a deeper treatment of the disturbances across forests to the provided citations, Goetz et al. 2012.
U.S.	Environmental Protection Agency	Need to note that that rising average climate impacts make forests more susceptible to episodic disruptions.	7. Forestry		266	10	We appreciate this suggestion, but space is limited, and the author team believes this is exactly the point just made, citing Jentsch et al. 2007. We have also included a new figure to emphasize the focus on warmer temperatures and drought effects.
U.S.	Environmental Protection Agency	Editorial: Delete the words "with higher temperatures" (redundant)	7. Forestry		266	17	After consideration of this point, we still feel the existing text is clear and accurate.
U.S.	Environmental Protection Agency	Revise sentence to: "Trees die faster when higher temperatures accompany drought; thus even shorter droughts can trigger mortality." Consider clarifying whether higher temperatures mean baseline warming as opposed to episodic heat waves.	7. Forestry		266	32	The text has been revised to incorporate this suggestion to clarify the effect of short droughts under increasing temperatures. The cited study is insufficient to distinguish effects of short waves vs. changes in

							mean conditions so we have not made any changes in response to the second part of the comment.
U.S.	Environmental Protection Agency	Before discussing projections, consider discussing the observed increases in wildfire size and intensity that have already been occurring.	7. Forestry		266	38	We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information to include.
U.S.	Environmental Protection Agency	"...conditions for western forests and eastern forests." Does this mean all forests (western + eastern = all?) or are there some forests not included here?	7. Forestry		267	4	We have modified the text to incorporate this statement of increased productivity and clarify the associated caveat.
U.S.	Environmental Protection Agency	Revise to omit or explain the term mesic (jargon)	7. Forestry		267	16	We removed the term "mesic" and restated the point.
Kavita	Heyn	Need to caveat and highlight uncertainties around the projected increase in area burned in the region in this section. For example, Littell el al. (2010) claim that it is hard to construct a relationship between fire and climate in Western Cascade forests, so this uncertainty should be considered in this section. In their assessment of the effects of climate change on vegetation in Oregon, Shafer et al. (2010) caution that occurrence of future fires is driven by a combination of favorable climate, ignition sources and a mechanism for rapid fire spread (strong winds and topography) – factors that are strongly influenced by local conditions and that are not fully accounted for in many climate change projections.	21. Northwest		731	17	The text has been revised to incorporate this suggestion.
Kavita	Heyn	The prediction of the probability of a very large fire year increasing from 1 in 20 to 1 in 2 is presumably drawn from the modeling results presented in Table 1 in Littell et al. (2010)? Would be good to make this clear, given it's such a startling jump in probability. Also suggest explaining this conclusion in a little more detail, including how this factors into the variability in modeling predictions for ecological subregions within the Northwest region. E.g. - is this really the increase in probability throughout the Northwest, or just in specific subregions?	21. Northwest		731	23	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	"Rising disturbance rates can increase harvested wood output and potentially lower prices, particularly given that annual U.S. forest growth currently exceeds harvesting." This is not intuitive and needs explanation. How can higher disturbance rates lower prices for HW ouput, unless you mean salvage of the diseased/dead wood (so not timber quality wood)? if the latter, make that clear. otherwise, more disturbance (meaning higher mortality) would likely increase prices as supply for merchantable timber goes down. though most disturbance would likely occur in the west, largely public lands, where are no/few mills to use salvage/deadwood (eg, pest mortality currently seen in CO), see figure 71., 7.6, 7.7	7. Forestry		267	23	Thank you for your comment. The text has been revised extensively in this section. Due to the size of the topic, and the page limit of the chapter, we focused on broad trends rather than delving too deep or providing such a level of specificity as described here about where the harvest occurs, under what condition, etc.
Kavita	Heyn	This map is too coarse to illustrate projected increases in area burned for different areas of the Northwest region. For example, because the division of areas is based on Bailey's Ecoregions of the United States (Bailey 1995), the Oregon Cascades are classified as mountains with altitudinal zonation and appear as one division on the map with a projection of 400-500% increase in area burned. However, according to Littell et al. (2010) there are significant differences in the projected fire area burned between Western and Eastern Cascade forests. These subregional idiosyncrasies do not appear	21. Northwest	21.7	733		Littell et al. 2010 do suggest more finely resolved differences, but finer analysis projections for the whole region have not yet been published. However, we have more carefully described these responses as

		on the map, which may be misleading. Suggest improving map resolution or division of areas to more accurately illustrate the projected increase in area burned in different parts of the region.					"sensitivity" and indicated that ecoprovinces as shown here have "broad" commonality in vegetation and climate.
Kavita	Heyn	Bailey (1995) is cited in the caption for the Projected Increase in Area Burned map in Figure 21.7 but is not included in the References section. Suggest including in the References section on this page.	21. Northwest		748	1	The text has been revised to incorporate this suggestion.
Kavita	Heyn	If “changes in the risk of very large, high-intensity, stand-replacing fires cannot yet be predicted” then stating that the “probability of a very large fire year would increase from 1 in 20 to 1 in 2” (Page 731, Lines 23-24) is not entirely consistent with this statement. Suggest acknowledging the uncertainties around fire risk in the section.	21. Northwest		734	21	This comment conflates total area with severity, driven by two different time scales of phenomena. Have clarified the text in two places in the section.
U.S.	Environmental Protection Agency	Delete "thus output are likely to be lowered". Begin a new paragraph starting with "Western Forests could…" On line 28 delete the word "increased. On line 29 add the word "content" after the word "nutrient".	7. Forestry		267	26	The text has been revised. We deleted the suggested text and modified the following sentence as suggested.
Kavita	Heyn	While we understand that there is ‘very high’ confidence in the general direction of change around forest mortality in the region (an increase), there are enough studies that point out uncertainties in localized fire risk and modeling of projected area burned (Page 744 states that “statistical models may over-predict area burned”). Suggest reconsidering the ‘very high’ level of confidence that increased disturbance will increase forest mortality due to area burned by fire, given some of the subregional uncertainties highlighted in cited studies (for example Western Cascade versus Eastern Cascade forests).	21. Northwest		744		The text has been revised to clarify aspects of this suggestion, but we feel the confidence is accurate since an increase in area and total trees killed (mortality) is virtually certain in forests aggregated at the regional level.
U.S.	Environmental Protection Agency	See earlier comments for p. 263, l. 20: this wording does not appear to be consistent with the cited study for this statistic, which does not differentiate the sources of CO2 emissions. Consider replacing with "anthropogenic CO2 emissions".	7. Forestry		269	2	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Revise line 12 to "…projected case studies, growing season lengthened but the number of days…". Please clarify the time period over which snow day decreases and water stress increases occurred in the Rocky Mountain forests (time periods for baseline and for the stated impacts).	7. Forestry		269	12	The text has been revised to incorporate this suggestion. We added additional text to provide details on the changes.
U.S.	Environmental Protection Agency	This figure has a lot of information but is difficult to comprehend. Unless additional explanation is provided, this figure may be more confusing than informative. Suggest significant revision and explanation, replacement, or removal.	7. Forestry	7.3	270		This figure has been deleted from the text as it is currently in journal review, which will not meet NCA deadlines. We have replaced this figure with Figure 2.17 from Vose et al. 2012.
U.S.	Environmental Protection Agency	See earlier comments on p. 263, l. 20; 269, l. 2: this wording does not appear to be consistent with the cited study for this statistic, which does not differentiate the sources of CO2 emissions. Consider replacing with "anthropogenic CO2 emissions".	7. Forestry		271	3	The text has been revised to incorporate this suggestion.
U.S.	Environ	Revise title to be more descriptive, like: "Historic and projected changes in forest carbon sources and	7.	7.5	273		The figure has been revised to

	mental Protecti on Agency	sinks". In reference to the figure on the right, the carbon fluxes demonstrated in the latter half of the century shows forests as carbon sources rather than sinks. The annual flux numbers in the right panel do not seem to match up with the annual projected flux numbers for the same climate scenarios in chapter 10 of USFS 2012, the RPA 2010 report (stated source). Where are these numbers from in that report or how were they derived from that report? Please provide more explanation/reconciliation of these numbers. Also, is it possible to remove the decimal places to make this less cluttered/more readable?	Forestry				incorporate this suggestion. This figure has been revised per the published report; an erratum is being developed for the referenced report which should more closely match these updated figures.
U.S.	Environ mental Protecti on Agency	This section should be more balanced and objective regarding the advantages and disadvantages of using forest products for bioenergy. For example, after the cited "socioeconomic effects," the section should acknowledge that this practice may also lead to perverse incentives and management behavior, such as over thinning, unnecessary fuel treatments, etc.	7. Forestry		274	1	We have extensively rewritten this bioenergy section to make it more policy neutral.
U.S.	Environ mental Protecti on Agency	This discussion of higher carbon emissions from bioenergy is incomplete and therefore misleading, and must be revised. The debate is not merely due to modeling assumptions, time horizons, etc.; more importantly and fundamentally, it is about how to accurately account for the impacts of biomass utilization (i.e., not simply presuming all biomass is carbon neutral). This section should cite the findings of a recent peer review panel set up through EPA's Science Advisory Board to study exactly this issue. One of their main conclusions is that not all biomass can, a priori, be considered neutral (http://yosemite.epa.gov/sab/sabproduct.nsf/0/57B7A4F1987D7F7385257A87007977F6/$File/EPA-SAB-12-011-unsigned.pdf). A more nuanced and complete discussion is warranted here, particularly in light of the fact that on page 274, lines 18-20, this section highlights the importance of "regional context and circumstances, such as feedstock type and prior management, land conditions, transport and storage logistics, conversion processes used to produce energy, distribution, and use" in the context of forest-derived biomass, which all play a role in the emissions related to biomass production and use.	7. Forestry		274	25	Due to the size of the sector, and the page limit for the chapter, we focused on the broad trends rather than delving too deeply or providing for a detailed discussion about the complex issues involved in this debate about how best to calculate carbon emissions from bioenergy. Biomass utilization is certainly a part of the time accounting. We modified the text to mention that the debate revolves around assumptions in the policy analyses such as logistical challenges, energy conversion efficiencies, temporal horizons defined, and the life cycle domain defined.
U.S.	Environ mental Protecti on Agency	This language implicitly focuses on forest residues (not roundwood) from salvage/fuel treatments from disturbance. though most disturbance would likely occur in the west, largely public lands, where are no/few mills to use salvage/deadwood (eg, pest mortality currently seen in CO), as seen in Figures 7.1, 7.6, 7.7. A recent study submitted to the Journal of Forest Economics suggests that the use of residues (having more value than currently) could also lead to perverse incentives and management behavior, such as over thinning, not necessary fuel treatments, etc (though this hasn't been established definitively yet due to lack of market). If accepted for publication in time, consider citing: Latta, G.S., J.S. Baker, R.H. Beach, S.K. Rose, and B.A. McCarl. In Review. A multi-sector intertemporal optimization approach to assess the GHG implications of U.S. forest and agricultural biomass electricity expansion. Submitted to: Journal of Forest Economics.	7. Forestry		274	38	The authors of the NCA Report have written it based upon a variety of sources, all of which were assessed under Guidance on Information Quality Assurance to Chapter Authors of the National Climate Assessment: Question Tools (2/21/2012), which is used by the NCADAC to assure for each source used in the NCA Report: (1) utility, (2) transpaency and traceability, (3) objectivity, and (4) integrity and security. This suggested reference does not meet the publication criteria.
U.S.	Environ mental Protecti on Agency	"While this bioenergy market allows managers to eliminate wastes and conduct forest health, stand improvement, and climate adaptation operations, it has yet to be made a profitable enterprise in most U.S. regions." - to what does "this bioenergy market" refer? To the current market? To the market for supply from salvage efforts?	7. Forestry		274	38	The text has been revised to incorporate this suggestion. The present bioenergy market is now referenced.

U.S.	Environmental Protection Agency	Editorial: Check for consistency when using the term "forestland" here, rather than "forest" as in other parts of the chapter. Is there a difference? If so, please explain.	7. Forestry		276	6	We reworded the sentence.
U.S.	Environmental Protection Agency	Very little attention to the role of globalized markets. Although it is mentioned in the title, no analysis or text was provided on the subject.	7. Forestry		276	1	Due to the size of the sector, and the page limit for the chapter, we focused on broad trends rather than delving too deeply or providing such a level of specificity.
U.S.	Environmental Protection Agency	It is implied, but somewhere this paragraph should explicitly say how federal lands are not managed the same as private, i.e. less responsive to the market.	7. Forestry		276	32	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	This sentence is a confusing transition - starts paragraph with public and private, then goes to private land owners then to unspecified regulations that are required but inconsistent with changing conditions. Please clearly articulate the point. What regulations? What penalties are implied here? Are these actual legal penalties, or reductions in expected income?	7. Forestry		277	2	The text has been revised to incorporate this suggestion. The paragraph focuses on management options and what may constrain adaptive management.
U.S.	Environmental Protection Agency	Consider adding information on forestland soils.	7. Forestry				We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information to include.
U.S.	Environmental Protection Agency	Traceable Account for Finding 2. In the text on assessment of confidence based on evidence, it is mentioned that there is pressure on forestland to be converted to ag land. This was not discussed in the text (all text on conversion focused on transitions to urban uses). This omission should be rectified.	7. Forestry				The section on "Forest Carbon Sequestration and Carbon Management" reflects the statement found in the Traceable Account. We have also added text in other sections of the chapter that relates to this topic.
U.S.	Environmental Protection Agency	Traceable Accounts, Key Message 3: In the text on description of evidence base, the argument seems one-sided and should be modified given that there is still ongoing scientific debate (i.e., no consensus) in the literature that fuel treatments (and forest biomass removal) reduce emissions (from fires, etc).	7. Forestry				After consideration of this point, we still feel that the existing text is clear and accurate. In the Carbon management section, we cite Vose et al 2012 to say that forest management assists in possibly avoiding future emissions.
U.S.	Environmental Protection Agency	Traceable Accounts, Key Message 3: The text in New Information and Remaining Uncertainties brings up the debate on carbon neutrality, avoided in the main text, but still dismisses it as simply an argument about modeling etc. See previous comment on page 274, lines 25-27. Strongly suggest revision.	7. Forestry				The text in the chapter was revised slightly to incorporate this suggestion to expand the issues related to this discussion. However due to the size of the sector, and the page limit for the chapter, we focused on the broad trends rather than delving too deeply

							or providing for a detailed discussion about the complex issues involved in this debate on how best to calculate carbon emissions from bioenergy.
U.S.	Environmental Protection Agency	Traceable Accounts, Key Message 3: In the text in Assessment of Confidence Based on Evidence: how does growth outstripping harvest serve as evidence for helping to finance salvage and reclamation? Is there high confidence in the formation of viable markets in this area, and if so, based upon what evidence? Numerous studies (even USFS 2012) show that the US may turn into a sink in the near future. On page 274, lines 18-20, this document highlights the importance of "regional context and circumstances, such as feedstock type and prior management, land conditions, transport and storage logistics, conversion processes used to produce energy, distribution, and use" in the context of forest-dervied biomass, which all play a role in the environmental impacts (including net GHG emissions) related to biomass production and use. Are these issues considered when stating there is "high confidence" that these markets will develop?	7. Forestry				After consideration of this point, we still feel the text is clear. The high confidence is based on an assumption that policy and economic energy valuations will make it competitive with fossil fuels. The development of markets is strongly tied to that assumption.
U.S.	Environmental Protection Agency	The new reports from the USDA should be cited and added to references.	7. Forestry		283	1	The text has been revised to incorporate this suggestion. The reports were cited in this chapter however the citation in the reference section was incorrect. This has been revised.
U.S.	Environmental Protection Agency	"As new climate adaptation plans are formed, further expansion of the U.S. urban landscape into suburban and exurban spaces is expected." Is this meant to imply that climate adaptation planning would result in expansion of urban areas? Or does it mean that, at the same time as climate adaptation plans are formed, further expansion will occur? If it is the former, please provide more explanation and scientific support for this statement. If the latter, please clarify.	11. Urban Systems, Infrastructure, and Vulnerability		420	39	Thank you for your suggestion. Based on your comment, edits have been made.
U.S.	Environmental Protection Agency	This chapter is missing a logical and important connection to the discussion in Chapter 25 on the social vulnerability of coastal communities, given that many of the largest U.S. cities are located along the coasts. It would be helpful to add a sentence like the following, perhaps after the sentence on exposure ["The vulnerability of different urban populations to hazards and risks associated with climate change depends on three characteristics: their exposure to particular stressors, their sensitivity to impacts, and their ability to adapt to changing conditions..."] - "For example, many major U.S. metropolitan areas are located on or near the coast and face higher exposure to particular climate impacts like sea level rise and storm surge (see Chapter 26: Coastal Zone, Development, and Ecosystems)."	11. Urban Systems, Infrastructure, and Vulnerability				Thank you for your suggestion. Based on your comment, edits have been made.
U.S.	Environmental Protection Agency	"Climate change increases the frequency and intensity of extreme events like extremes of heat, heavy downpours, flooding from intense precipitation and storm surges, and disease incidence from temperature and precipitation changes." - This sentence is out of place here and should be used earlier in the section to set the context for how climate change will threaten the well-being of urban residents. Suggest moving to page 420 after lines 13-15: "Direct and interacting effects of climate change will expose people who live in cities across the U.S. to multiple threats" because it answers the question, what are these multiple threats?	11. Urban Systems, Infrastructure, and Vulnerability		421	13	Thank you for your suggestion. Based on your comment, edits have been made.
U.S.	Environmental	The chapter should point out the significant variety across urban settings and conditions. It would be helpful to note that climate change impacts on urban infrastructure (water, transportation, electricity	11. Urban				Thank you for your suggestion. After consideration of this point, we feel

	Protection Agency	supply, etc.) are distinct between acute meteorological events and climate change impacts, among urban areas of different geographic locations, hydroclimatic settings, urban forms, and urban history. Some in-depth discussion may better serve the purpose. The trends in urban adaptation discussion is rather sketchy.	Systems, Infrastructure, and Vulnerability				that the existing text addresses your comment.
Luisa	Cristini	I would add not the RAPIDLY changing one	1. Executive Summary		3	13	It is not clear what section this comment refers to.
Luisa	Cristini	Please add value in degrees centigrade. Also later in the chapter.	1. Executive Summary		3	21	Because this is a US National Assessment the authors have chosen to use the official US metrics for temperature throughout.
Luisa	Cristini	Please add ocean after Arctic	1. Executive Summary		4	17	The intent is to refer to both the Arctic ocean and the land surface, so there is no need to add the word ocean.
Luisa	Cristini	I would use CONVERTING rather than maintaining.	1. Executive Summary		5	19	A change in this language has been made.
Luisa	Cristini	Please delete AND CLIMATE before events	1. Executive Summary		8	9	The authors are comfortable with the existing language.
Luisa	Cristini	I would change populations with groups	1. Executive Summary		8	28	This text now appears in a different section (Context and Background) and has been modified.
Luisa	Cristini	How is climate change affecting mental health?	1. Executive Summary		8	36	There are a variety of ways that climate affects mental health, described in the literature and within the health chapter . Language is modified to provide an example.
Luisa	Cristini	Please include US-affiliated pacific Islands (USAPI) in the same box as Hawaii.	1. Executive Summary	1.1	11		The change has been made.
Luisa	Cristini	I would use "challenge of climate change" rather than "climate challenge".	1. Executive Summary		16	26	Language has been modified.
Luisa	Cristini	Acronyms should be explained at least once.	1. Executive Summary	1.1	20		Acronyms have been defined in the caption.
U.S.	Environmental Protection Agency	For clarity, suggest rephrasing this sentence clause as follows "Although we interact with ecosystems and ecosystem services every day…"	8. Ecosystems, Biodiversity, and		292	1	Changed as suggested.

			Ecosystem Services				
U.S.	Environmental Protection Agency	To paraphrase, this sentence says that a better understanding of how every climate change impact matters to people may help us deal with climate change. This is very vague and not well articulated; plus, the term "matters" is a poor choice of word as it connotes subjectivity, and the notion that we might be able to understand "everything" is not realistic. This sentence should be more directly framed in terms of a process, for example: 1. a better understanding of CC impacts on biodiversity and ecosystem services will 2. help us to better manage ecosystems in a way that promotes resilience to climate change. However, the uncertainty in our ability to understand and forecast the magnitude of CC impacts should be noted, especially in the context of being able to manage for them.	8. Ecosystems, Biodiversity, and Ecosystem Services		292	11	Thank you for your suggestion. Edits have been made to improve clarity.
U.S.	Environmental Protection Agency	This section's description of freshwater use in the U.S. is not entirely consistent with a similar section in Chpt 3 (Water Resources, page 118, lines 20-29). Different numbers and studies are described (see pasted Chpt 3 excerpt below). It would be ideal for these two sections to describe the same findings. Ch 3, p. 118, 20-29 "At the national level, total freshwater withdrawals (including both water that is withdrawn and eventually consumed and amounts that return to the original surface or groundwater source) and consumptive uses have leveled off since 1980 at 350 and 100 billion gallons per day respectively, despite the addition of 68 million people from 1980 to 2005 (Kenny et al. 2009). Irrigation and all electric power plant cooling withdrawals currently account for approximately 77% of total withdrawals, municipal and industrial for 20%, and livestock and aquaculture for 3%. Most thermoelectric withdrawals are returned back to rivers after cooling, while most irrigation withdrawals are used up by the processes of evapotranspiration and plant growth. Thus, consumptive water use is dominated by irrigation (81%) followed distantly by municipal 28 and industrial (8%) and the remaining water uses (5%)."	8. Ecosystems, Biodiversity, and Ecosystem Services		292	17	No change. The chapters are not inconsistent; they are just different. Our presentation is much more general and simplified. It is appropriate for the water chapter to have a more detailed presentation.
U.S.	Environmental Protection Agency	This paragraph references water storage and snow pack, but does not directly connect the two. Decreased snow pack is mentioned, but another equally important issue is the loss of water storage services provided by the snowpack as a result of early snowmelt. For example, high elevation snowpack in the California Sierra Nevada provides the rich agricultural landscape of the Central Valley with a critical water supply into the summer months. Under climate change, this snowpack is anticipated to melt earlier such that there is a loss of water storage for these important agricultural areas (in addition to possible flooding as a result of early melt-out).	8. Ecosystems, Biodiversity, and Ecosystem Services		292	20	Thank you for your suggestion. Edits have been made to improve clarity.
U.S.	Environmental Protection Agency	This paragraph references projected habitat loss to support the statement of local extinctions--this makes sense but I suggest adding "habitat loss and" to the sentence: Habitat loss and "local extinctions of fish and other…" In addition, this entire paragraph might be better suited to go under the plants & animals section, like page 297 line 20 with the discussion of trout.	8. Ecosystems, Biodiversity, and Ecosystem Services		292	29	Text changed as suggested, but the paragraph has not been moved as suggested. The focus here is on ecosystem-scale effects.
U.S.	Environmental Protection	[This comment also applies to page 197, line 19] As a complement to the Wenger et al. 2011 findings, Jones et al. 2012 analyzed a broader set of fish guild impacts from climate change for the entire lower 48, not just the interior West (Jones et al. also used SRES scenarios and multiple GCMs). Given the purpose of the NCA, these broader findings would provide richer sources of projected impacts. Jones,	8. Ecosystems, Biodivers		292	30	No change. While the comment suggests a good specific example, the authors feel the existing examples are appropriate.

	Agency	R., C. Travers, C. Rodgers, B. Lazar, E. English, J. Lipton, J. Vogel, K. Strzepek, J. Martinich (2012). Climate Change Impacts on Freshwater Recreational Fishing in the United States. Mitigation and Adaptation Strategies for Global Change, http://link.springer.com/article/10.1007/s11027-012-9385-3	ity, and Ecosystem Services				
U.S.	Environmental Protection Agency	These two paragraphs go into much detail on the effects of aquatic pollution but there is no tie to climate change. I suggest deleting these paragraphs unless a clear link to climate change can be made and supported. The following paragraph (lines 17-29) discusses DOC vis-a-vis climate change and is a stand alone paragraph in that sense. However, if it is supposed to add support to the preceding two paragraphs, it does not. The last paragraph on page 293 discusses increased precipitation (under climate change) which will increase pollution to rivers and coastal waters, but this paragraph does not need the 2 paragraphs recommended for deletion to support this.	8. Ecosystems, Biodiversity, and Ecosystem Services		292	34	No change. Both paragraphs start with a climate change link with precipitation as a driver of discharge, which is the driver of pollution.
U.S.	Environmental Protection Agency	This paragraph discusses the impact of more precipitation on the Gulf of Mexico's dead zone. However, it is never stated (nor supported with references) whether or not this region is expected to experience more precipitation. The reader assumes that it is, but it needs to be made clear. Also, it is unclear how agricultural practices can affect the dead zone under a climate change scenario of increased precipitation. It is hinted that if ag practices were to decrease N application in the Mississippi basin then increased precipitation might have a beneficial effect in reducing the area of the dead zone because the pollution would be more diluted. Is this correct? Even if so, doesn't N have a very long residence time in the soils within the watershed such that N inputs to the river will continue despite reductions in agricultural N application?	8. Ecosystems, Biodiversity, and Ecosystem Services		293	30	This paragraph has been revised in response to comment #42481 to address the importance of fertilizer use and its interaction with precipitation. The paragraph does state the precipitation is expected to increase in the Midwest.
U.S.	Environmental Protection Agency	The paragraph preceding this one discussed anoxic conditions following water pollution and concomitant algae blooms. Can't the increased air temperatures also cause dead zones of anoxic conditions that are associated with the decay of organic matter following algae blooms? This could be better described, specifically in lines 8-9, to support how these blooms can "exact a cost."	8. Ecosystems, Biodiversity, and Ecosystem Services		294	3	We don't have space to go into the detailed mechanisms of how dead zones form. Our point here is to establish the link between changes in precipitation, discharge, nutrient inputs, and eutrophication.
U.S.	Environmental Protection Agency	With the except of Box 2 (which is great!), this chapter seems to be lacking in good graphics that help describe the vulnerability of ecosystems to climate change. Figure 8.1 (Water Supplies Projected to Decline) has little to do with ecosystem impacts at all, and should be replaced with something more relevant to the content of the chapter. Similarly Figure 8.2 describing the amount of surface chlorophyll in North Carolina estuaries following hurricane events is not particularly interesting for the reader.	8. Ecosystems, Biodiversity, and Ecosystem Services				No change. We feel the graphics we have usefully support the main points that we are making.
U.S.	Environmental Protection Agency	Figure 8.2. For such a summary review document on the effects of climate change, a better and more convincing set of graphs might come from a meta-analysis or other type of published review that includes an analysis of these metrics following many hurricanes, not just one or a series of closely timed hurricanes. That said, the caption does not tie hurricanes to climate change. A connection must be made here demonstrating what the connection between hurricanes and climate change is--for example: are these hurricanes caused by climate change? Are the salinity and algae effects worse because of climate change? Are the ecosystems not able to buffer against the effects of climate change but there is no effect on the hurricane itself? Furthermore, the caption to this figure should restate that increased algae blooms can lead to dead zones after the water goes anoxic during the decay of the	8. Ecosystems, Biodiversity, and Ecosystem Services	8.2	295		The point of this figure is to emphasize the links between precipitation, discharge and nutrient loading to coastal waters, not to talk about the links between climate change and hurricanes. The caption has been edited to make the link between increased algae blooms and dead zones.

		algae. Otherwise, it is not clear what is the problem with increased algae (or chlorophyll), similarly with increased salinity. This last point is especially important because none of the figures are referenced in the text, as such they should be stand-alone pieces of information.					
U.S.	Environmental Protection Agency	This sentence is unclear, especially how the latter half, "on the movements of materials and flow of energy" relates to the first half.	8. Ecosystems, Biodiversity, and Ecosystem Services		295	20	The sentence has been edited to clarify its meaning.
U.S.	Environmental Protection Agency	Throughout this paragraph, suggest framing this in terms of impacts on ecosystem services from climate change. For example, suggested changes to this sentence are underlined: "forests, and barrier islands provide an ecosystem service of defending coastal ecosystems and infrastructure against storm surges. Losses of these ecosystems and their ecosystem services..."	8. Ecosystems, Biodiversity, and Ecosystem Services		296	2	Changed as suggested.
U.S.	Environmental Protection Agency	"coastal development, erosion, and sea level rise" - This sentence mixes non-climate change and climate change impacts without distinguishing which is which. Suggest that these distinctions be made clear. And if these impacts interact, then that should be stated too.	8. Ecosystems, Biodiversity, and Ecosystem Services		296	3	No change. The focus here is not the impact of climate change on coastal habitats, rather it is the effect of the loss of coastal habitats on the vulnerability of coastal ecosystems and infrastructure.
U.S.	Environmental Protection Agency	This fire damage statistic does not distinguish between climate change related damages and non-climate change related damages. From a climate change perspective, this statistic is not very meaningful unless it can be shown relative to previous years (e.g., as a time series) or if just the "mega-fire" climate change damages can be reported. However, there is a confounding issue of increased development in the wildlife-urban interface such that each fire is more likely to have increased damages to human life and property.If the intent here is to indicate the potential for future damages by illustrating the current magnitude of losses, that needs to be made clear, with appropriate caveats and limitations.	8. Ecosystems, Biodiversity, and Ecosystem Services		296	18	No change. The dollar values are useful, even without historical context. And the importance of "some forest management" practices as a contributing factor other than climate has been mention in response to comment #5901.
U.S.	Environmental Protection Agency	This is presented in terms of changes that will render landscapes unrecognizable by humans; however, and in part related to recognizability, changes in ecosystem function as a result of changes in species assemblages and ranges should also be emphasized as important aspects.	8. Ecosystems, Biodiversity, and Ecosystem Services		296	21	No change. Changes in specific ecosystem functions a result of changes in species assemblages are discussed elsewhere in the chapter.
U.S.	Environmental Protecti	Clarify the time period over which landscapes will become "almost unrecognizable"	8. Ecosystems,		296	21	No Change. This is such a general statement that it is impossible to put a time period that would apply to the

	on Agency		Biodiversity, and Ecosystem Services				full range of ecosystems mentioned.
U.S.	Environmental Protection Agency	Only flora is mentioned here, but much work has also looked at faunal distribution shifts and assemblages. This should be broadened to include fauna.	8. Ecosystems, Biodiversity, and Ecosystem Services		296	24	Thank you for your comment. Within chapter length contraints, this topic is discussed, to the extent possible, in the chapter section titled, "Plants and Animals".
U.S.	Environmental Protection Agency	This fire section does not relate back to species distribution shifts. This section should be moved to previous section discussing extreme climate events, including fire.	8. Ecosystems, Biodiversity, and Ecosystem Services		296	32	No change. In the extreme events section the focus is on really big (extreme) fires. Here the focus is on more "normal" fires, or the introduction of fire to places that have not had fires before.
U.S.	Environmental Protection Agency	Suggest a different term than "species assemblages." This is an instance of jargon that could be rephrased for clarity	8. Ecosystems, Biodiversity, and Ecosystem Services		296	39	No change. The authors and, especially, the NCA staff have worked hard to make the language accessible to the largest possible group of readers.
U.S.	Environmental Protection Agency	This discussion does not clearly identify the climate-related driver for the described shifts in habitat. Many of these, if not all, are likely driven by changes in temperature (but could also include changes in precipitation). Please note the drivers for these shifts where possible.	8. Ecosystems, Biodiversity, and Ecosystem Services		296	39	No change. There are too many specific examples to add a driver for each. It is better to be more general about the driver.
U.S.	Environmental Protection Agency	Needs citation(s)	8. Ecosystems, Biodiversity, and Ecosystem Services		296	40	Changed as suggested.
U.S.	Environ	Needs citation(s)	8.		297	1	No change. Multiple references are

	mental Protecti on Agency		Ecosyste ms, Biodivers ity, and Ecosyste m Services				provided in the following sentence.
U.S.	Environ mental Protecti on Agency	Reasons why species may not be able to keep pace with climate change are more complex than just the two reasons listed. Species interactions, whether those that have evolved over time prior to climate change, or novel interactions under changing climate, also may determine a species success or failure in responding or adapting to climate change. For example, even mobile species (e.g., birds, butterflies, mammals, etc) may not be able to keep pace if their host plants, food sources, etc are not able to "keep pace." Alternatively, a species may face a new competitor, predator, or pathogen that it has no evolutionary experience with and is thus displaced or otherwise unable to adapt to the novel interaction. There are a myriad of complex scenarios involving species interactions that we cannot predict or project.	8. Ecosyste ms, Biodivers ity, and Ecosyste m Services		297	2	The sentence has been edited to clarifiy that these are not the only two reasons why species may not be able to keep pace with climate change.
U.S.	Environ mental Protecti on Agency	This paragraph states that these are "obvious" and "visible" changes. Perhaps "measurable" and "quantifiable" would be more accurate. If one were to go to these sites of change, would they notice the difference? Probably not unless they had data collected prior to climate change. What is the magnitude of these biome boundary shifts? What is the implication of these shifts from a human or biodiversity or ecosystem service perspective?	8. Ecosyste ms, Biodivers ity, and Ecosyste m Services		297	8	No change. The authors and, especially, the NCA staff have worked hard to make the language accessible to the largest possible group of readers.
U.S.	Environ mental Protecti on Agency	Page 292, line 29 states 47% decline, here it is a 48% decline in trout habitat loss. Need to ensure consistency between the two instances.	8. Ecosyste ms, Biodivers ity, and Ecosyste m Services		297	20	Fixed as suggested. It's 47%.
U.S.	Environ mental Protecti on Agency	"Bark beetle outbreaks in the Greater Yellowstone Ecosystem are outside the historic range of variability" - presume "outside the historic range of variability" represents an increase. In number? range? severity? Needs clarification.	8. Ecosyste ms, Biodivers ity, and Ecosyste m Services		298	2	The text has been edited to clarify that outbreaks are occurring in habitats where outbreaks either did not previously occur or were limited in scale.
U.S.	Environ mental Protecti on Agency	Please correct the sentence, "Phenology has been called a globally coherent fingerprint of climate change impacts." It is not phenology that has been called this, but the effect of climate change on the directional patterns of species' life history phenologies.	8. Ecosyste ms, Biodivers ity, and Ecosyste		298	8	Changed as suggested.

			m Services				
U.S.	Environmental Protection Agency	The content is good, but the "example" should not be called an example of changed migration timing, instead it is demonstrating an adverse effect of changes in migration timing.	8. Ecosystems, Biodiversity, and Ecosystem Services		298	36	The phrase "for example" has been removed.
U.S.	Environmental Protection Agency	Editorial: This should be in its own paragraph; it is not bird related.	8. Ecosystems, Biodiversity, and Ecosystem Services		298	41	Changed as suggested.
U.S.	Environmental Protection Agency	This needs some clarification. The sentence could be read as implying that climate change, not simply change, is an inherent property of natural systems. At a minimum, there is no indication that climate change is any different than the "inherent" changes ecosystems have adapted to in the past. Additionally, this phrasing could also imply that altered ecosystems are not subject to change (whether climate-driven or otherwise). Both natural and altered ecosystems need to be considered.	8. Ecosystems, Biodiversity, and Ecosystem Services		299	8	No change. The sentence is not talking about climate change and is making a simple statement that "change is an inherent property of natural ecosystems."
U.S.	Environmental Protection Agency	Needs citation(s)	8. Ecosystems, Biodiversity, and Ecosystem Services		299	10	Citation added.
U.S.	Environmental Protection Agency	"forward-thinking" is a vague, potentially loaded term. Needs clarification or consider a different descriptor; 'proactive', 'visionary' or 'creative' are alternatives.	8. Ecosystems, Biodiversity, and Ecosystem Services		299	15	"forward-thinking" has been deleted.
U.S.	Environmental Protection	This wildlife corridors example needs elaboration in general and an explanation of how it is related to climate change. Will corridors assist migration for niche-tracking species or is this to increase existing connectivity between habitat patches, or something else?	8. Ecosystems, Biodivers		299	25	The text has been edited to clarify that wildlife corridors are used to connect fragments of wildlife habitat.

	Agency		ity, and Ecosystem Services				
U.S.	Environmental Protection Agency	Does the third strategy deal with restoration? This needs clarification, a general audience will not understand as it is currently written.	8. Ecosystems, Biodiversity, and Ecosystem Services		300	8	The text has been edited to clarify its meaning.
U.S.	Environmental Protection Agency	Each strategy needs citation(s).	8. Ecosystems, Biodiversity, and Ecosystem Services		300	7	No change. A citation is provided for each strategy at the end of the sentence.
U.S.	Environmental Protection Agency	Why is this an alternative approach to the previous 5 strategies? Couldn't this strategy be in addition to the others rather than an alternative?	8. Ecosystems, Biodiversity, and Ecosystem Services		300	13	"alternative" has been changed to "additional"
U.S.	Environmental Protection Agency	The "stage" should include biological properties as well as physical properties; thus, change "physical" to "biophysical"	8. Ecosystems, Biodiversity, and Ecosystem Services		300	15	Changed as suggested.
U.S.	Environmental Protection Agency	This point should be emphasized by giving the reader a sense of the vastness of forest affected (killed) by bark beetles.	8. Ecosystems, Biodiversity, and Ecosystem Services		301	14	No change. This is covered earlier in the chapter and elsewhere in the assessment.
U.S.	Environmental	Please state the climate change link that has caused or is correlated with this finding.	8. Ecosyste		302	8	Added additional information to Box text on climate driver causing this

	Protection Agency		ms, Biodiversity, and Ecosystem Services				change.
U.S.	Environmental Protection Agency	Is this shift in line with what would be predicted under climate change? Are they flowering earlier?	8. Ecosystems, Biodiversity, and Ecosystem Services		303	21	This is an observed study not a projected study; box text description of example has been modified to clarify shift and satisfy this question.
U.S.	Environmental Protection Agency	Unclear if this variation is due to climate change	8. Ecosystems, Biodiversity, and Ecosystem Services		303	23	This study evaluated trends in Bison weight changes, interannual variation in precipiation patterns, and grass (grazing) biomass production. The study revealed underlying relationship between climate variability and trophic dynamics. Text in Box has been modified to better communicate climate change influence.
U.S.	Environmental Protection Agency	Does this environmental variation include climate change? Can the extent of the climate influence be stated?	8. Ecosystems, Biodiversity, and Ecosystem Services		303	26	Text in Box was revised to be more clear on the influence of climate change.
U.S.	Environmental Protection Agency	Please provide citation(s) for statement that dry cooling and solar PV are being deployed because of water availability concerns.	10. Water, Energy, and Land use		388	23	The text has been edited for clarity.
U.S.	Environmental Protection Agency	Other industries and municipalities are also involved in this competition for water rights, and interstate and international commitments can also add to constraints on water availability. These should be noted in addition to energy and agriculture as critical stakeholders.	10. Water, Energy, and Land use		389	29	The text has been amended to note additional key water users.
U.S.	Environmental Protection Agency	"Texans, for example, experienced the hottest and driest summer on record." As stated, this can easily be perceived as saying the hottest and driest regardless of location. Presume this refers to the hottest and driest for Texas. Please clarify.	10. Water, Energy, and Land use		389	36	This is meant to refer to the hottest and driest Texas summer on record. After consideration of this comment, we think the existing text is clear and accurate.

U.S.	Environmental Protection Agency	Suggest revising the caption for Fig. 10.1 to clarify relevance to water, energy, and land. As presented here, this more properly belongs in Chs. 2, 19, or 20.	10. Water, Energy, and Land use	10.1	390		The caption has been edited to explain the purpose of the figure.
U.S.	Environmental Protection Agency	Suggest revising the caption for Fig. 10.2 to clarify relevance to water, energy, and land. As presented here, this more properly belongs in Chs. 2, 3, 19, or 20.	10. Water, Energy, and Land use	10.2	391		The caption has been edited to provide more information. The supporting text for this Key Message has also been significantly revised. We think the purpose of the figure is now clear.
U.S.	Environmental Protection Agency	Clarify what is meant by the statement that climate change is projected to "affect surface and groundwater supplies". Presume that the intent is to convey that these will be affected adversely, but it is not specified.	10. Water, Energy, and Land use		402	10	During the course of revisions, this text was removed. We have attempted to be clear throughout the chapter about the type of impacts expected.
U.S.	Environmental Protection Agency	Provide citation(s)	10. Water, Energy, and Land use		402	26	We have added citations as suggested.
U.S.	Environmental Protection Agency	Delete "and diesel fuel". If you're talking about corn (as stated on the next phrase), the primary fuel is ethanol, not diesel. In addition, the vast majority of the biofuel in the U.S. is ethanol, not diesel.	10. Water, Energy, and Land use		403	30	After consideration of this point, we still feel the existing text is clear. Ethanol is the primary fuel, but biodiesel is also a component.
U.S.	Environmental Protection Agency	This statement is somewhat misleading because ethanol production also produces large amounts of co-products, such as distillers dried grains, that are used as animal feed. Accordingly, these acres in reality produce both ethanol and animal feed.	10. Water, Energy, and Land use		403	41	After consideration of this point, we still feel the existing text is clear. The author team had extensive discussions about exactly how to frame this issue in a clear way.
U.S.	Environmental Protection Agency	Editorial: This transition is awkward - there is a jump directly from acres of cropland to commodity prices with no connection.	10. Water, Energy, and Land use		403	42	The biofuels section has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Editorial: The phrase "that is more rapid than" could be clarified, or given the preceding phrasing, removed. The concept that biofuel production is rising more rapidly than agricultural growth should perhaps be addressed separately from the remaining factors. Please rephrase.	10. Water, Energy, and Land use		404	1	We appreciate the suggestion. In the course of revisions, this section and some of the detailed examples were shortened. The author team deliberated and selected the most important issues to include.
U.S.	Environmental Protecti	Editorial: This transition is also awkward, jumping from crop prices to environmental benefits.Suggest starting a new paragraph at "Biofuels have the potential..."	10. Water, Energy,		404	7	The text has been revised to clarify.

	on Agency		and Land use				
U.S.	Environmental Protection Agency	Delete the modifier "very" in "...is very close to its RFS2 target level..." for accuracy.	10. Water, Energy, and Land use		404	18	We appreciate the suggestion. In the course of revisions, this section and some of the detailed examples were shortened. The author team deliberated and selected the most important issues to include.
U.S.	Environmental Protection Agency	Delete "entire plant rather than just the". It is adequate to say "biofuels derived from the non-food portions of plants". Additionally, some cellulosic fuels, such as corn stover, do not derive from the entire plant since the corn grain would have been removed, but are targetted as cellulosic fuels.	10. Water, Energy, and Land use		404	20	After considering this suggestion, the authors still feel that the existing language is clear and accurate.
U.S.	Environmental Protection Agency	There was in fact a small amount of cellulosic biofuel production in 2012. Please delete the phrase: "No commercially viable refineries currently exist for cellulosic biofuel production (though several commercial refineries are in development in the U.S.), and", and replace it with: "Cellulosic biofuels have not yet been produced in large volumes in the United States, though small volumes have been produced at numerous small research and development facilities and pilot plants. In 2012 the first cellulosic RINs (credits used to track renewable fuel production under the EPA's Renewable Fuel Standard) were generated. There are currently two small commercial cellulosic biofuel facilities in the United States that are structurally complete and in start-up mode, and several additional facilities are expected to complete construction in the next two years."	10. Water, Energy, and Land use		404	21	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Suggest revising this section accordingly (adding the underlined text): While the estimated cost of producing cellulosic ethanol is currently higher than the cost of corn ethanol production (NRC 2011), these costs are expected to continue to decline in future years. Cellulosic feedstocks necessary to meet the aggressive RFS2 target of 16 billion gallons annually could require up to an additional 30 to 60 million acres of land (NRC 2011) or alternatively be sourced entirely from currently unused agricultural residues, MSW, and other wastes.	10. Water, Energy, and Land use		404	23	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	The chapter would significantly benefit from a hard look at its intended goal. There is substantial good and relevant information regarding energy, but the connections to land and water are spotty. The discussion of biofuels on pp. 403 and 404, for instance, provide strong information on the advantages and disadvantages of biofuels, but the connections to land and water could be much stronger. There is also very little discussion about the energy requirements for water supply and treatment, and approaches to reduce energy (and GHG emissions) associated with clean water supplies.	10. Water, Energy, and Land use				We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include. The text has been amended to provide additional information on the connections between energy and water and land. It has been explained that the Energy sector provides a useful way to view the interactions between the three sectors.
U.S.	Environmental Protection Agency	The first two sentences of this chapter seem contradictory (influence health in "many" ways; "some" threats will intensify). Perhaps replacing "many" with "numerous" would reduce the sense of contradiction in these first two sentences. Please revise for clarity.	9. Human Health		334	1	The text has been revised to incorporate this suggestion. The authors have replaced "many" with "numerous."
U.S.	Environ	This sentence is very misleading- it makes it sound like US impacts will only occur if/when there are	9.		334	7	The text has been revised to

	mental Protecti on Agency	disruptions elsewhere. The sentence could be changed to read: "Public health in the US can be affected by disruptions of physical, biological, and ecological systems, both domestic and foreign [or 'both at home and elsewhere/abroad' or 'locally and in other nations' etc].	Human Health				incorporate this suggestion. The authors reworded the text to clarify that the sentence refers to disruptions both originating in the U.S. and elsewhere.
U.S.	Environ mental Protecti on Agency	Edit sentence to: "Key climatological drivers of health impacts include: increasingly frequent, intense, and longer-lasting extreme heat, which worsens drought, wildfire, and air pollution risks;…"	9. Human Health		334	9	The text has been revised to incorporate this suggestion.
U.S.	Environ mental Protecti on Agency	Consider adding "current level of health" or "healthiness" or "existing health concerns" to the list of vulnerability attributes of people.	9. Human Health		334	14	We agree with your suggestion and have added "current level of health" as an example of an attribute of people vulnerable to health impacts related to climatic change.
U.S.	Environ mental Protecti on Agency	This needs to be clarified for a lay-person reading level- explain what 1-10ppb is and whether it is significant amount. Revise to something like: "Summertime ground-level ozone pollution (smog), which can cause or aggravate respiratory illnesses, is projected to significantly worsen due to climate change" or "Climate change is projected to worsen air pollution, significantly increasing the concentration of pollutants like ground-level ozone that affect respiratory health"	9. Human Health		334	22	We agree that providing a reference on what are significant increases in concentration levels of ground-level ozone would be helpful. A definition of ozone will be included in globalchange.gov.
U.S.	Environ mental Protecti on Agency	There needs to be some mention of the uncertainty associated with projected PM2.5 levels due to a changing climate. Jacob and Winner (2009) summarized the climate/AQ models that had looked at climate change impacts on surface PM2.5 and concluded that the range of results included increases and decreases. The first draft IPCC WG1 5th assessment also pointed out that the signal of climate impacts on PM pollution is model-dependent with precipitation projections being key. One sentence mentioning the relatively low confidence in PM projections, or at least highlighting the uncertainty w/ the response of PM, would be more consistent with the latest aggregate research.	9. Human Health		334	22	We have revised the text to address uncertainty in the responses of different airborne particles to climate change.
U.S.	Environ mental Protecti on Agency	1000 premature deaths per 1.8 degree rise in global temperature, or in US temperature?	9. Human Health		334	27	Thank you for your question. The text has been revised to clarify.
U.S.	Environ mental Protecti on Agency	"could occur" doesn't imply cause/effect- can this be restated such that "Current estimates suggest that a 1.8F rise in temperature could cause 1000 premature deaths each year due to worsened ozone and particle pollution" (this is also the first mention of particulate air pollution, and the discussion doesn't say anywhere that climate change will impact particulate matter).	9. Human Health		334	28	The text has been revised to incorporate this suggestion. The sentence in question was revised, deleting "could occur". In addition, an introductory sentence was added to this section to mention particulate matter.
U.S.	Environ mental Protecti on Agency	Clarify whether the $65 billion is nationwide annually or for a specific year or if it is some culumative total.	9. Human Health		334	32	The $6.5 billion nationwide health-related cost is based on an assessment of health impacts in the U.S. during 2000 to 2002, resulting from ozone levels that exceed national standards. The $6.5 billion is expressed in 2008

							U.S. dollars. The text has been revised to incorporate this clarification.
U.S.	Environmental Protection Agency	Clarify what "Simultaneous" is in reference to. Revise, if appropriate, to something like: "Simultaneous exposure to MULTIPLE air pollutants" or "Simultaneous exposure to allergens and other air pollutants…"	9. Human Health		335	17	We changed the text to “simultaneous exposure to toxic air pollutants” to distinguish from pollens.
U.S.	Environmental Protection Agency	There are too many figures (4) on ragweed pollen. Given the limited pages available for each chapter, more than two pictures of ragweed plant and pollen is unnecessary. As it is, the extensive coverage of this one health threat places too much emphasis on this subject, especially considering that it is not as life threatening, nor is the science as certain regarding the magnitude of impacts, as extreme heat or ozone.	9. Human Health		335	11	We agree with this comment. We have taken out three figures on ragweed.
U.S.	Environmental Protection Agency	This is a great graph. A map representation of the data may help better communicate these changes to the public. See EPA's indicator of this same data by the same source (Ziska et al 2011) published here: http://www.epa.gov/climatechange/images/indicator_downloads/ragweed-download1-2012.png A higher resolution image of this figure can be provided by EPA, if necessary.	9. Human Health	9.2	336		We edited Figure 9.2 to clarify and become more informative.
U.S.	Environmental Protection Agency	This is the first time the word "aeroallergen" appears. May want to use in text too, or define that plant-based allergens in the air are aeroallergens.	9. Human Health		336	10	Thank you for your comment. This section has been edited, and the reference to aeroallergens has been deleted.
U.S.	Environmental Protection Agency	This is a great figure. Consider adding text explains that it is both the increase in CO2 atmospheric concentration and the subsequent warming (lengthening of the season) that impact aeroallergens.	9. Human Health	9.3	337		We have added text in the report that indicates that increased CO2 can contribute to increased production of plant-based allergens.
U.S.	Environmental Protection Agency	Consider also discussing the changes in wildfire duration, size, and intensity.	9. Human Health		340	1	Thank you for your suggestion. We added text that addresses your comment and is consistent with Chapter 2: Our Changing Climate.
U.S.	Environmental Protection Agency	"This section should include the following citations for recent, relevant heat mortality studies: (1) Voorhees et al. 2011. Climate Change-Related Temperature Impacts on Warm Season Heat Mortality: A Proof-of-Concept Methodology Using BenMAP. http://pubs.acs.org/doi/pdf/10.1021/es102820y. (2) Greene S, Kalkstein LS, Mills DM, Samenow J (2011) An examination of climate change on extreme heat events and climate-mortality relationships in large U.S. cities. Weather Clim Soc 3(4):281–292 http://journals.ametsoc.org/doi/abs/10.1175/WCAS-D-11-00055.1?journalCode=wcas (3) Barnett et al. 2012, Cold and heat waves in the United States. http://www.ncbi.nlm.nih.gov/pubmed/22226140"	9. Human Health		342	1	We have included the suggested references to the temperature section.
U.S.	Environmental Protection	The phrase "have sustained" could be misleading- it sounds like the word "sustained" is used to mean "maintain" rather than "suffer". Consider dropping "have" to show that it is past tense, or change the word completely to "experienced" or "suffered" to show that it was an event, not a long term occurrence.	9. Human Health		342	4	We agree with your suggestion and have changed "maintained" to "suffered."

	Agency						
U.S.	Environmental Protection Agency	Something seems to be missing here. As written, this is a fairly generic statement that has no relation to climate change. Without a connection to climate change, the utility of the sentence is quite limited. Perhaps "Deaths that occur during extreme heat events result from…"	9. Human Health		342	5	Sentence seems clear as written.
U.S.	Environmental Protection Agency	The Medina-Ramon and Schwartz study addresses extreme cold events, but the sentence highlights "extreme snow" and "ice storms" neither of which are directly addressed in M-R&S 2007… (and my impression is that Yu et al. 2011 is similarly focused on temperature)	9. Human Health		343	10	Text has been changed to focus on cold.
U.S.	Environmental Protection Agency	The text here appears to presume that all extreme precipitation events will result in flooding, which is the type of event that is most commonly associated with waterborne disease and water intrusion. That presumption is not necessarily true.	9. Human Health		343	22	The authors agree and have edited the text to address this comment.
U.S.	Environmental Protection Agency	Suggest revising to use a term other than "present." This may be technically correct, but it is not a term that will be commonly understood by many readers.	9. Human Health		343	23	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	The end of this sentence: "insect-host interaction, host immunity, and pathogen evolution" and "invasive insect-borne pathogens" on page 344 (lines 2 and 3) are concepts that most non-specialist readers will not comprehend. Define, clarify, or revise.	9. Human Health		343	37	We agree with your suggestion. "Pathogen" is defined in a glossary that will be included on globalchange.gov. Invasive has been deleted.
U.S.	Environmental Protection Agency	Suggest changing to: "Climate change increased risk in countries where insect-borne diseases are ALREADY commonly found can also increase susceptibility of North Americans, as trade with, and travel to, tropical and subtropical areas continues to expand."	9. Human Health		344	6	Thank you for your suggestion. We have changed the text to mention that climate change effects on the geographical distribution and incidence of vector-borne diseases in other countries where these diseases are already found can also affect North Americans, considering increasing trade with, and travel to, tropical and subtropical areas (McGregor 2011; Wilson 2009).
U.S.	Environmental Protection Agency	The figure caption uses the phrase "the tick that transmits Lyme disease", but multiple species are capable of transmitting Lyme. Perhaps you are referring to the black-legged tick (I. scapularis) which is the main bug on the east coast… but there is also the western black-legged tick (I. pacificus) which is believed to be responsible for the majority of new confirmed cases of Lyme disease in the Pacific region. Clarify wording so that it doesn't sound like only one tick is capable of transmitting Lyme- a very dangerous message for public heath concerns.	9. Human Health	9.8	345		Point well taken. We have added the species name, Ixodes scapularis, as per check with the original reference (Brownstein et al., EcoHealth 2005).
U.S.	Environmental	Consider removing or replacing this figure. It is difficult to decipher what the key message is, what each part of the figure is intended to represent, and where to start. The information can be conveyed more	9. Human	9.10	345		It is unclear what figure this comment addresses; it says figure 9.1 (which is

	Protection Agency	clearly and accurately in text.	Health				on p. 335 in the January 11, 2013 public draft) and p. 345 (which contains figure 9.8 in the January 11, 2013 public draft). If 9.8, that figure is being greatly modified.
U.S.	Environmental Protection Agency	Suggest changing the term "present." This may be technically correct, but it is not a term that will be commonly understood by many readers.	9. Human Health		347	5	We agree with your comment and have changed "present" to "arise."
U.S.	Environmental Protection Agency	CRITICAL COMMENT: Much better coordination is required between this section and the Agriculture chapter (6). Only one of the 12 citations listed here are included in Ch 6. This discussion should be a summary of what is presented in Ch 6, not an entirely new analysis or review. At a minimum, the key citations need to be consistent, even if the emphases of the two chapters are different.	9. Human Health		348	12	Thank you for your comment. Because the focus of this chapter is the Human Health Sector, the impacts on food security are described mainly from the perspective of this sector. However, this section has a direct link to the Agriculture Chapter: Key Message 6.
U.S.	Environmental Protection Agency	If retained, the discussion of food security should also note the potential threats to US food security due to food security issues outside the US.	9. Human Health		347	12	The section on Food Security begins by mentioning global effects of climate change on food production and quality. Given the chapter's space limitations and while we appreciate the suggestion, we feel the existing text points to global connections.
U.S.	Environmental Protection Agency	It is presumed that the mental health effects associated with extreme weather events include the mental health/ stress-related effects of loss of family member and friends and loss of property/ home/ livelihood from those events. If not, such effects need to be considered.	9. Human Health		349	14	This is a good point. However space constraints prevented including an analysis of how and why people suffer mental health problems following disasters; we limited ourselves to documenting that it occurs.
U.S.	Environmental Protection Agency	It is difficult, without proper titles, to distinguish that the top left figure includes projections, while all the rest of the figures are historical.	9. Human Health	9.12	350		We changed the title of this figure to address this comment.
U.S.	Environmental Protection Agency	Consider explaining why there is such a big gap in the US asthma rates figure (top right).	9. Human Health	9.12	350		We appreciate the suggestion, but space is limited. The author team has deliberated, and given that the chapter focused on broad trends for the topic, we made sure to include the full citations for original source materials for the components of Fig. 9.12, including the asthma graphic, so that those interested in a deeper treatment of the topic can be referred to the provided citations. For the

							asthma graphic in question, Akinbami et al. (2011) reported that in 1997, survey measures changed to capture different aspects of asthma prevalence, making direct comparisons of estimates before and after the change challenging. The measure most comparable to the pre-1997 survey measure ('current asthma prevalence') first became available in 2001.
U.S.	Environmental Protection Agency	The sentence on lines 5-6 that starts "U.S. population trends..." is a bit unclear - clarify whether numbers are rising because of overall population growth, or the % of the population that is elderly is rising (due to increased life expectancy).	9. Human Health	9.12	350		The caption was changed to state that overall population growth is projected to continue to at least 2050, with older adults being an increasing proportion of the population.
U.S.	Environmental Protection Agency	Line 9 says that the poor can afford less measure to "protect" them- but they can also afford less measures to "treat" them when health impacts do occur.	9. Human Health	9.12	350		Good point. The caption was changed to include this suggestion.
U.S.	Environmental Protection Agency	Change the end of the first sentence to read"..in the U.S., as when Hurricane Katrina ravaged New Orleans in 2005".	9. Human Health		351	23	The text was revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	In the third sentence, consider using another example, such as the Derecho in 2012, which knocked out power during very hot/humid days.	9. Human Health		351	25	We were unable to locate a reference to support a statement on the derecho causing multiple system failures.
U.S.	Environmental Protection Agency	In the last sentence, the use of the word "our reserves" on line 29 is a vague- please clarify.	9. Human Health		351	29	We have changed the text, "our reserves" to "resources needed to respond."
U.S.	Environmental Protection Agency	There are a LOT of example of Hurricane Katrina throughout this chapter. This chapter would greatly benefit from the use of other examples, like recent widespread droughts, wildfires, or at least Superstorm Sandy	9. Human Health				Sandy occurred after the draft was prepared and after the literature cut-off date, precluding inclusion of publications discussing Sandy relating to health impacts. However, mention of Sandy has since been included in other chapters of this report.
U.S.	Environmental Protecti	The phrase "Introduction of a new disease" is misleading. The disease was "introduced" in the 1950s. The use of the verb "has" also confuses the sentence- generic introduction of new diseases "could" devastate populations. Please clarify if this is referring to introduction of a disease that is new to the	9. Human Health		353	20	The spread of some diseases such as the chikungunya virus is rising, and a growing number of people in other

	on Agency	US. The term "devastate" also needs to be clarified. This term is subjective and can easily imply different impacts to different people.					parts of the world have been infected.The text in question with “devastated” is no longer in the chapter.
U.S.	Environmental Protection Agency	Suggest clarify/edit sentences to: "Activities that reduce carbon pollution often also provide co-benefits in the form of preventative health measures. For example, reliance on cleaner alternative energy sources for electricity production and more efficient and active transport, like biking or walking, can have immediate public health benefits, through improved air quality and lowered rates of obesity, diabetes, and heart disease. Reducing carbon pollution also reduces long-term adverse climate-health impacts, thus producing cost savings in the near- and longer-term." This clarifies the message of co-benefits.	9. Human Health		353	24	We thank the reviewer for the helpful suggestion, which has been incorporated in the text.
U.S.	Environmental Protection Agency	It is unclear what is meant by "The relationship". Please clarify if this means "Prevention of exposure to other climate change impacts similarly results in cost savings"	9. Human Health		353	29	The section identified has been rearranged to clarify, and to incorporate your suggestion.
U.S.	Environmental Protection Agency	Edit the fourth sentence to: "When asked about climate change impacts, most Americans..." if that is accurate.	9. Human Health		353	36	We have edited the text. Thank you for the correction.
U.S.	Environmental Protection Agency	It seems incomplete to note that "health insurance coverages has been declining" without mentioning the Affordable Care Act and the projections that health insurance coverage will increase in the coming years.	9. Human Health		354	8	We added text to mention the Affordable Care Act.
U.S.	Environmental Protection Agency	Editorial: Suggest changing sentence to read: "This makes the US population more vulnerable, especially because shortages of health care and public health professionals are projected by 2020."	9. Human Health		354	11	Thank you for your comment. The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	The word "mainstream" is a bit ambiguous. Please clarify if this means mainstream public health policies.	9. Human Health		354	17	We have reworded the text to clarify the meaning of "mainstream" in the sentence.
U.S.	Environmental Protection Agency	Is there a more general example of the air quality co-benefits of climate-based strategies than the Midwestern bicycle study noted here? What about citing the EPA/NHTSA greenhouse gas rule for heavy-duty vehicles which is projected to reduce CO2 emissions by 76 million tons and at the same time project up to $4.2 billion in human health benefits?	9. Human Health		354	36	We added the following EPA citation that addresses this comment: U.S. Environmental Protection Agency, Office of Transportation and Air Quality. EPA and EPA-420-F-12-051, August 2012.
U.S.	Environmental Protecti	There should be some acknowledgment of the differences between co-benefits of, say, air pollution and climate change reduction due to switching from fossil fuels to renewables which will likely have no impact on consumers other than price changes, in contrast to co-benefits resulting from lifestyle	9. Human Health		354	23	The text has been revised to incorporate similar comments, on p.354 in the section on 'Prevention

	on Agency	changes.					Provides Protection' which describes the health benefits resulting from lifestyle changes like active transit, in the contrast to those other health benefits resulting from diminished air pollution and longer-term climate change reductions from switching to fossil fuels.
U.S.	Environmental Protection Agency	CRITICAL COMMENT: Delete this entire paragraph. This is prescriptive, can be considered alarmist, incomplete (does not cover other sources of methane), and the health information presented does not seem settled in the scientific literature. Seems inappropriate and could detract from the information in the chapter.	9. Human Health		355	11	The Authors disagree with the assertion that this paragraph is prescriptive (the language states this is one option that has been studied), or alarmist (there is no language exaggerating any threats). Text has been revised to help clarify the range of possible co-benefits.
U.S.	Environmental Protection Agency	The word" identifiable" is very odd. Please replace "identifiable" with "vulnerable" and replace "more vulnerable" (line 29) with "at a higher risk"	9. Human Health		355	28	Thank you for your comment. The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Revise these sentences to: "Mitigation and adaptation policies could also prevent decreases in crop and livestock production from climate change and increases in food prices associated with agricultural losses. Because low-income populations spend a higher percentage of their income on purchasing food than high-income populations, policies to reduce climate change also have the potential to improve food security." Please also consider referencing the agriculture chapter here and providing appropriate citations for these sentences.	9. Human Health		355	33	Authors have deliberated and after consideration of this point, decided to delete this sentence. The impacts of climate change mitigation may not be evident for some time. We have referenced the food security issues for low-income populations in the Traceable Account for Key Message #1.
U.S.	Environmental Protection Agency	Editorial: Please finish this citation: e.g., 2005, Oceanography 18(2):136–147, http://dx.doi.org/10.5670/oceanog.2005.49.	9. Human Health		371	31	Thank you for your comment. We have revised the reference to add the missing information.
U.S.	Environmental Protection Agency	Please finish this citation.	9. Human Health		375	37	Thank you for your comment. We have revised the reference to add the missing information.
U.S.	Environmental Protection Agency	In line with our comment on page 334, lines 22-33, please revisit the confidence assessments in the Traceable Account for Key Message 1. Page 358, Assessment of Confidence: Based on current literature, we recommend renaming "decreased air quality" to "decrease ozone air quality", or reducing the "very high" confidence to "low" or "medium" confidence if PM and ozone are kept together under the air quality category.	9. Human Health				The text has been revised to incorporate this suggestion, rather than in the confidence assessment.
U.S.	Environ	This chapter provides an excelllent discussion of traditional knowledge on pages 444-445. However, in	12.				The text has been revised to

	mental Protection Agency	the sections that follow, the chapter does not clearly present what is traditional knowledge and what information is from the peer-reviewed scientific literature. We believe it is important to provide both types of information, but that it is confusing and possibly misleading when they are mixed within the same paragraph or sentence as is the case throughout this chapter. As general practice for a report that is a Highly Influential Scientific Assessment, we stress the importance of clearly demarcating grey literature from peer-reviewed scientific literature, and that citations to grey literature be used sparingly and only when they add additional key knowledge not found in the scientific literature. There are a number of instances of over-reliance on grey literature in this chapter without providing the primary source of where the information came from originally (specified in the comments below).	Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources				incorporate a number of new, peer-reviewed scientific references. The authors of the NCA Report have written it based upon a variety of sources, all of which were assessed under Guidance on Information Quality Assurance to Chapter Authors of the National Climate Assessment: Question Tools (2/21/2012), to assure for each source (1) utility, (2) transparency and traceability, (3) objectivity, and (4) integrity and security. All sources were assessed for IQA compliance.
U.S.	Environmental Protection Agency	Recommend that Key Message #1 and its accompanying text (starting on page 445) be edited to more clearly refer to and distinguish between observed and projected future climate impacts, and to include more caveated language to reflect the state of the science on attribution. The verb tense "...are threatening Native American…" implies that the impacts noted are observed impacts, and the text also focuses primarily on observations. Yet for most of the listed impacts, the science does not support the attribution of all observed recent change to climate change and this chapter should be careful not to imply such a relationship. For example, Chapter 7 of the NCA states, "Because disturbances are normal yet rare at large scales, the extent to which recent forest disturbances can be directly attributed to climate change is uncertain" (pg 266, line 24). Recommend deleting "forest loss" and "habitat damage" from the list as they are already covered under "ecosystem changes" and there are many non-climate factors and drivers for these impacts. Also, because the text does not discuss ocean acidification, recommend either including some text with citations for this or deleting it from the key message.	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources		441	14	We changed the text to Key Message 1 to state: "Observed and future climate change impacts… threaten Native American…" to address this reviewers concern. We believe this edit reflects the science cited in this article on both observed and future impacts and that the use of the word threaten relates to both current and future threats. Instead of deleting forest loss and habitat damage, we changed the text to state "ecosystem changes such as forest loss and habitat damage." We deleted ocean acidification from the list per the reviewer's suggestion.
U.S.	Environmental Protection Agency	Key Message #2 states "…are exacerbated by land-use policies…" - Please provide more explanation and support for this statement in the underlying text on page 447. There are no examples or citations provided about how land-use policies exacerbate tribal vulnerabilities.	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources		441	24	The text has been revised to incorporate this suggestion, in both the wording in Key Message #2 and by adding a couple sentences and citation in the main text.
U.S.	Environmental Protection Agency	Key Message #4 states that there are damages to "...homes, schools…" - Please provide more explanation and support for this statement in the underlying text on pages 451-452. There are no examples or citations provided about how homes and schools are damaged by permafrost thawing.	12. Impacts of Climate Change		441	33	"The text has been revised to incorporate this suggestion. We added the following phrase to the end of the first sentence following the Permafrost Thaw Key Message (directly following

			on Tribal, Indigenous, and Native Lands and Resources				the word “roads”): “from differential settlement, slumping, and/or collapse of underlying base sediments.”
U.S.	Environmental Protection Agency	Key Message #5 states that relocations are causing "...loss of community and culture, health impacts, and economic decline..." Please provide more explanation and support for this statement in the underlying text on page 453. There are no examples or citations provided about how this is occuring.	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources		441	39	The text has been revised to incorporate this suggestion and additional references have been included that directly address this comment, which we refer you to that include more in-depth discussions on the topic.
U.S.	Environmental Protection Agency	The Trainor et al. (2009) paper did not directly study or document boreal forest migration or wildlife range changes. Please cite the primary sources that document these changes.	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources		445	39	We deleted the statement "including northward migration of the boreal forest and changes in the distribution and density of wildlife species" and added Cochran et al. 2013 to the first part of the sentence "Observed impacts from the causes and consequences of climate change include species loss and shifts in species range" because Cochran et al. provides a discussion of and citations for more in-depth observed impacts of climate change.
U.S.	Environmental Protection Agency	Our previous comment on attribution for observed vs. future impacts applies to this sentence, which should be reworded. Loss of biodiversity and increases in invasives are projected under climate change, but observed changes cannot be entirely attributed to climate change. In addition, the citation ITEP (2011) is to a website that does not indicate where the information came from originally. Please cite the primary sources of the information and indicate which of the impacts are these traditional knowledge observations [and from which tribe(s)] and which are from Chapters 7 and 8 of the NCA.	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources		445	40	The first part of the sentence is changed to "Observed impacts from the causes and consequences of climate change…" We did not edit the second sentence because it states that loss of biodiversity, etc. have been observed but not necessarily only due to climate change. In regards to the ITEP comment, please see our response to comment #11106.

U.S.	Environmental Protection Agency	The reference to Ch 20 should be deleted because many of the regional chapters also include discussion of wildfire, not just the Southwest, and it's not necessary to list them all. The reference to Ch 2 should be replaced with Ch. 7 Forestry, because that is where the primary discussion of wildfire in the NCA occurs.	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources		446	4	We deleted the reference to Chapter 20 and replaced the reference to Chapter 2 with Chapter 7: Forestry, as recommended.
U.S.	Environmental Protection Agency	The references to IPCC 2007 and NWF 2011 are not consistent with the citations in Ch. 7 for the same projected impacts. Please revise to ensure consistency or simply cite Ch. 7.	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources		446	6	We deleted the citations to IPCC 2007 and NWF here and added a citation to Chapter 7:Forestry, per the recommendation.
U.S.	Environmental Protection Agency	Delete "cataclysmic" - it is highly subjective and all types of fires can affect/devastate communities.	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources		446	15	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	The ITEP 2010 and 2011 citations are to a website that does not indicate where the information came from originally. Please cite the primary sources of the information or delete these references. The Kaufman 2011 citation is to a New York Times article - given the availability of other, more appropriate source citations, please delete this.	12. Impacts of Climate Change on Tribal, Indigenous, and		446	22	The authors of the NCA Report have written it based upon a variety of sources, all of which were assessed under Guidance on Information Quality Assurance to Chapter Authors of the National Climate Assessment: Question Tools (2/21/2012), to assure for each source (1) utility, (2)

			Native Lands and Resources				transparency and traceability, (3) objectivity, and (4) integrity and security. All sources were assessed for IQA compliance.
U.S.	Environmental Protection Agency	The Ferguson and Crimmins 2009 citation is to a website article. Please replace with a more appropriate primary scientific source for the existence of long-term drought on the Colorado Plateau.	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources		447	10	The text has been revised to incorporate this suggestion by adding a reference for the existence of long-term drought on the Colorado Plateau.
U.S.	Environmental Protection Agency	Our previous comment on clearly noting what is traditional knowledge applies to this sentence "This warming is accompanied by…". Which changes are documented by in the scientific literature and which changes are traditional knowledge? It may be useful to include a sentence that these impacts are expected to continue under future climate change.	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources		449	15	The suggested phrase has been inserted into the revised text.
U.S.	Environmental Protection Agency	Please correct the citation to provide the date the image was pulled from the web, rather than saying "no date"	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources	12.4	450		The text has been revised to incorporate this suggestion by adding the date the information became available on the website provided.
U.S.	Environmental Protecti	Recommend adding a clause or sentence to clarify how stronger winds are consistent with what scientists expect under Arctic climate change. Otherwise, it may not be clear to the reader how this stronger winds relate to climate change.	12. Impacts of		450	13	The text has been revised to incorporate this suggestion by adding the following clause: “observations

	on Agency		Climate Change on Tribal, Indigenous, and Native Lands and Resources				which are consistent with scientific findings showing changing Arctic wind patterns which are, in turn influencing loss of sea ice and shifts in North American and European weather" (Overland, et al, 2012).
U.S.	Environmental Protection Agency	What is meant by "…far beyond hunting access"? This is presumed to refer to Native hunting range, but could also refer to predator hunting range.	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources		450	15	The text has been revised to incorporate this suggestion. We added several clarifying words.
U.S.	Environmental Protection Agency	Relocation plans for U.S. Pacific island territories - if they exist - would be appropriate to discuss here, but Tuvalu is outside the scope of a national climate assessment. Please delete.	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources		453	24	The text has been revised to incorporate this suggestion. The example of Tuvalu has been replaced by "including Hawaii."
U.S.	Environmental Protection Agency	Please ensure that all citations are complete (many in this list are not, which makes it difficult to review their relevance and appropriateness). Overall, ensure all references and parenthetical citations are formatted consistently according to the report standards.	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and		464	1	References have been revised, as needed, to incorporate this suggestion. All citations have been reviewed and corrected for completeness and consistency.

			Resources				
U.S.	Environmental Protection Agency	The Traceable Accounts for this chapter should be revisited because the level of detail and explanation provided do not support a conclusion of Very High confidence for each key message. There may also need to be a discussion between the chapter authors and the NCADAC regarding guidance for how the confidence levels should be applied in cases where the multiple sources of information are from grey literature and/or traditional knowledge. Suggest that there needs to be discussion about whether these should be categorized as "methods vary" or "methods emerging" and implications for assessing confidence level.	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources				It is the opinion of the authors that the addition of multiple peer-reviewed articles supporting each key message and throughout the document has addressed these concerns.
Paul	McLaughlin	Rosina Bierbaum, Arthur Lee, Joel Smith Convening Lead Authors, Chapter 28: Adaptation National Climate Assessment and Development Advisory Committee U.S. Global Change Research Program Suite 250 1717 Pennsylvania Ave, NW Washington, DC 20006Dear Doctors Bierbaum, Lee and Smith,Greetings. I have recently read the chapter on adaptation in the NCADAC Draft Climate Assessment Report. The report does an excellent job of summarizing the current state of adaptation planning in the U.S. across various sectors, systems and scales as well as related issues such as barriers to adaptation etc. However, I believe that the report might be strengthened further by a more explicit consideration of adaptation as a theoretical concept(s).As currently written, the chapter treats adaptation primarily as a social process or outcome; that is, adaptation is defined as the “Adjustment in natural or human systems to a new or changing environment” (NCADAC 2013, p. 985). Adaptation is further differentiated from alternative social processes or outcomes such as mitigation and vulnerability. However, adaptation can also be thought of as a series of interrelated theoretical concepts or mechanisms --homeostatic, developmental, rational choice, and populational mechanisms -- that can be employed to explain each of the above outcomes as well as the origins of climate change itself (McLaughlin and Dietz 2008; McLaughlin 2011). Although each of these mechanisms brings about a better match or fit between social structures -- social habits, roles, routines, and organizations, communities and their environments, the causal processes used to achieve this fit are distinct in each case. For example, organizations adapt homeostatically by using the flexibility built into existing organizational routines to adjust to changes in their environment. Developmental adaptation involves adjustment through organizational growth and the elaboration or addition of routines. Organizations also adapt through rational choice mechanisms when they use conscious forethought and planning to evaluate the costs and benefits of alternative strategies. Finally, populations of organizations adapt through differential persistence and	28. Adaptation				Thank you for your comment. The authors are not evaluating the adaptation process. We are just trying to take stock of what is happening so far, not the theoretical pinnings of these issues. Moreover, as a result of public meetings where decisions were made about the scope of this chapter, it was decided that our chapter would not focus on the theoretical foundations of adaptation but instead highlight empirical examples. As such, no change was made.

		propagation.In the absence of an explicit discussion of these alternative theoretical concepts and mechanisms, the draft report treats calculative decision making or rational choice as the default mechanism of adaptation. This implicit theoretical stance is evident in the various tables of the report summarizing adaptation planning activities by federal agencies (Table 28.1), state agencies (Table 28.2), local and regional governments (Table 28.3), non-governmental entities (Table 28.4), and the private sector (28.5) as well as Figure 28.3 and the discussion of the Adaptation Process on pp. 998-1000. Although a focus on rational choice mechanisms is a logical starting point, I believe that the section on the Adaptation Process would be significantly strengthened by an explicit discussion of the limits of conscious forethought and planning as a general explanation of social change (Hannan and Freeman 1989; Simon 1957; Toulmin 1981) and a consideration of alternative mechanisms of adaptation. As Scott (1998:256) has so convincingly demonstrated, attempts to rationally plan villages, communities and cities from the ground up invariably fail because they ignore the myriad social and ecological practices that have "evolved outside, and often in contravention, of the formal rules." Research and policy-making on adaptation to climate change needs to avoid this conceptual trap. The cognitive limits on decision making and the uncertainties associated with climate change itself assure that much of the social dynamics related to climate adaptation will occur outside the boundaries of conscious rational planning. Thus, the development of effective adaptation strategies will require a consideration of all four concepts or mechanisms of adaptation. Such a broader conceptual stance would allow the insights of alternative theoretical perspectives such as institutional theory to be brought to bear on questions such as the facilitation and dissemination of best practices (NCA draft, p.989). Also conspicuously missing from the current literature on climate adaptation is a detailed discussion of populational mechanisms of adaptation such as found in the organizational ecology literature (Hannan and Freeman 1989), including the newly emerging literature on intraorganizational evolution (Warglien, 2005). My own work on climate adaptation (McLaughlin 2011) discusses how the above four mechanisms of adaptation might be integrated using the concept of a socially constructed adaptive landscape. I believe that these theoretical perspectives, particularly those incorporating a populational perspective, will allow the development of more robust and flexible adaptive strategies and policy options. They will also facilitate the application of dynamic statistical techniques (Tuma and Hannan 1984) to study questions of adaptation. Such techniques avoid the need to make equilibrium assumptions about social processes and allow the time paths of change -- e.g., the rates of founding, disbanding, merger and change of organizations -- to be studied directly. Sine and Lee's (2009) event-history analysis of entrepreneurial activity in the wind energy sector from 1978 to 1992 is a model in this regard. Such methods are ideally suited to studying the impacts of policies or major political or environmental events on organizational vital rates (using period effect variables), the interactions between organizational populations, and the direct and indirect effects of climate change on organizations over long time periods. I hope the committee finds the above comments helpful. I thank you for your time and consideration.Sincerely, Paul McLaughlin Department of Sociology 121H Sturges Hall SUNY Geneseo Geneseo, NY 14454					

		mclaughp@geneseo.eduReferencesHannan, M. T., & Freeman, J. 1989. Organizational Ecology. Cambridge, MA: Harvard University Press.McLaughlin, Paul. 2011. “Climate Change, Adaptation and Vulnerability: Reconceptualizing Societal-Environment Interaction within a Socially Constructed Adaptive Landscape.” Organization and Environment 24(3):269-291.McLaughlin, Paul and Thomas Dietz. 2008. “Structure, Agency and Environment: Toward an Integrated Perspective on Vulnerability.” Global Environmental Change 18:99-111.National Climate Assessment and Development Advisory Committee. 2013. “Chapter 28: Adaptation.” National Climate Assessment Draft Report. http://ncadac.globalchange. gov/download/NCAJan11-2013-publicreviewdraft-chap28-adaptation.pdfScott, J. C. (1998). Seeing Like a State: How Certain Schemes to Improve the Human Condition have Failed. New Haven, CT: Yale University Press.Simon, Herbert A. 1957. Administrative Behavior. New York: Macmillan.Sine, W. D., and Lee, B. H. (2009). “Tilting at Windmills? The Environmental Movement and the Emergence of the U.S. Wind Energy Sector.” Administrative Science Quarterly, 54, 123-155.Toulmin, S. (1981). “Human adaptation.” In U. J. Jensen & R. Harre (Eds.), The Philosophy of Evolution (pp. 176-195). New York, NY: St. Martin’s Press.Tuma, N. B., and Hannan, M. T. 1984. Social Dynamics: Models and Methods. New York, NY: Academic Press.Warglien, M. 2005. “Intraorganizational Evolution.” In J. A. C. Baum (Ed.), The Blackwell Companion to Organizations (pp. 98-118). Malden, MA: Blackwell.					
U.S.	Environmental Protection Agency	This is a great opening paragraph on this subject.	13. Land Use and Land Cover Change		471	17	We greatly appreciate your positive comment.
U.S.	Environmental Protection Agency	What about reported data (to USDA etc)?	13. Land Use and Land Cover Change		472	2	We agree that the data sources listed in this sentence could be broadened, and edits have been made.
U.S.	Environmental Protection Agency	It would be useful to note that it is also in some cases costly to change in addition to being entrenched.	13. Land Use and Land Cover Change		472	20	We agree with the general need expressed by this comment; edits have been made.
U.S.	Environmental Protection Agency	Suggest reconsidering the word choice "even" here, as the country is rural and increasingly so as people move to cities. Inserting "especially" or something to that effect would make this sentence stronger.	13. Land Use and Land Cover Change		472	28	Good suggestion. Edit made.
U.S.	Environmental Protection Agency	How much of the forest/grasslands are public vs private? Important factor in this story	13. Land Use and Land Cover Change		472	34	Based on this suggestion, edits have been made.
U.S.	Environmental Protection	The colors used to denote grassland and mechanically disturbed land are very similar; suggest finding a way to increase contrast (perhaps something that is friendly to black and white printers such as dots or stripes). Also, a map should be provided showing the vulnerability and resilience (projected) across the US. This could be shown as a heat map in combination with the current map if the pies were offset	13. Land Use and Land Cover	13.1	473		"Grassland/shrubland" is dark brown while "mechanically disturbed" is dark green. We feel that there is sufficient differentiation between these two

	Agency	rather than on top of the map. Alternatively, if another chapter has a vulnerability & resilience map, then that chapter & figure should be referenced.	Change				colors. In regards to additonal maps, we appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include.
U.S.	Environmental Protection Agency	It seems that this definitional problem also applies to other categories (e.g., barren, grassland) however, the footnote gives the appearance that this issue is unique to the forest sector. This should be clarified.	13. Land Use and Land Cover Change	13.1	474		After consideration of this point, we still feel the existing text is clear and accurate. As indicated, this is an "example" of definitional differences.
U.S.	Environmental Protection Agency	The importance of impervious vs pervious surface should briefly be stated (i.e., note why changes in impervious surfaces are of interest).	13. Land Use and Land Cover Change		476	13	Text has been modified.
U.S.	Environmental Protection Agency	Should refer to Chapter 7 (Forests) in this discussion, and note in particular that since 1990 net CO2 uptake from forests has increased in the US, with forests acting as a net C sink but that the USDA's 2012 publication (Forest Service 2010 Resources Planning Act Assessment) projects a decline in forest carbon stocks over the next 5 decades.	13. Land Use and Land Cover Change		480	37	The section references the forestry chapter. We have focused on the uncertainties associated with carbon stock estimates, and especially projections, because we believe strong statements about the state of the carbon stocks are unwarranted by the science. Here we add a reference back to projected losses of forest, in addition to uncertainties about sensitivity to changes in climate: "The projected declines forest area (Figure 3.3) put these carbon stores at risk. Additionally, The magnitude rate of the sink carbon uptake on a given acre of forest can vary with weather, making it potentially sensitive to climate changes (Schwalm et al. 2012)." Lastly, we feel the current references are appropriate and adequate given the chapter's space limitations.
U.S.	Environmental Protection Agency	Add Alaska and Hawaii to this figure, if possible.	14. Rural Communities	14.1	496		We added Alaska and Hawaii to the map.
U.S.	Environmental Protecti	Replace the word "additional" with a more appropriate word, like "disproportionate" to better clarify that changes in the viability of even one sector may affect rural communities differently, and potentially more severely, than urban communities.	14. Rural Communities		496	18	Thank you for your comment. The text has been revised to incorporate this suggestion.

	on Agency						
U.S.	Environmental Protection Agency	If possible, update this figure with more current data. Please add Alaska and Hawaii.	14. Rural Communities	14.2	497		Thank you for your comment. This is the most recent data we have available. We have added Alaska and Hawaii.
U.S.	Environmental Protection Agency	Consider discussing impacts of extreme events and health, which would better connect the "ripple effect" impacts with people in this overview paragraph, rather than focusing only on biological or ecologically related impacts. As an example, rural communities have been significantly impacted by the recent drought across the southern Plains. Nationally, we see these as impacts to agriculture, but they are affecting rural communities more immediately in a variety of ways that need to be at least recognized here.	14. Rural Communities		498	1	Thank you for the observation. The text is revised to try to capture the human dimension here as well as in the later discussion of "ripple effects."
U.S.	Environmental Protection Agency	Split this long sentence into two, like: "…and other amenities. They also provide urban residents…"	14. Rural Communities		498	15	Thank you for your comment. The text has been revised to incorporate these suggestions.
U.S.	Environmental Protection Agency	This figure would be more appropriately included in the discussion of benefits of climate change. Revise title to be more descriptive and include Alaska and Hawaii in the figure.	14. Rural Communities	14.3	499		We agree in part with the comment; there are some benefits. We have amended the caption to address this. We do not have map data for Alaska and Hawaii.
U.S.	Environmental Protection Agency	Please check to make sure "20 to 40 days" is correct here- it appears that there are significant agricultural areas in which the increase in growing season could be well over 40 days (NE, upper Midwest, NW).	14. Rural Communities	14.3	499		The text has been revised to address this comment. It is 20 to 70 days.
U.S.	Environmental Protection Agency	The phrase "cropping patterns" is unclear. Revise to clarify whether this shift is due to humans response to climate change or to climate change shifting them on their own. I.e., is this describing a natural shift in crop range or changing agricultural practice (or a combination)? Regarding timing of planting and harvesting, can one distinguish between climate-driven changes and human-driven changes?	14. Rural Communities		499	19	Text regarding cropping ranges has been modified to make it clear that farmers are responding to climate change by shifting cropping patterns and altering the timing of planting and harvesting.
U.S.	Environmental Protection Agency	Change "diminished" to "diminishing"	14. Rural Communities		499	24	Thank you for your comment. The text has been revised to incorporate this suggestion, changing "diminished" to "diminishing."
U.S.	Environmental Protection Agency	Please consider including environmental flow requirements as an important water demand.	14. Rural Communities		500	1	We thank the reviewer for an important observation, and have amended the text to reflect the importance of environmental flow demand.
U.S.	Environ	Please clarify what is meant by "dependent species"	14. Rural		500	15	Thank you for your comment. We have

	mental Protection Agency		Communities				reworded the sentence for clarification.
U.S.	Environmental Protection Agency	Are there are more recent estimates of sea level rise threats in Florida?	14. Rural Communities		500	23	To our best knowledge, the Stanton and Ackerman 2007 paper is the most recent peer-reviewed and comprehensive study on projected economic impacts of climate change on Florida's major industries, and meets the Guidance on Information Quality Assurance to Chapter Authors of the National Climate Assessment: Question Tools (2/21/2012). This Guidance is used by the NCADAC to assure for each source used in the NCA Report: (1) utility, (2) transparency and traceability, (3) objectivity, and (4) Integrity and security.
U.S.	Environmental Protection Agency	Is there a more recent figure that can be used here?	14. Rural Communities	14.4	501		This figure is the most recent.
U.S.	Environmental Protection Agency	Are there more recent studies for extreme weather and beach erosion that can be cited here?	14. Rural Communities		502	1	Coastal Impacts, Adaptation, and Vulnerabilities: a technical input to the 2013 National Climate Assessment, authored by leading scientists and experts, emphasizes the need for increased coordination and planning to ensure U.S. coastal communities are resilient against the effects of climate change. We have added the citation.
U.S.	Environmental Protection Agency	Please provide references for the impacts listed here (wildfire, flash flooding, storm surge, river flooding, drought, and extremely high temperatures can alter the character and attraction of rural areas as tourist destinations)	14. Rural Communities		502	4	It is not clear whether the comment refers to the impacts (wildfire, flash flooding, storm surge, river flooding, drought, and extremely high temperatures) or to whether character and attractiveness of destination can be affected. Material on the various impacts is available in appropriate NCA chapters.
U.S.	Environmental Protection	Please add Alaska and Hawaii to this figure	14. Rural Communities	14.5	503		We added Hawaii and Alaska to this figure.

	Agency						
U.S.	Environmental Protection Agency	Revise sentence to read: "…(such as extreme heat, storm events, and coastal and riparian flooding) tend to be more associated with specific local vulnerabilities, and the risks are somewhat easier…"	14. Rural Communities		504	18	We thank the reviewer for the helpful suggestions, which has been incorporated into the text.
U.S.	Environmental Protection Agency	Editorial: Revise sentence to something like: "Impacts due to climate change will cross community and regional lines, making solutions…"	14. Rural Communities		506	1	We thank the reviewer for the helpful editorial suggestion, which has been incorporated into the text.
U.S.	Environmental Protection Agency	The text says there are six states and only five are listed. Please add the missing state.	14. Rural Communities		506	31	Thank you for your comment. The text has been revised.
U.S.	Environmental Protection Agency	Suggest clarifying this sentence to read "...population changes between 2000 and 2010 ranging from a 25% decline to an 86% increase over the decade.	14. Rural Communities		506	34	Thank you for your comment. The text has been revised to incorporate your suggestion.
U.S.	Environmental Protection Agency	Suggest changing "industry" to "industry representatives" or other term that focuses on the people, consistent with descriptions of other stakeholders listed here.	14. Rural Communities		507	8	We appreciate your suggestion which has been incorporated into the text.
U.S.	Environmental Protection Agency	Change "increased CO2 by more than" to "increased atmospheric CO2 by more than"	15. Interactions of Climate Change and Biogeochemical Cycles		519	17	Thank you for your suggestion; Key Message #1 has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Change "increased CO2 by more than" to "increased atmospheric CO2 by more than"	15. Interactions of Climate Change and Biogeochemical Cycles		520	7	Thank you; Key Message #1 has been revised to incorporate this suggestion.
U.S.	Environ	Revise the citation for the caption. Ideally the citation would rely solely on peer-reviewed information.	15.	15.2	522		We have revised the caption for

	mental Protection Agency	If necessary, cite Chambers and Walsh as personal communication and note the extent of the changes due to their input.	Interactions of Climate Change and Biogeochemical Cycles				context. There are no substantive differences between this graphic and many others in the peer-reviewed literature - the differences are only in the visual presentation. Because of this, and because of a need for simplicity, we retain the original figure.
U.S.	Environmental Protection Agency	Suggest adding a reference to Fann and Risley (2011) at the bottom of the first paragraph on sulfur aerosols. This reference quantifies the large human health benefits of the SOx/NOx reductions of the past decades.	15. Interactions of Climate Change and Biogeochemical Cycles		526	2	Thank you for your suggestion. This reference has been added.
U.S.	Environmental Protection Agency	This figure does not show "the interdependence of biogeochemical cycles, climate change, and other environmental stressors." It is a nice illustration, but does not indicate any interdependence or even represent processes. Suggest removing or replacing this figure.	15. Interactions of Climate Change and Biogeochemical Cycles	15.4	527		Thank you for your comment. This figure and caption will be replaced.
U.S.	Environmental Protection Agency	This paragraph should also mention black carbon along with methane as an opportunity for co-benefits. Can reference EPA's Report to Congress on Black Carbon, or the recent "bounding study" from Tami Bond.	15. Interactions of Climate Change and Biogeochemical Cycles		528	24	Thank you for your comment. The text has been edited in regards to this suggestion.
U.S.	Environmental Protection Agency	"temporarily" needs clarification - a sink must store carbon for an extended period of time before it is an effective sink.	15. Interactions of Climate Change and Biogeochemical Cycles		529	2	Thank you for your comment. Minor edits have been made in regards to this suggestion.
U.S.	Environmental	Overall, the text box is a fine representation of a couple of different approaches to estimating land-based carbon sinks, but it goes into some detail about the differences between the EPA Inventory	15. Interacti		529	2	Thank you for your suggestion. Edits have been made in regards to this

	Protection Agency	methods and the SOCCR methods. At the same time, however, the comparison is not exhaustive so it's not 100% clear exactly why the differences between the two approaches occur. Without doing a comprehensive assessment, it is difficult to know exactly why the two approaches give different results, and it's very likely that the reasons given in the text box -- the omission of wetlands (except for peatlands remaining peatlands) from the EPA Inventory and the possible role of emissions from lakes and reservoirs, which are also omitted from the EPA Inventory -- are not the full story. Our preference would be for the text box to either (1) conduct a comprehensive assessment of the differences between the EPA and the SOCCR approaches (this is likely beyond the scope of the report and would be fairly time-consuming), or (2) replace the existing paragraph on p.15-24 with a couple of sentences that read something like, "These two methods use different datasets, different models, and different methodologies to estimate land-based carbon sinks in the US. In particular, we note that the EPA Inventory, consistent with IPCC Guidelines for national inventories, includes only carbon sinks designated as anthropogenic while the SOCCR analysis does not make this distinction. Though a comprehensive assessment of the sources for the variability is beyond the scope of this report, the numbers suggest that the US carbon sink is between XX and XX."	ons of Climate Change and Biogeochemical Cycles				suggestion.
U.S.	Environmental Protection Agency	The title for this text box is more appropriately "Estimating the U.S. Carbon Sink" - there is little here that describes or characterizes the sink or the processes associated with the sink. See the previous comment.	15. Interactions of Climate Change and Biogeochemical Cycles		529	1	Thank you for your comment. We have edited the title in regards to this suggestion.
U.S.	Environmental Protection Agency	Figure 17.1 in the Southeast chapter shows a graphic with ozone getting worse in the southeast but better in the cooler Midwest and Northeast regions. Yet the chapters on the Midwest and Northeast do not mention it. If the graphic is valid, then it is as important to show the improvement in the cooler areas as it is to show projected deterioration in the Southeast. A consistent story across NCA chapters about increased tropospheric ozone levels is needed.	16. Northeast				After consideration of this point, we still feel the existing text is clear and accurate. The results for the Northeast in this study appear to be somewhat ambiguous. We cite a different study that suggests a small increase in ozone in a specific setting.
U.S.	Environmental Protection Agency	What does "huge" mean in this context? Is there a more precise term that could be used here?	16. Northeast		549	31	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	What does "profoundly" mean in this context? Is there a more precise term that could be used here?	16. Northeast		550	4	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	The authors of the Northeast Chapter should consider emulating the approach taken by the Southeast Chapter in communicating climate change and climate change scenarios. Temperature map: Some readers may find it difficult to match the shades on the figure with the legend, and the colder shade in NW Maine is almost indistinguishable from most of the state. The figure would be easier to read if there were only 5-7 shades of yellow to red being used, instead of 9. Actually, only about 5 shades	16. Northeast	16.1	550		We thank the reviewer for the helpful suggestion, some of which has been incorporated into the figures. The precipitation figure is no longer included in the chapter.

		show up in the map anyway. Precipitation: Some readers may find it difficult to match the shades on the figure with the legend. The figure would be easier to read if there were only 4-5 shades of blue used, instead of 9. Actually, only about 3 shades show up in the map anyway. But the shades in the map do seem to suggest that precipitation is only 10-17 inches over Chesapeake Bay, upper Delaware Bay, and the NJ barrier islands. That may be an artifact, but it highlights the problem with using so many shades of blue.					
U.S.	Environmental Protection Agency	At the end of the paragraph, add a % value that compares the 74% increase in heavy precip in the NE with the increase across the nation.	16. Northeast		551	15	After consideration of this point, we still feel the existing text is clear and accurate. That number comes from sources that did not provide that number, and our consistent approach across all the chapters used a different interval.
U.S.	Environmental Protection Agency	The two paragraphs seem to largely repeat the same content, with only subtle differences. It would probably be more helpful to have two maps, one with today's climate and one with the future climate., as in Figure 23 of the regional scenario report.	16. Northeast		552	6	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Why limit this sentence to WV, MD, and DE? The regional scenarios report shows a doubling almost everywhere in the region.	16. Northeast		552	8	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	What does "could" mean in this context? Elsewhere the chapter uses "is expected".	16. Northeast		552	9	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Why does the text say this impact will happen "by the 2050s" when the figure shows the change over the period between 2041 and 2070. Would the typical reader realize that when you say "double by the 2050s" you mean compared with the 1980s?	16. Northeast	16.3	552		The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	The text says that the majority of MD, DE, WV, and NJ are projected to have more than 15 additional days above 95 degrees. The map in Figure 16.3, though, appears to show that the majority of neither WV nor NJ may exceed 15 days above 95 degrees.	16. Northeast		552	16	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Either cold air outbreaks need to be explained more fully, or the second half of the sentence needs to be deleted or better explained. It is not clear why melting ice would slow the mitigation of Arctic air blasts. One might expect the opposite: That there would be less bitterly cold air because the arctic has more open water during winter.	16. Northeast		553	1	The text has been revised to incorporate this suggestion.
U.S.	Environmental	This statement is true for 2/3 of the northeast, but not for Maine where sea level rise is about the global average. The differential is only about 2 inches in Massachusetts.	16. Northeas		553	18	The text has been revised to incorporate this suggestion.

	Protection Agency		t				
U.S.	Environmental Protection Agency	This statement needs additional clarification with regard to the assumed sea level rise. Given the syntax of previous sentences, one might assume that "could" refers back to the maximum projected rise of 52 inches. Yet a 52-inch rise would bring spring high water (not the 3-year flood level) up to the level that is the 10-year flood today, along a typical coast where the spring tide range is 5.5 feet and the 10-year flood level is 6.5 feet.	16. Northeast		553	22	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	The figure title needs to be revised to better describe the figure itself. The current title does not match well with the photo. The figure shows Irene, but it does not show flooding. Perhaps, "Hurricane Irene, which brought heavy flooding to the Northeast"	16. Northeast	16.4	554		The text has been revised to incorporate this suggestion.
Y. Armando	Nieto	It is also important to add that preparing for climate change will help positively impact public health in the short and long term. We propose the following addition to the sentence:...Using scientific information to prepare for 14 these changes in advance provides economic opportunities, and proactively managing the risks 15 will reduce costs over time "and would positively impact the public's health in the short and long term"...	1. Executive Summary		3	16	Modifications to text in this chapter have been made that respond to this comment, although not in this location.
Y. Armando	Nieto	We recommend specifically calling out the fact that the most vulnerable communities are low-income communities of color....Certain groups of people are more vulnerable to the range of climate change-related 14 health impacts, including the elderly, children, the poor, and the sick. "Many times the communities most vulnerable to the impacts of climate change are low-income communities of color". Others are vulnerable 15 because of where they live, including those in floodplains, coastal zones, and some urban areas...	1. Executive Summary		5	15	The authors believe the existing language is appropriate.
Y. Armando	Nieto	The Climate Assessment Report states multiple times that the solutions to many agricultural challenges in regard to climate change will require "innovative" strategies. By definition innovation is the development of new ideas through solutions that meet new requirements. By advocating for innovative agricultural management solutions, it implies a technological approach to mitigating the problems we are facing today.There are many strategies to make farms and the overall agricultural sector resilient. Many of those strategies require a return to past practices (for example: integrated pest management, poly-crop fields, integrating animals and crops, improving practices to increase Soil Organic Matter such as reducing how much a field is tilled, etc). The only solution to building resilient farms is not technology-based but also includes organic, sustainable methods of farming.	6. Agriculture				Reading beyond the quote from the Wikipedia definition of innovation reveals that technologies are only one of five alternatives for accomplishing innovation. Products, processes, services, or ideas are alternatives to technologies for achieving innovation. No change in the text is needed.
Dale	Quattrochi	The text provides an example of Miami, FL as the most populous metropolitan areas, but Atlanta, GA should also be added since it is the larges metropolitan area in size, in the southeast.	17. Southeast and Caribbean		583	28	The text has been revised to incorporate this suggestion.
Dale	Quattrochi	Ice storms should be added as a factor along with freezing winters since ice storms do a significant amount of damange in the southeastern U.S.	17. Southeast and Caribbean		584	17	The text has been revised to incorporate this suggestion
Dale	Quattrochi	Text mentions U.S. Highway 64 being raised four feet to allow for sea level rise. Where is Highway 64 located in its relationship to the coast?	17. Southeas		591	12	The text has been revised to incorporate this suggestion

			t and Caribbean				
U.S.	Environmental Protection Agency	Can the number of deaths attributed to Sandy be stated in terms of the Northeast rather than the US as a whole? These deaths presumably all occurred in the Northeast, and stating the fact in that context removes any confusion that deaths may have occurred in other regions.	16. Northeast		555	1	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Please clarify "not a surprise". As written, it implies that solely because NY has 600 miles of coastline and 500,000 people living in floodplains, that the severity of the storm and its impacts should not be a surprise. This should be tied explicitly to the previous sentence that such impacts could have been expected in this situation.	16. Northeast		555	10	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Is the qualifier "state-owned" critical here? Do private roads make up a significant fraction of the total?	16. Northeast		554	15	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	It would be helpful to provide a brief explanation of how urban heat islands work and why temperatures are higher in urban areas compared to rural areas.	16. Northeast		556	17	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	It would be helpful to put these increases into context. Can estimates be provided of current mortality and morbidity associated with heat and with ozone exposure?	16. Northeast		557	8	The text has been revised to incorporate this suggestion.
Dale	Quattrochi	There only is passing mention (with very limited substance) regarding the effects of lightning on air quality and human health in the southeastern U.S. Under climate change scenarios where there is increased thunderstorm activity, there is a subsequent increased probability that more lightning will occur. This will potentially increase hazards to human health and property via a corresponding prevalence of lightning strikes. Lightning is also a contributor to increases in ozone. Lightning increases nitrogen oxide, particularly in the upper troposphere, which leads to increased ozone as a contributor to air quality problems over the region. Thus, there is a positive feedback mechanism that leads to an elevation of greenhouse gases via increased lightning activity. The absence of any real discussion of lightning impacts in the southeast U.S. as a result of climate change, therefore, is a significant omission from this chapter of the NCA draft report.”	17. Southeast and Caribbean				Given the limited space alloted to the chapter, we made choices about the issues on which to focus. Lightning was not considered one of the most salient concerns right now, but could be covered in more depth in subsequent quadrennial assessments.
U.S.	Environmental Protection Agency	To what extent does the fact that many of the residents in the NY/NJ metropolitan area live in high-rises affect the points made here? Obviously this population remains vulnerable to storm surge, but the vulnerability to loss of life and injury is not the same compared to a like number of people living in single-story residences.	16. Northeast		557	23	While the comment suggests a good specific example, the authors feel the existing examples are appropriate and adequate. Also, space is too limited for all the relevant examples.
U.S.	Environmental	General comment on 'Stressed Infrastructure' section: The text in this section includes some specific economic and other impacts data related to the transportation sector that are shown in Table 16.1.	16. Northeas		558	16	The text has been revised to incorporate this suggestion.

	Protection Agency	Specific costs and extent of areas at risk that relate to the transportation sector include stresses on roads, rail lines, airports, and ports. The other three sectors included in Table 16.1, namely communication, energy, and water and waste, are dealt with perfunctorily on page 560, lines 1 through 5. Considering the magnitude of incurred and potential infrastructure stresses and costs in these three sectors, there should be some numbers that quantify the risk. This approach will also lead to internally consistent presentation of content and data among the sectors in this section.The prose seems unconnected with the table of impacts. Most likely, the table of impacts needs to be substantially simplified. It is a bit unclear from the fact of the table why the table is even here--it looks like something that belongs in one of the sectoral chapters instead. One can either (a) create a table to summarize the story that the prose tells anyway, a sort of reader aid; or (b) reproduce a table from another report and then say something about the table, for example by discussing one column and allow the reader to explore the other columns. But this table seems to be neither. Finally, there is no obvious structure for the section, which appears to be entirely about transportation in spite of the name of the section.	t				Concerning the table, we are not inclined to change it since it represents an actual example of a stakeholder developed product in one place, rather than a composite assessment.
U.S.	Environmental Protection Agency	The discussion of infrastructure stress and vulnerability should refer to the NCA chapters on specific sectors - transportation, water, and energy that provide additional detail on specific infrastructure vulnerabilities.	16. Northeast		558	16	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	The key message for this section is correct, but underplays the extent to which infrastructure is already being compromised. This is a point that is made throughout the chapter, but seems to be downplayed in this message. Perhaps "Infrastucture is now, and will be increasingly..."	16. Northeast		558	17	After consideration of this point, we still feel the existing text is clear and accurate. Key Messages 1-3 highlight increasing hazard with climate change; noting present vulnerability distracts from that point, makes the messages longer, and would really deserve to be done for all three messages if was done for one message. Also this is really a national issue rather than specific to the NE.
U.S.	Environmental Protection Agency	The parenthetical here seems awkward regarding verb tense. As written, it is correct, but the 1-4 ft refers to sea level rise (singular), which would suggest "1 to 4 feet [of sea level rise] is projected…"	16. Northeast		558	20	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	CRITICAL COMMENT: The statement about $6 trillion being exposed to coastal flooding has problems. First, the text should clearly indicate that the source for this estimate is grey literature (a report by the World Wildlife Fund). Second, the WWF report cited does not indicate the level of peer review to which the report was subjected. Third, this chapter seems to have mischaracterized the WWF report in several ways: (a) $6 trillion exposure is for the 17 largest port cities, including Miami and New Orleans. (b) the total exposure to floods from that study includes exposure due to current circumstances and future development; it is wrong to say that sea level rise exposes all of those assets; (c) Table 3.2.3 in the WWF report seems to suggest that the incremental exposure to a potential 100-year flood for those five cities is about $600 billion per foot of sea level rise. Fourth, the WWF estimates appear to be based on a very coarse model designed for global-scale analysis, not for estimating the impacts on a given city. At a minimum, this should be pointed out.	16. Northeast		558	20	The text has been revised to incorporate this suggestion.

U.S.	Environmental Protection Agency	This sentence might be a mis-statement of what the study showed, and the authors should fact check the part about roads and rails. Many such studies estimate the mileage of roads that pass through low areas, which is different from the mileage of roads that are actually so low-lying. Roads through wetlands, for example, are not flooded twice daily but rather are built on roadbeds that may be considerably higher. Major roads are often built above the 100-year flood level even while the surrounding ground is much lower. While it is possible for LIDAR studies to use actual road elevation, many studies do not do so and the authors of such studies often are not explicit about this distinction. The studies still provide useful quantification, but the words that one uses to describe the results are different for a road that actually is two feet above the high water mark, and a road that is at 12 feet running through land that is at 2 feet.	16. Northeast		558	23	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	This statement needs important clarification. First, assume that we accept the assertion that 30% of the Port of Baltimore would be in the 100-year flood plain (if that is what "exposed to flooding" on line 21-22 means). Even if that is so, the economic importance of the Port of Baltimore to the State of Maryland does not demonstrate that there are significant economic ramifications to a lot of the port being in the floodplain. One would have to demonstrate that the floods would close the port for a significant period of time often enough to matter. Ports are inherently along the water with their lowest land occasionally flooded, but that does not necessarily matter as long as the docks, cranes, and tracks are secure and undamaged. Those facilities are rebuilt every few decades anyway. (If the text is intended to assert that 1/3 of the Port of Baltimore would be tidally inundated with a two foot rise in sea level, by contrast, that assertion does not appear correct and probably results from the unavailability of LIDAR when the DOT 2008 study was conducted.)	16. Northeast		558	28	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Presume that "New York" refers only to New York City. Please make changes if appropriate to avoid confusion.	16. Northeast		558	22	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Please provide citation for NYC panel findings.	16. Northeast		558	31	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	"Override" seems out of place here. Perhaps "exceed" or "overcome" would be more appropriate.	16. Northeast		561	24	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	CRITICAL COMMENT: The key quantitative assertion about the loss of wetlands in Blackwater Wildlife Refuge is potentially problematic for several reasons. First, the parenthetical explanation about the 6.6-foot sea level rise scenario is distracting and unnecessary. One could get almost 5 feet of relative sea level rise from the 4-foot high global scenario already discussed, plus the 0.6 feet of subsidence calculated by Holdhal and Morrison (1974). This needs clarification. Furthermore, the Maryland DNR report cited is not, in fact, the source of these figures. Rather the source is an unpublished GIS analysis. It is possible, perhaps likely, that unpublished GIS analyses ignored vertical wetland accretion, and thus over-state wetlands loss. They often ignore landward migration of wetlands as well. A final problem is that it is unclear whether the statement in Public Review Draft is even in the Maryland DNR report being cited. No page number was provided, but the text and Table on pages 21-22 provide estimates	16. Northeast		561	29	The text has been revised to incorporate this suggestion.

		for the impact of 0.25, 0.5, 0.75, and 1.5 foot rises in sea level. The text in that report mis-states the contents of the table that it is describing, with the table saying that the 66% wetlands loss is caused by a 1.5-foot rise while the text says 3 feet. This situation helps to demonstrate the problem with relying on secondary sources. At a minimum, the source of the data should made clear and its limitations pointed out, as appropriate.					
U.S.	Environmental Protection Agency	Reference to the 6.6-foot scenario, not otherwise in this chapter, is distracting and probably unnecessary, since you have already talked about and explained a 4-foot global rise.	16. Northeast		561	30	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	It seems odd that the only example of tidal marshes and swamps is the Blackwater National Wildlife Refuge. If this refuge is featured because it is the most vulnerable of sites, or is the only one in the Northeast, then the sentence should state that. Otherwise, its inclusion is out of place, a single example that is cited here without explanation or context.	16. Northeast		561	32	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	To further drive home the point that New England led the way on adaptation, the report should probably also mention that MA, ME, and RI had each adopted some form of "rolling easement" policy by 1990 to ensure that wetlands or dunes migrate inland as sea level rises. You could cite CCSP 2009, page 159.	16. Northeast		562	6	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	This figure is not very informative. Given the interest in keeping the document to a manageable length, this should be removed or replaced with graphics that convey information.	16. Northeast	16.11	565		The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Please clarify "washed out." Is it the culvert itself that is washed out, or the culvert and roadway?	16. Northeast		565	21	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	This paragraph should be rewritten to clarify the key issues. As written, there is no way for non-experts to understand what is meant by "culvert governance" or what is meant by complexity related to the governance map. Are these maps REALLY "global" in scale? What is the importance of the calendar? It's assumed this is a calendar of particular events, but that is completely unclear in the current explanation.	16. Northeast		556	1	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	To avoid the appearance of a bias toward the negative, the chapter should show graphs for both extreme hot days and the reduction of extreme cold days. Intuitively useful metrics for extremely cold days might be average number of days with overnight low below 0 degrees F, or daily high below 32 degrees F.	16. Northeast				We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include.
U.S.	Environmental Protection Agency	"But this and other adaptations will not be cost- or risk-free". The text that follows the key message does not discuss potential costs or risks associated with "this and other adaptations". In the absence of supporting data, this can be perceived as the authors' opinion based on personal perspective. Please add supporting data or remove this phrase.	16. Northeast		560	14	The text has been revised to incorporate this suggestion.

U.S.	Environmental Protection Agency	Does "hundreds of million visitors" double count people who visit more than once? If so, "visitors" should be changed to "visits". Also, some coordination and consistency checking is needed across chapters on matters that arise in several chapters, because the coastal chapter reports only "millions" of visitors. It seems very unlikely that 100 times as many people visit the Southeast as visit the coast, especially since half the nation's population lives in the coastal zone, according to the coastal chapter.	17. Southeast and Caribbean		583	26	The cited reference refer to visitors, as does the chapter text, so it is accurate. Two additional references have been added to another sentence also refer to visitors.
U.S.	Environmental Protection Agency	Please check the citation for the population and visitors statement. The Census Bureau brief cited here does not appear to provide any information on tourism. Please complete the Census Bureau citation (report number, authors, etc.)	17. Southeast and Caribbean		583	26	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	This is a very interesting map, which probably needs to be referenced in the text. Suggest the caption be clarified. Perhaps the title should include "by state". One EPA reviewer interpreted the figure as indicating that Tennessee and Georgia each lost at least $1 billion in a weather disaster more 33 to 42 times during the 30 year period, while that fate only befell Louisiana and Florida 25-32 times. Because it seems surprising that Florida would have experienced $1 billion in losses fewer times than Tennessee, an explanation for how that occurred is needed. If the state-specific shading does not refer to the number of times a given state has experienced $1 billion in losses, then an even more detailed explanation is needed.	17. Southeast and Caribbean	17.1	584		The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Please check the citation for Fig 17.1. It currently cites http://www.ncdc.noaa.gov/billions/Population Distribution and Change: 2000 to 2010, summary statistics. The "Population Distributions…" would seem to be a typo from the previous citation.	17. Southeast and Caribbean	17.1	584		The text has been revised to incorporate this suggestion.
Rosie	Stahl	I would like to analyze and comment on the executive summary of the Third National Climate Assessment draft by using the six key traits of "stickiness" shared by Chip and Dan Heaths' Made to Stick book. Heaths' traits are to a successful message includes: simplicity, unexpectedness, concreteness, credibility, use of emotion and the use of stories. The executive summary lacks three of the six components: the trait of unexpectedness, use of emotion and use of stories. I would assume that people who choose to read this report are already genuinely interested in climate change and are reading for knowledge. If the assessment is meant to persuade those who are concerned or disengaged, the summary needs to include something unexpected that will attract the reader's attention. Secondly, it lacks the trait of being emotional to the reader, especially to those who are non-believers often looking to debunk climate change. Inserting a story such how a person or animal was affected by heat or droughts can help people care more and become engaged in environmental movements. Third, using a myth busters type of approach in the summary can help people better follow along the multiple examples used and break down any incorrect knowledge they may already have. Lastly, I believe that if the region graph was moved closer to the beginning, it would intrigue readers to read further. I found the graph very interesting as I typically am not aware of what is happening in other parts of the country, but find myself often curious. Also, if there was the ability to include other continents or parts of the world, it would entice readers to care more.	1. Executive Summary				Thanks for your comments, it is useful to think about the report as a communication document. However, its primary purpose is as a scientific assessment, which limits the capacity to focus on emotive statements. We have incorporated your suggestion to include an infographic- map of regional impacts in the Executive Summary.
U.S.	Environmental Protection Agency	Please check the citation for Louisiana's Coastal Master Plan and cite appropriately (author-date). The website shows the report's formal title as "Louisiana's Comprehensive Master Plan for a Sustainable Coast", with the Coastal Protection & Restoration Authority of Louisiana as the responsible organization.	17. Southeast and Caribbean		585	6	The text has been revised to incorporate this suggestion.
U.S.	Environ	Please state which figure it is referencing. Presumably in this case it is 17.3.	17.		586	7	The text has been revised to

	mental Protection Agency		Southeast and Caribbean				incorporate this suggestion.
Luisa	Cristini	The whole chapter 29 seems to me a bit too vague. The main research goals are identified, but they are still very broad and do not point at the open questions and gaps of knowledge that remains after the assessment. I expected more specific description of objectives for each chapter or theme. The chapter basically states that research is needed in every field of climate sciences although it does not state specifically what the needs are. I suggest to develop the chapter or to cut it and include the content in the others.	29. Research Agenda for Climate Change Science				The chapter has been restructured and is now explicitly focused on research for assessments.
U.S.	Environmental Protection Agency	This statement is unclear. Although there may not be any statistically significant trend in tornados, the comment regarding better reporting calls into question whether the statistical analysis accounts for better reporting or not. This should be clarified. The statement should also clarify what trend is being analyzed - is this number, size, damage?	17. Southeast and Caribbean		586	13	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Is there a more recent citation that can be used here?	17. Southeast and Caribbean		586	13	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	These maps are good. Only suggestion is to either remove the latitude-longitude lines or label them.	17. Southeast and Caribbean	17.4	588		The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	These maps are good. Only suggestion is to either remove the latitude-longitude lines or label them.	17. Southeast and Caribbean	17.5	589		The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	San Juan is not especially vulnerable to sea level rise, though the extremely coarse digital elevation model data might suggest otherwise. The low portions of San Juan are about as high as the highest portions of Galveston. St. Petersburg is also very vulnerable. San Juan is vulnerable to riverine flooding.	17. Southeast and Caribbean		591	2	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Should clarify where NC is raising Highway 64 to address sea level rise, as the highway runs the length of the state.	17. Southeast and Caribbean		591	13	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection	Given the socioeconomic diversity of coastal populations in the SE, it would be good to include a statement on sea level rise vulnerability and environmental justice, and/or references to the discussion of coastal vulnerability in Chapter 25. Findings from a recent study could be included. Martinich, J., J.E. Neumann, L. Ludwig, L. Jantarasami (2013). Risks of sea level rise to disadvantaged communities in the	17. Southeast and Caribbea		593	8	The text has been revised to incorporate this suggestion.

	Agency	United States. Mitigation and Adaptation Strategies for Global Change. Accessed at: http://www.springerlink.com/content/x411112212347762/.	n				
U.S.	Environmental Protection Agency	Please insert "may become unavailable or " after "insurance" and before "costs will increase". There should be ample citations to insurance unavailability in Florida.	17. Southeast and Caribbean		593	10	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Clarify whether Nichols et al. made this assertion for the southeastern USA. If so, the specific section of that report should be cited since Nichols et al. is a long chapter not specifically focused on the southeast.	17. Southeast and Caribbean		593	22	The precise page for this assertion has been added to the reference
U.S.	Environmental Protection Agency	Figure 17.8 maps of South Florida could also include the adaptation scenarios map created by the South Florida Regional Planning Council with the cooperation of various counties (Manny Cela of SFRPC created the map. Report by Cela et al. is referenced in the NCA Coastal technical inputs report by Burkett and Davidson (2012)).	17. Southeast and Caribbean	17.8	594		After consideration of this point, we still feel the existing text is clear and accurate. These maps are quite interesting but they do not fit the theme of this text box and would require a new box.
Michael	Kruk	Insert the word "The" at the beginning of the first three (3) Key Messages. Remove the word "now" on key message #1, first sentence.	2. Our Changing Climate		25	27	Regarding the first part of this comment, after consideration of this suggestion, we still feel the existing text is clear and accurate. Regarding the second part of this comment, we have incorporated the suggested change.
Michael	Kruk	As currently worded, this sentence on sea-ice loss implies there will be a point of an ice-free arctic. Suggest adding the words "...or will not be seasonally replenished" to clarify that winter ice will still form.If that is not the case, then the authors should state at what year the arctic will be ice-free.	2. Our Changing Climate		26	33	A short sentence about summer ice loss was added to the Key Message. Details about seasonality are contained in the main text (where they belong, if the Key Message statement is to be succinct), including a clear statement that winter sea ice is not going away.
Michael	Kruk	Remove the word "painstakingly." It is an unnecessary and subjective adjective that detracts from the science of the manuscript.	2. Our Changing Climate		28	8	The text has been revised to incorporate this suggestion.
Michael	Kruk	add "weather" so it reads, "...monitor the Earth's weather and climate system."	2. Our Changing Climate		28	10	The text has been revised to incorporate this suggestion.
Michael	Kruk	Reword the sentence beginning with "Atmospheric water vapor..."The reason is that the wording of "...as have sea levels." is awkward and makes the sentence hard to read and interpret.	2. Our Changing Climate		28	14	The text has been revised to incorporate this suggestion.
Michael	Kruk	Please explain in the text why the "base period" for comparison in most of the Figures in the chapter is 1901-1960.Secondly, the use of this base period is very unconventional. Moreover, examining Fig 2.2 shows that period to be one of the coldest on record - thereby making ANY comparison to it	2. Our Changing Climate				A discussion of the choices for base periods has been put into a Box at the beginning of the chapter.

		automatically above "normal." This skews the results.Why not do a base period of 1971-2000?Also, some Figures use the base period 1901-1960 and others use 1971-2000 (Fig 2.4, 2.5), and yet others use 1971-1999 (Fig 2.7). Why not one base period across all Figures?					
Michael	Kruk	The words "dry belt" imply a range of values, say between 23-40 N/S latitude. Instead, anything greater than 23 N/S is listed and a singular value is not a "belt." Please clarify.	2. Our Changing Climate		32	21	The text has been revised to incorporate this suggestion.
Michael	Kruk	"...less frequent but more intense."What is the science behind this statement? Can we attribute this to changes in the number and size of cloud condensation nuclei? It cannot be "increased water vapor" because that alone does not explain the "less frequent" wording. Please clarify with a scientific basis for the sentence.	2. Our Changing Climate		32	27	After consideration of this point, we still feel the existing text is clear and accurate. "Less frequent but more intense" means that there are fewer rainy days but more intense rainy days across most of the U.S. Hence there is a change in the distribution of daily precipitation. References have been added.
Michael	Kruk	Remove the word "Generally" from the figure title.On the same note, can a better Figure title be made? I understand the target audience, but it sounds like the title belongs as part of the caption (same can be said for Fig 2.4).How about, "Projected Percent Change in Annual Average Precipitation"?Also, here is a good example of the use of a base period 1901-1960 that is "to be redone with the base period 1971-2000." WHY?	2. Our Changing Climate	2.5	34		The figure titles have been revised to incorporate this perspective. A box has been added to the chapter to explain the base periods.
Michael	Kruk	Please insert the word "The" at the beginning of the sentence. Generally, sentences (let alone paragraphs) should not begin with numbers or acronyms.	2. Our Changing Climate		35	8	The text has been revised to incorporate this suggestion.
Michael	Kruk	For the sentence starting with, "These advances..." - please rephrase this sentence. Suggest removing the words "together with the continued warming." It's hard to read as currently written.	2. Our Changing Climate		35	17	The text has been revised to incorporate this suggestion.
Michael	Kruk	The U.S. Average inset box plot is buried and mixed within the other regional graphs.Suggest moving the U.S. Average box to underneath the legend so it stands on its own.	2. Our Changing Climate	2.6	36		The figure has been revised to incorporate this perspective. The report will be published as an interactive pdf document. This will have a feature that one can click on a particular graph and it will provide a version of the image with better visibility.
Michael	Kruk	The gradient in the red colors on the far right (A2) scenario are very hard to see.	2. Our Changing Climate	2.7	37		The figure currently adheres to NCA guidelines for legends.
Michael	Kruk	For the sentence containing, "...particularly in high elevation and coastal areas..."Suggest removing the words "consistent with rising sea surface temperatures" as it is highly unlikely for rising SST's to impact the length of the growing season at high elevations away from the coast. It reads as if those words were just stuck onto the sentence to provide some sort of scientific explanation for the change in the western U.S.If the change in the growing season can in fact be attributed to rising SSTs, then a citable reference is needed.	2. Our Changing Climate		39	37	We have made the suggested change.
Michael	Kruk	The U.S. Average inset box plot is buried and mixed within the other regional graphs.Suggest moving the U.S. Average box to underneath the legend so it stands on its own.	2. Our Changing	2.11	42		The figure has been revised to be consistent with NCA style standards. In

			Climate				the interactive pdf, it will be possible to zoom in on particular plots within the figure.
Michael	Kruk	What are the "large-scale circulation changes"? Is it due to a jet stream moving north?The sentence discussing the SW precipitation (line 11-13) is really vague and is in need of more scientific explanation. How do the authors attribute the reduction in precipitation in this region of the U.S. is caused by "heating of the global atmosphere"? Was there a downscaled study done to show this?To be honest, the chapter could do without this entire paragraph as currently written. Suggest rephrasing, adding in science basis, or deleting completely.	2. Our Changing Climate		43	8	Heating of the atmosphere induces several circulations changes. For the Southwest US, the expansion of the Hadley circulation causes a shift in the subsidence regions leading to the projected reduction in precipitation. However, space does not permit such a detailed explanation.
Michael	Kruk	The Chapter uses a lot of different modeling scenarios, including CMIP 3, CMIP 5, NARCCAP, etc.In the 2009 report, only the CMIP3 suite was used because that is what AR4 was using.Now, AR5 is using CMIP5. To be consistent, shouldn't this report be ONLY using CMIP5 as it offers pathways (instead of scenarios), and a better resolution (as stated on page 29)?With so many different approaches, it questions the results and findings of the report as not one result is consistent with another. Then there is the added complication of using different and odd base periods mixed in with different models. Can the authors please clarify and explain their reasoning? Particularly why CMIP5 isn't use more throughout?	2. Our Changing Climate				The box on models used in the assessment, in the supporting text for KM 1, has discussion on why both CMIP3 and CMIP5 scenarios are used in the chapter. We have expanded the discussion in that box.
Michael	Kruk	Line 12 of the caption: replace the words "could be expected to" with "would".	2. Our Changing Climate	2.13	46		We have adjusted the wording somewhat following the commenter's suggestion.
Michael	Kruk	Remove the words "and uncomfortably" as this is a subjective adjective.	2. Our Changing Climate		51	19	The text has been revised to incorporate this suggestion
Michael	Kruk	"...number of cold waves..." Extreme cold waves?	2. Our Changing Climate		52	12	Changed to "extreme cold wave". Since "cold wave" does not have an exact definition, the characterization of these as "extreme" is a matter of judgment. For this report, we are identifying "cold waves" as cold periods that will occur on average only once every 5 years. This is sufficiently rare that characterization as "extreme" seems reasonable. We have added the word "extreme" before "cold wave".
Michael	Kruk	"...lowest levels on record." Since 1901?	2. Our Changing Climate		52	13	We added the phrase "since 1895".
Michael	Kruk	"Attribution of flood events..."Attribution to what? Global climate change? Human influences? Urban sprawl? Land-use changes?Please clarify what is meant by "attribution."	2. Our Changing Climate		55	13	Recommended rewording has been inserted, although it is the "changes in flooding" that are the issue here.
Michael	Kruk	"...depending on the situation..."How about rephrasing to say, "...depending on antecedent conditions..."	2. Our Changing		55	19	We have modified the text. Relevant surface conditions depend on

			Climate				antecedent events as well as land surface characteristics, topography, etc.
Michael	Kruk	"While a 2-inch rain..."What is the context for these final sentences? A 2-inch rain falling on a D-4 drought region has impacts. A 2-inch rain falling in Charleston, SC on top of high tide has impacts. Please provide some scientific context for this argument.	2. Our Changing Climate		55	20	We have removed this sentence.
Michael	Kruk	Caption - what is "VIC model"?And yet another model other than CMIP3, CMIP5, NARCCAP...just adding to the confusion.	2. Our Changing Climate	2.22	58		This is the Variable Infiltration Capacity hydrologic model to which the caption references refer. This is now spelled out in the caption
Michael	Kruk	..."virtually every measure..."Be specific. WHICH measures? PDI? ACE? Counts? Frequencies?	2. Our Changing Climate		59	18	We have modified the text on hurricanes for clarity. Additional references have also been included.
Michael	Kruk	Line 36, "...continued warming of the tropical oceans by heat-trapping gases."Remove the words, "heat-trapping gasses." The fact is, the oceans are warming, both by CO2 uptake and solar radiation.Be careful when using the word "Hurricane." It only applies in the Atlantic basin. Globally, the term "Tropical Cyclone" is favored. Please fix.	2. Our Changing Climate		59	36	We have removed "heat-trapping gases." The warming scenarios used by the models are indeed forced by more than greenhouse gas. Since we are focusing mostly on Atlantic storms, we feel that “hurricanes” is appropriate and is more readily recognized by the intended readership.
Michael	Kruk	The reference for Vose, 2012 is incorrect. Should it not be Vose et al., 2012b that refers to the changes in extra-tropical cyclones, winds, and waves?	2. Our Changing Climate		60	13	Reference changed to Vose et al. (2013).
Michael	Kruk	"...the wintertime circulation..."Which one? The AO? The NAO? The PNA and NAO combined? Please clarify.	2. Our Changing Climate		60	26	The study of Francis and Vavrus (2012) evaluated changes in 500 hPa wave amplitude, regardless of the mode of variability (NAO, AO, PNA, etc.). They did not tie their findings to any particular mode. Moreover, the main issue with this study is the reproducibility of their conclusions. The text has been changed to cite Screen and Simmonds (2013) and their findings that call into question the conclusion of Francis and Vavrus (2013). We now note the important sensitivity to the choice of the metric of wave activity.
Michael	Kruk	What is "IBTrACS"?	2. Our Changing Climate	2.23	61		IBTrACS could be expanded to read: International Best Track Archive for Climate Stewardship, and refers to a global best track data set for tropical cyclones that merges information from multiple meteorological centers around the globe.

Michael	Kruk	"...compared with the period 2001-2020."Wow. Where are the data for 2013-2020 coming from? Is the figure based on a model output, which is in turn based on modeled input data? Garbage in, garbage out?Why does this "base period" differ (again) from everything else used in this Chapter?	2. Our Changing Climate	2.24	62		The previous figure was illustrating the response of the hurricane activity to a gradually changing forcing. Only the forced response was illustrated. Assuming that the response is roughly linear for the CMIP3 A1B scenario (justified by inspection of global mean temperature) it seems acceptable to illustrate this rate of change in terms of a difference between two averaged periods along the trajectory. The reader is perhaps confusing this approach with decadal prediction, where one is actually attempting to predict the state of the Atlantic climate at a particular time, including the time-evolving internal variability component (e.g., AMO). When one is focused on illustrating the forced response, the internal variability component plays the role of the noise in which the forced response (signal) is buried until it emerges (is detected). The detectability timescale for the Cat 4-5 changes illustrated in the figure is of the order of six decades according to Bender et al. However, the authors have decided to remove this figure for other reasons.
Michael	Kruk	Remove the words, "Like mercury in a thermometer". This is unnecessarily wordy.	2. Our Changing Climate		63	5	Analogies such as this provide useful references for the general public to understand the causes of sea level rise.
Michael	Kruk	Remove the entire sentence, "Proxy data have shown..."	2. Our Changing Climate		63	10	This sentence explains an important piece of evidence showing that the modern rate of rise is much higher than that of the previous 2000 years.
Michael	Kruk	Put a period after "the last century." Then delete everything else in that paragraph.The entire paragraph doesn't flow well. Each sentence is a new idea, concept, etc., and none of them support one another.	2. Our Changing Climate		63	13	This has sentence has been clarified to make it clearer that the recent acceleration was in addition to the acceleration observed in the salt marsh record described above.
Michael	Kruk	"...local high-tide level..."Do the authors mean MHHW? If so, please state it explicitly. Many coastal residents are familiar with this terminology, and saying anything else is watering down the importance of this finding.	2. Our Changing Climate		63	40	The text has been changed as recommended.
Michael	Kruk	What is the title of this Figure?Also, the caption is mis-leading. It says, "...data collected from the U.S.	2. Our	2.25	64		Caption now says North Carolina.

		East Coast."True, but it really is only North Carolina - not the entire East Coast. So just state it as it is. Call a cow a cow. The data were collected from tidal gauges off of North Carolina.	Changing Climate				
Karin	Bumbaco	Is OA research really "new"? As far as I know, it's been around for a while but has received increased attention in recent years.	21. Northwest		722	40	Although the research may not be new, the level of concern is.
Karin	Bumbaco	I find this paragraph hard to follow. It's too generalized and not very explicit about the uncertainty in some of the numbers given or even where in the PNW these changes were observed. Furthermore, the statement "snowpack decreased 0% to 30%" is worded poorly. If it decreased 0% then it stayed the same. That should be explicit such as "changes in snowpack were not observed or there were decreased up to 30%".	21. Northwest		723	5	The text has been revised to incorporate this suggestion.
Karin	Bumbaco	The wording of this sentence is awkward.	21. Northwest		725	22	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	It might be clearer to mention all four adaptation pathways. The CCSP SAP 4.1 also used three pathways: Structural protection, elevating land and structures, and retreat. That is, CCSP SAP4.1 subdivided protection into hard structural protection and the soft protection options. To avoid confusion, the Restore Americas Estuaries (Benoit et al.) report on adaptation and the EPA report on Rolling Easements (Titus 2011) presented all four options separately. In the Southeast, the two types of protection are so fundamentally different that one ought not lump them into a single category. Barrier islands are being elevated, for example, while parts of the former Everglades are protected with a dike. Louisiana also is following a combination of natural deltaic land-surface elevation, and dikes. The accommodation options, while conceptually different, is not really a viable long-term pathway in most locations and is mostly a temporary approach until a decision is made between structural protection, nonstructural protection, and retreat.	17. Southeast and Caribbean	17.8	594		The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	These sentences could lead one to infer that people are already dying because of global warming. It would be useful to clarify whether conclusions can be drawn regarding current increased mortality and the effects of climate change, or whether the discussion points out potential health impacts.	17. Southeast and Caribbean		595	10	After consideration of this point, we still feel the existing text is clear and accurate. The text as is does not make any mention of attribution of deaths to climate change. The wording here is intended to highlight the established negative health effects of extreme heat, and to highlight the observed increases in temperature in several major Southeast cities - and the corresponding above-average mortality rates.
U.S.	Environmental Protection Agency	Please clarify "highest increase" relative to heat index. Is this highest absolute or relative? What is the baseline period to which this is being compared?	17. Southeast and Caribbean		595	13	During subsequent revision, the text in question was deleted as the reference was outdated.
U.S.	Environmental Protection Agency	The title of this section should be revised. Much of the discussion does not explicitly make the connection to extreme heat. There are several discussions of increasing temperatures, but these are not necessarily instances of extreme heat.	17. Southeast and Caribbean		595	6	The text has been revised to incorporate this suggestion.

U.S.	Environmental Protection Agency	The caption for this figure needs clarification. Is this peak ozone, average (and if so, over what time period), etc.	17. Southeast and Caribbean	17.10	596		The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	This is a useful figure. Nevertheless, it is different from the comparable figure in Tagaris et al. 2009. It zooms in on the southeast, which is to be expected. But it also uses different increments of ozone for the scale. A note to that effect should be added. Moreover, the revised scale (and the geographical limits of the map) hide the areas with the greatest increase in ozone: In the original journal article, one can see that ozone would increase by 3.57-5.00 ppb along most of the Texas Gulf Coast. This map only goes up to 3.0 ppb and cuts off the Texas Gulf Coast - the boundaries should be extended enough to include the entire Texas coast. The authors should be commended for including Ohio and other northern states, so that the reader can see that ozone wold decline in some areas. That inclusion shows that the authors are being objective about the implications of climate change, and not merely highlighting adverse impacts, which clearly dominate in the southeast.	17. Southeast and Caribbean	17.10	596		After consideration of this point, we still feel the existing text is clear and accurate. The caption clearly indicates that this figure was adapted to the Southeast chapter and Texas is not in the Southeast Region of the National Climate Assessment. The ozone concentration increments used in this map were specifically chosen by the original study author (Tagaris) to highlight projected conditions in the Southeast.
U.S.	Environmental Protection Agency	This figure shows ozone getting worse in the southeast but better in the cooler midwest and northeast areas. Yet the chapters on the midwest and northeast do not mention it. If the graphic is valid, then it is as important to show the improvement in the cooler areas as the deterioration in the southeast. A consistent story across NCA chapters about increased tropospheric ozone levels is needed.	17. Southeast and Caribbean	17.10	596		After consideration of this point, we still feel the existing text is clear and accurate. The issue of O3 was selected as relevant to this region, but other regions made different choices.
U.S.	Environmental Protection Agency	The sentence implies that the losses stated for North Carolina are agriculture-related, but this is not clear. Please clarify.	17. Southeast and Caribbean		597	18	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	This sentence needs additional clarification. One would normally expect that if fires become more frequent, then they would be less intense because there would be less time for the soil to accumulate fuel between fires.	17. Southeast and Caribbean		597	37	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	The sentence suggests that land use changes prevents "a useful adaptive strategy". Presumably this refers to prescribed burning as the adaptive strategy being prevented. If so, that should be clarified. One could also consider growth management as part of the adaptation strategy to enable continued application of this "useful adaptive strategy."	17. Southeast and Caribbean		598	2	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	The term "anxiety" needs some clarification. Presumably, most of the adverse effects of climate change will cause some people considerable anxiety and many people some level of anxiety. If there is medical evidence of anxiety disorder in these cases, then that should be noted. If the cited study just happened to mention the routine anxiety which is ubiquitous, then that "definition" should be noted at the beginning of the chapter (if at all). As is, the text seems to be suggesting that droughts in the Caribbean have a unique problem with anxiety.	17. Southeast and Caribbean		598	37	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protecti	The innovative recycling project discussed in this box seems potentially important, but a more detailed explanation of what happened is needed. The assertion that wetlands filtered some treated water is insufficient to explain why one county had so much more water.	17. Southeast and		599	16	There is not room to add a great deal of detail here but the text has been revised to point to a location for

	on Agency		Caribbean				additional information as requested in this comment.
U.S.	Environmental Protection Agency	This figure caption only mentions structural engineering options, and does not mention the environmental consequences to the estuary. Alternative adaptation approaches could also include higher water prices or mandatory conservation; these need to be mentioned as well.	17. Southeast and Caribbean	17.12	600		Maps or figures of rainfall changes were not included since there is so much uncertainty in projections.
U.S.	Environmental Protection Agency	Figure 17.10 in the Southeast chapter shows a graphic with ozone getting worse in the southeast but better in the cooler midwest and northeast areas. Yet the chapter on the midwest and northeast do not mention it. If the graphic is valid, then it is as important to show the improvement in the cooler areas as the deterioration in the southeast. A consistent story across NCA chapters about increased tropospheric ozone levels is needed.	18. Midwest				We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include. Ozone is not a major issue for this region.
U.S.	Environmental Protection Agency	Traceable account (key message 3/6, p. 637) The section starting on p. 625 initially notes that more than 20 million people experience AQ that fails to meet NAAQS, but later (page 637) notes that 26 million people live in counties that fail PM2.5 NAAQS and 24 million live in counties that fail O3 NAAQS. While the text on p. 625 is technically correct, it would be better to ensure that these numbers are consistent in both text and traceable account.	18. Midwest				After consideration of this point, we still feel the existing text is clear and accurate because the statistics are not measured everywhere in the MW region. However, based on details provided in the traceable account for a larger area, we know it to be more than 20 million.
U.S.	Environmental Protection Agency	Traceable account (key message 3/6, p. 638) The statement regarding warmer temperatures lead to worsening air quality should be clarified. It is likely true for ozone air quality, but the relationship is not as clear for PM.	18. Midwest				The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	CRITICAL COMMENT: Relate this key sentence to the Midwest with a simple "a key economic sector in the Midwest" kind of phrase. The last phrase in this sentence, discussing advances in genetic and agronomic technology could be too prescriptive. Genetic technology is not addressed in this chapter or in Chapter 6 (Agriculture) and this statement is therefore not supported by the assessment and should be removed. The authors should also reconsider the statement regarding agronomic technology, which is only lightly addressed in this chapter.	18. Midwest		617	14	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Please be careful to note that the region is not a net absorber of carbon, the region's forests are. Suggest revising to "…drive the habitats of many tree species northward. These forests' role as…".	18. Midwest		617	20	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Consider mentioning humidity here.	18. Midwest		617	24	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protecti	Consider adding drought here.	18. Midwest		617	30	After consideration of this point, we still feel the existing text is clear and accurate. There is little evidence that

	on Agency						meteorological droughts have intensified.
U.S.	Environmental Protection Agency	Presume that the term "altered" implies worsening rather than mitigating the effects of non-climate stressors. Suggest changing "altered" to "multiplied" or adding "multiplied".	18. Midwest		618	10	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Please clarify using direct language the phrase "ways that most people would consider detrimental". Consider including firm language on the costs outweighing the benefits.	18. Midwest		618	16	After consideration of this point, we still feel the existing text is clear and accurate. A cost-benefit analysis was not conducted.
U.S.	Environmental Protection Agency	The sentence that begins "Much of the region's…" does not fit into the paragraph about urban risks. Please move this to a more appropriate place. The sentence that begins on line 22 with "Most of the region's population…" should be moved to the first topic sentence of this paragraph.	18. Midwest		618	19	The sections identified have been rearranged to incorporate your suggestion.
U.S.	Environmental Protection Agency	Please elaborate on or briefly describe the types of potential opportunities for this region to reduce GHGs.	18. Midwest		618	26	The text has been revised to incorporate this suggestion but in the text for this KM.
U.S.	Environmental Protection Agency	Include text that reads something like "as the 900-2010 average" at the end of this sentence	18. Midwest		618	32	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	The sentence that begins with "These trends are consistent…" consists of two distinct thoughts. Revise to: "…concentrations of heat-trapping gases. Spatial variability of warming trends is also influenced…". Then, on line 36, start a new paragraph beginning with the sentence "The amount of future warming..."	18. Midwest		618	33	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Delete "current" from this sentence.	18. Midwest		618	40	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Please change "more than 1 deg F" to "1.5 deg F" to be consistent with Fig 18.1	18. Midwest		618	32	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protecti	Add the end year to this figure (2010?). Consider adding the other shorter trends discussed in the text (from 1950 and 1980 on)	18. Midwest	18.1	619		The graph has been extended to 2012.

	on Agency						
U.S.	Environmental Protection Agency	If possible, add 2012 data.	18. Midwest		619	6	After consideration of this point, we decided to retain 2011 to highlight vulnerability to extremes.
U.S.	Environmental Protection Agency	Same as previous comment on this key message. Relate this key sentence to the Midwest with a simple "a key economic sector in the Midwest" kind of phrase. The last phrase in this sentence, discussing advances in genetic and agronomic technology could be too prescriptive. Genetic technology is not addressed in this chapter or in Chapter 6 (Agriculture) and this statement is therefore not supported by the assessment and should be removed. The authors should also reconsider the statement regarding agronomic technology, which is only lightly addressed in this chapter.	18. Midwest		619	11	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Please define carbon fertilization	18. Midwest		620	9	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	The title of this figure is not at all descriptive. Change to something like: "Projected Mid-Century Temperature Changes in the Midwest"	18. Midwest	18.2	620		The figure has been clarified.
U.S.	Environmental Protection Agency	The relation to the temperature and precipitation variations described here to extreme events is unclear. Do the "high temperatures" and "cold air outbreaks" fit the definition of "extreme events"? Are these changes in extremes, changes in frequency, or changes in variability (or changes in all of these)? Drought and flooding should also be included here if the intent is to focus on extremes.	18. Midwest		621	9	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	This paragraph should refer to Chapter 6	18. Midwest		621	9	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Please clarify if this is showing historic, experimental, or projected relationships. Also specify the years for which the temperature/yield change data represent, and the averaging period over which the temperatures are compared.	18. Midwest	18.3	622		After consideration of this point, we still feel the existing text is clear and accurate.
U.S.	Environmental Protection Agency	It is presumed that the pollination and grain-filling periods are during the summer months. This should be clarified. Suggest changing the text to read, "...harvests were lower in years with maximum summer (June, July, August) temperatures higher than the average..."	18. Midwest	18.3	622		The text has been revised to incorporate this suggestion.

U.S.	Environmental Protection Agency	See previous comment regarding this key message: Revise to "…drive the habitats of many tree species northward. These forests' role as…". Please be careful to note that the region is not a new absorber of carbon, the region's forests are.	18. Midwest		622	9	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Consider citing the USFS RPA report here.	18. Midwest		623	2	We have added the suggested citation in our chapter assessment.
U.S.	Environmental Protection Agency	Revise to: "The frequency of major heat waves in the Midwest has increased…"	18. Midwest		624	1	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	CRITICAL COMMENT: There are numerous problems with this graphic. In general, it is not a compelling graphic- the blue bars highlight the technical scenario designations (A1 and B2) and do not convey that this figure is about projected mortality. The title should include "in Chicago in 2100". Please clarify if the average projected increases in deaths are annual or for the full period 2080-2100? On line 20, change the word "mitigation" to "adaptation". This seems like an error. The description of the findings of Palecki et al. should be (at a minimum) revised to explain why they apply to the 2006 heat wave (5 years after publication of this article). The recent Klinenberg book on the 1995 Chicago heat wave seems particularly appropriate to cite here, particularly the book's discussions of the differences in social adaptive capacity and the clear differences in mortality that were achieved because of the ability to adapt. Finally, there seems to be a significant disconnect between historical and projected mortality rates that needs to be addressed. Historical data suggest that the mortality rates are falling substantially, while the projected mortality rates are shown as rising above anything previously experienced. These two trends appear to be contradictory in the absence of additional explanation. Questions include the extent to which adaptive measures have played a role in the historical decline (rather than shorter or less severe heat waves); whether adaptive measures have been included in projected mortality; and the extent to which "natural" adaptation has also been included in the projections.	18. Midwest	18.5	624		We thank the reviewer for the helpful suggestion and have removed the figure in favor of text explanation.
Brian	Zachariah	While climate change may be a given 1) weather is not climate, 2) geological time is not "within living human experience," 3) consensus is not scientific proof and 4) there is no proof that the current level of climate change is either unusual in a geological time frame nor human-caused. Therefore, as a physician and scientist, I find this report badly flawed due to its assumptions from the outset, especially as regards point 4 above.					Additional description of attribution of climate change has been added to Chapter 2. The commenter also may find the Commonly Asked Questions appendix to be useful.
Michael	Kruk	Given the increasing evidence for changes in precipitation across the region, I am stunned this isn't Key Message #4. Why are changes in precipitation ignored in this NCA report? The 2009 edition covered it nicely, showing images of increasing drought occurrences and increases in heavy precipitation events (some associated with landfalling tropical systems). As such, I strongly feel something must be said about changes in precipitation across the Southeast - even if it isn't "high" confidence. This is fairly well covered in the Ingram (2012) publication and needs to be incorporated herein as well. One cannot discuss climate change impacts in the Southeast and not include precipitation; especially as it is so closely tied to freshwater resources and water management.If the authors want to continue to omit this Key Message, then please explain why - not only here in the reviewer comments, but also in the	17. Southeast and Caribbean				Maps or figures of rainfall changes were not included since there is so much uncertainty in projections. However, some additional text has been incorporated based on this comment.

		document itself. Tell the citizens who live there why changes in precipitation are not considered to be important.					
Whitney	Gray	This chapter discusses "iconic" species, but ignores the consequences of climate change on already threatened and endangered species, such as extinctions/extirpations.	8. Ecosystems, Biodiversity, and Ecosystem Services				No change. Indeed our focus has been on changes in species assemblages, consistent with our focus on ecosystem services and on new findings.
Whitney	Gray	The word "modify" should be changed to "moderate" more properly indicating the role ecosystems play in reducing the severity of climate-driven factors.	8. Ecosystems, Biodiversity, and Ecosystem Services		292	17	Changed as suggested.
Whitney	Gray	Much is made here about the negative effects of sediment transport as adding pollutants to downstream waterbodies. However, sediment transport, with accompanying nutrients can play a vital positive role in the shoreline dynamics of coastlines, and the life cycles of coastal and marine plants and animals.	8. Ecosystems, Biodiversity, and Ecosystem Services		292	14	We have added a sentence: " Sediment transport, with accompanying nutrients can play a vital positive role in the shoreline dynamics of coastlines, and the life cycles of coastal and marine plants and animals."
Whitney	Gray	It should be mentioned here that more intense rainfalls, not just increased amounts of rainfall, as predicted for many areas across the country, may compound erosion and nutrient-laden run-off.	8. Ecosystems, Biodiversity, and Ecosystem Services		293	30	Thank you for your suggestion. Mention of “increases in intense rainfalls” has been added.
Whitney	Gray	In order to be more geographically balanced, this section would benefit from mentioning potential changes in the Everglades, where shifts in species assemblages, shifts in habitats and habitat boundaries, and expansions of invasive exotic plant and animal species are all being documented. The Everglades and South Florida are centers of climate change research and federal and state investment, and should be more represented throughout the Report.	8. Ecosystems, Biodiversity, and Ecosystem Services		296	20	No change. While the comment suggests a good specific example, the authors feel the existing examples are appropriate.
Whitney	Gray	The final 2 columns in the table are incomplete for the Wetlands Land Cover Class.	13. Land Use and Land Cover	13.1	474		Table has been modified.

			Change				
Whitney	Gray	This sentence should include ecosystems, as in: Nonetheless, land [use] change decisions may affect the vulnerabilities of households, organizations, communities, and ecosystems to the effects of climate change.	13. Land Use and Land Cover Change		478	17	We agree. Text has been modified.
Whitney	Gray	A phrase could be added here to illustrate how land use decisions affect ecosystems: A lack of culverts underneath a coastal roadway may keep salt marsh habitat from migrating inland with sea level rise.	13. Land Use and Land Cover Change		479	2	Good suggestion. Text has been modified.
Whitney	Gray	The economic impact of the Gulf of Mexico and Atlantic fisheries cannot be overstated in this report, yet it is hardly mentioned. Numerous studies have examined the effects of higher ocean temperatures on commercially important species and could be cited. The Gulf and Atlantic fisheries of the Southeast represent a significant proportion of national seafood availability, which could be damaged as a result of climate change.	17. Southeast and Caribbean				We have added a relevant fisheries reference, but the authors are unaware of any specific economic studies of impacts to fisheries from a changing climate in the SE.
Whitney	Gray	The caption indicates that "adaptation options include changes in reservoir storage and release procedures, and possible phased expansion of reservoir capacity." There is great concern that such reservoir expansion would further damage vital freshwater, nutrient-carrying flows that are necessary for the success of the shellfish fisheries at the mouth of the Apalachicola. Some indication of the trade-offs inherent in choices between adaptation options would be instructive and is warranted, especially in this example.	17. Southeast and Caribbean	17.12	600		The text has been revised to incorporate this suggestion.
Whitney	Gray	The Assessment of confidence located on this page says that "sea level rise will continue if greenhouse gas concentrations continue to rise." This is misleading. Better phrasing might be: sea level rise will continue even if greenhouse gas emissions were eliminated altogether. The problem with the original phrase is the "if."	17. Southeast and Caribbean		603	1	The text has been revised to incorporate this suggestion.
Whitney	Gray	In overemphasizing the role of natural variability in climate change, this chapter seems to overlook one of the conclusions from Chapter 2, lines 25 through 27: Natural variability, including the effects of El Nino and La Nina events and various ocean cycles, also affects climate, but the changes observed over the past 50 years are far larger than natural variability can account for.	17. Southeast and Caribbean				This comment is inconsistent with the current state of the science on this topic for the SE region.
Whitney	Gray	Change "of" to "in" Wrong:...increasing disease outbreaks of ecologically important species... Right:...increasing disease outbreaks in ecologically important species...	24. Oceans and Marine Resources		844	3	The text has been revised to incorporate this suggestion.
Whitney	Gray	This chapter is skewed toward the Western US, Pacific, and western Arctic.	24. Oceans and Marine Resources				After consideration of this point, we still feel the existing text is clear and accurate, and there are examples such as Atlantic fisheries.
Whitney	Gray	There is only one mention of the role and importance of mangroves to marine ecosystems. Mangroves	24.				While the comment suggests a good

		play a vital role as fish nursery and essential habitat for a large proportion of commercially and recreationally important fisheries.	Oceans and Marine Resources				specific example, the authors feel the existing examples are appropriate and adequate.
Whitney	Gray	This chapter has poor coverage of the role of coastal ecosystems in the life cycles of many economically important species.	25. Coastal Zone Development and Ecosystems				The text has been revised to mention the link between coastal ecosystems and fisheries more directly throughout the chapter.
U.S.	Environmental Protection Agency	Revise sentence to: "Degraded air quality is due to human-induced emissions and increased pollen seas duration is projected to be amplified under higher temperatures. However…". Omit "this exposure to" and "and thus increase the human health effects from heat waves". Please clarify by adding a sentence on the human health impacts of greater exposure to degraded air quality.The last sentence (line 7) that begins with "Increased temperatures could also..." does not belong in this paragraph- please move to a more appropriate place.	18. Midwest		625	2	The text has been revised to incorporate the first suggestion. On the second point, this is the human health impact, so it does belong here.
U.S.	Environmental Protection Agency	Revise sentences to: "…"co-benefits" of reducing climate change, by improving human health via cleaner air quality and increased physical fitness. The maps below projects such health benefits… areas in the Midwest in 2012. This action would save 1295 lives..." It is not clear that the $5 billion versus $8 billion is from health savings of increased fitness.	18. Midwest		625	14	The caption has been clarified.
U.S.	Environmental Protection Agency	Please clarify the periods for which the comparisons are made (baseline and projected).	18. Midwest	18.6	625		This comment does not appear to be relevant to the material at hand since there is no base and projected period. The paper uses only historical data and then reduces the car trips to estimate health effects.
U.S.	Environmental Protection Agency	Please clarify: "Comparatively" to what? (demand now). Please clarify if "highest demand" is meant to refer to highest demand during the year or in the country, etc. Consider introducing the term heating degree days here.	18. Midwest		626	9	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	The phrase "these issues and climate change" is confusing- suggest deleting "these issues and" and just say climate change.	18. Midwest		626	20	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Revise to: "an aging, less reliable electric distribution grid, which will require…"	18. Midwest		626	23	The text has been revised to incorporate this suggestion.

U.S.	Environmental Protection Agency	Please clarify what the subsidies are on (fossil fuels?).	18. Midwest		626	31	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	This is not an appropriate title for a figure. Revise to something like: "Mid-century changes in precipitation projected for the Midwest"	18. Midwest	18.7	628		After consideration of this point, we still feel the existing text is clear and accurate.
U.S.	Environmental Protection Agency	In reference to the phrase "Both indicate that…", please clarify what "both" is referring to (Both bottom left and top right figures?)	18. Midwest		628	10	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Change "no longer hold" to "are no longer appropriate"	18. Midwest		629	9	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Revise sentence to: "…more severe, observed records demonstrate and climate models project less snow..." Observed records do not project.	18. Midwest		629	15	This text has been completely revised to better reflect a range of comments.
U.S.	Environmental Protection Agency	Please clarify what the phrase "less likely to cover as large an area" is in reference to (less likely than what?)	18. Midwest		629	21	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Revise sentence to something like: "As surface area has been increasingly converted to impervious surfaces (such as asphalt) and extreme precipitation events have intensified, combined sewer overflow has degraded water quality, a phenomenon expected to continue to worsen with increased development and climate change." Please check the tenses used in this sentence.	18. Midwest		630	4	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Editorial: delete the "a" from "of the a need"	18. Midwest		630	32	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Please clarify if "these surfaces" is referring to Lake Superior or of all Great Lakes. Please consider discussing Lake Michigan as well.	18. Midwest		631	3	The text has been revised to incorporate this suggestion.

U.S.	Environmental Protection Agency	Revise to: "water quality, habitats, and aesthetics, and could potentially heighten"	18. Midwest		631	6	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Revise to: "Increased winter air and water temperatures led to a 71% decrease in Great Lake ice cover between…". Also note a missing parenthesis on line 11.	18. Midwest		631	9	This text has been completely revised to better reflect a range of comments.
U.S.	Environmental Protection Agency	Please clarify the time periods to which the phrase "open nearly two weeks longer" is referring. Is this the same as 1994 to (presumably) today or 2011, given the citation to Millerd 2011?	18. Midwest		631	15	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Consider omitting the two images of Lake Erie- they are not the best tools for demonstrating climate change because they show one lake, over a very short time difference relative to climate change, and it is unclear whether the images are showing an average over all of winter or just a snapshot of one day in winter, opening the door for concerns over "cherry picking" results. At the very least, provide titles like "Winter 2008-2009".	18. Midwest	18.8	631		We thank the reviewer for the helpful suggestion and have removed the images.
U.S.	Environmental Protection Agency	Clarify that the cargo in the first sentence (line 10) is being carried on ships- or whatever is appropriate (example: "that can be carried on ships."). Please define or rephrase the term "draft-limited". Please clarify if the required reduction in cargo is due to ships hitting the bottom.	18. Midwest		632	10	The text has been revised to incorporate this suggestion.
Christopher	Miller	“within 4 feet of high tide line” – could be misinterpreted as 4 feet horizontally instead of 4 feet 'above' the high tide line. Suggest re-wording here and elsewhere in the report where it recurs.	1. Executive Summary		4	34	The authors agree and have modified this language.
Christopher	Miller	A thermometer is not an observing system – it’s a sensor. Suggest referencing land-based network like COOP or CRN. This system is more correctly characterized later in the report.	1. Executive Summary		3	19	The language has been amended to refer to networks of satellites, thermometers, etc.
U.S.	Environmental Protection Agency	The paragraph is describing how projected increase in high temperature extremes and heat waves will negatively affect livestock and CAFOs, but then only goes on to discuss livestock, without specifically addressing CAFOs. Suggest either addressing CAFOs or dropping the mention.	19. Great Plains		664	22	We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include.
U.S.	Environmental Protection Agency	Please add the year or years represented by the data shown in Fig 19.1	19. Great Plains	19.1	659		We thank the reviewer for the helpful suggestion, which has been incorporated into the figure.
U.S.	Environmental Protection	The extended growing season by mid-century is compared to what period? 2012? 1900-2000? Please clarify.	19. Great Plains		660	6	The text has been revised to incorporate this suggestion.

	Agency						
U.S.	Environmental Protection Agency	Please clarify the baseline against which the comparisons in this paragraph are made.	19. Great Plains		660	9	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	It would be preferable to include one or more specific citations for the statement that the summer increase in air conditioning demand will outweigh the winter heating demand. This statement also requires clarification on a number of counts. Does this comparison refer to energy use? If so, is this energy end use (vs. primary use including power generation losses)? What are the baseline and future time periods for the comparison?	19. Great Plains		663	13	Due to the size of the topic, and the page limit for the chapter, we focused on broad trends rather than delving too deeply or providing such a level of specificity. However, a citation is provided and the text has been clarified.
U.S.	Environmental Protection Agency	Please add citation for statement regarding aquifer recharge by rainfall	19. Great Plains		664	4	We have added the suggested citations in our chapter assessment.
U.S.	Environmental Protection Agency	The opening sentence suggests that this paragraph covers only the benefits of climate change. Suggest adding a new opening sentence that indicates that there are positive and negative consequences to agriculture related to climate change. Also suggest adding some discussion of the potential for drought in the Northern Plains. The negative imapcts of climate change in the second half of the paragraph should tie back to agricultural productivity.	19. Great Plains		664	6	The sections identified have been rearranged to incorporate your suggestion.
U.S.	Environmental Protection Agency	It is presumed that species are shifting their distributions spatially, but this could also be construed as saying the distributions between species are shifting. Please clarify	19. Great Plains		666	12	Both spatial distributions of species are occurring and distributions between species. Climate induced migrations may affect obligate species so that disruption of these obligate relationships can be affected. Current text already indicates that ecosystem level considerations need to be studied as species shift.
U.S.	Environmental Protection Agency	Please explain the connection between the modification of seasonal lakes by agricultural practices and climate change. Also clarify what is meant by "modified" - is this contaminants in the water, changes in vegetation, location, depth, etc.?	19. Great Plains		666	17	The text has been revised to clarify that the lakes will be further altered by temperature changes. Since agricultural practices reflect a broad range of activities, we did not expand on specifics given the space limits, but the citations provide details.
U.S.	Environmental Protection Agency	Please note the baseline periods against which these comparisons are being made.	19. Great Plains		666	20	The text has been revised to incorporate this suggestion.
U.S.	Environ	Does the benefit to plants from higher temperatures include effects of extreme heat? Or does this refer	19. Great		668	1	The sections identified have been

	mental Protecti on Agency	to temperature changes within a specific range? This should be clarified.	Plains				rearranged to incorporate your suggestion.
U.S.	Environ mental Protecti on Agency	It seems that it would be more appropriate here to discuss "tribal populations" (plural) rather than "tribal population" (singular). The singular has the connotation of a single group, even though the tribes are distinct entities.	19. Great Plains	19.7	670		The figure & caption has been clarified.
U.S.	Environ mental Protecti on Agency	The severe water constraints in the southern Plains discussed later in the chapter had substantial impacts to energy production, especially in Texas. The fact that Texas is nearly isolated from the national electricity grid had significant impacts for its ability to meet electricity demand during 2011 and into 2012. It would be good to note this specific instance of impact in this paragraph or in the Summer of 2011 box.	19. Great Plains		663	10	The text has been revised to incorporate this perspective.
U.S.	Environ mental Protecti on Agency	Suggest starting the sentence thus: 'The Southwest, comprising six states (California…'	20. Southwe st		687	32	We appreciate the suggestion, but feel the current text is appropriate and adequate given the chapter's space limitations and the multiple maps that show which states are included. It also conforms to the text offered in other regional chapters.
U.S.	Environ mental Protecti on Agency	Rather than stating the amount of population increase, state that the population will rise 68% to 94 million.	20. Southwe st		687	36	The text has been revised to incorporate this suggestion.
U.S.	Environ mental Protecti on Agency	Change the end of sentence to read, '…high-value specialty crops, including certain vegetables, fruits, and nuts.' As written now, it sounds as though all vegetables, fruits, and nuts are high-value specialty crops.	20. Southwe st		688	6	We appreciate the suggestion and have revised the text accordingly.
U.S.	Environ mental Protecti on Agency	Sentence can be improved/clarified by changing the end to read, '…vary considerably across the region, with various portions experiencing either decreases or increases.' As written, it sounds as though certain portions are experiencing both decreases and increases, which I don't think is the intent.	20. Southwe st		688	26	The text has been revised to incorporate this suggestion.
U.S.	Environ mental Protecti on Agency	It would be preferable to compare the B1 scenario for 2041-2070 with the A2 scenario over the same period. Having one period from 2041-2070 and the other from 2070-2099 seems to compare apples with oranges. A more-consistent comparison is seen in Figure 20.1 on page 689.	20. Southwe st		688	34	Thank you for pointing out this confusing text. We have rewritten this section to eliminate confusion in comparing the scenario projections.
U.S.	Environ mental Protecti on	Clarify whether there are eight or 16 adjacent cities on the border. As written, the reader could infer that there are eight such cites on each side of the border.	20. Southwe st		690	17	Thank you for your comment. We have adjusted the text to clarify that we were referring to 8 pairs of cities on either side of the border.

	Agency						
U.S.	Environmental Protection Agency	The issues in this paragraph need to be tied back to vulnerability to climate change.	20. Southwest		690	17	Thank you for your comment. The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	The values shown in Fig 20.2 seem to show percent OF current, rather than percent CHANGE FROM current, SWE accumulation.	20. Southwest	20.2	691		Thank you for this helpful comment, regarding the wording of the Figure 20.2 caption. We have changed the caption to clarify the intent.
U.S.	Environmental Protection Agency	Explain why Colorado is excluded from these calculations.	20. Southwest		693	19	Thank you for your question. The citation used for this statistic did not include Colorado because it is somewhat anomalous compared to the other Southwestern states in this regard.
U.S.	Environmental Protection Agency	Insert 'incidence of' into the middle of the last phrase of the sentence: '…increased incidence of wildfire.'	20. Southwest		695	9	Thank you for your suggestion. After consideration of this point, we still feel the existing text is clear and accurate. We feel "increased wildfire" is equivalent in meaning and more succinct.
U.S.	Environmental Protection Agency	General comment about 'Sea Level Rise and Coastal Damage': It would be good to include in this section some text specifically about storm surge.	20. Southwest		695	34	Thank you for your comment. Due to the page limit for the chapter, we were unable to delve more deeply into the topic of storm surge. The Southwest Technical Report (Garfin et al. 2012) has additional details.
U.S.	Environmental Protection Agency	Change '…poses a risk…' to 'poses a threat…'	20. Southwest		696	15	Thank you for your suggestion. The text has been changed accordingly.
U.S.	Environmental Protection Agency	Please revise the caption for Fig. 20.6 The figure does not discuss public health at all, and only illustrates one component of health stressors related to climate change	20. Southwest	20.6	698		Thank you for your comment. The figure and caption have been completely revised to better illustrate the connection of increased heat and health impacts.
U.S.	Environmental Protection Agency	Suggest adding a mention of lack of air conditioning to complement the lack of shade trees and other greenery in less-affluent neighborhoods.	20. Southwest		699	1	Thank you for your suggestion. We have added a mention of lack of access to air conditioning in the text of our chapter assessment.
U.S.	Environ	"Almost complete loss of subalpine forests is expected by the 2080s" - This key message is worded	21.				The text has been revised to

	mental Protection Agency	much more strongly than the supporting text in this chapter, which cites only one study and uses the modifer "may undergo almost complete conversion..." (page 734, lines 20-21). Suggest revisiting level of confidence in this conclusion. The Traceable Accounts state that "Evidence that subalpine forests are likely to undergo almost complete conversion to other vegetation types is moderately strong (relatively few studies, but good agreement)…" If this is the case, why is only one study cited in the chapter body? See additional comment below on traceable accounts terminology.	Northwest				incorporate this suggestion.
U.S.	Environmental Protection Agency	"Evidence that subalpine forests are likely to undergo almost complete conversion to other vegetation types is moderately strong (relatively few studies, but good agreement)…" - what is meant by moderately strong here? It seems like there should be a separate assessment of confidence for the subalpine forest conclusion that utilizes the Very High/High/Med/Low construct, and which should reflect back into how the conclusion is worded in the Key Messages.	21. Northwest				The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Please clarify the figure legend and caption. It is presumed that the shift illustrated here represents the difference between 1948 and 2008. As currently presented, it is not clear whether "1948-2008" refers to a baseline period or to the years of comparison.	21. Northwest	21.1	723		The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	The phrasing here is a bit awkward. It would be more appropriate to use consistent phrasing ("deriving most of its streamflow from snow melt" vs. "rain-dominant").	21. Northwest		724	22	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Suggest that the term "evaporative demand" be defined since many non-technical audiences will not know what this is	21. Northwest		725	12	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Suggest the following additions to the introductory clause: "In the absence of adaptation planning and action,…" Without additional explantation, it is unclear whether this refers to planned adaptation or some kind of autonomous adaptation within the hydrologic cycle of the Northwest.	21. Northwest		725	18	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Please specify where the impacts to annual hydropower production are expected - Snake or Columbia River basins or both?	21. Northwest		725	18	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	An additional citation for discussion of fish impacts is: Jones et al. 2012. Climate change impacts on freshwater recreational fishing in the United States. Mitig Adapt Strateg Glob Change. DOI 10.1007/s11027-012-9385-3. (http://link.springer.com/article/10.1007/s11027-012-9385-3)	21. Northwest		725	28	The suggested paper is a national-scale paper, whereas the chapter cites finer-scale regionally-specific studies of ecological impacts of climate change on fish.
U.S.	Environmental Protection	Suggest adding a cross-reference to the Oceans chapter 24 after the discussion of harmful algal blooms.	21. Northwest		728	25	There was no mention of HAB in the Ocean chapter.

	Agency						
U.S.	Environmental Protection Agency	This section needs to refer to the Forests chapter (Ch 7)	21. Northwest		731	1	Reference to forest chapter added.
U.S.	Environmental Protection Agency	The other chapters focused on the A1 emissions scenario, while here A1B is used. If possible, it is preferable to provide results that are associated with the A1 scenario rather than A1B. If such results are not available, some explanation of why A1B is used here rather than A1.	21. Northwest		731	23	There is no “A1” scenario.
U.S.	Environmental Protection Agency	What is the projected late century decrease due to? Does this mean there will be decreased risk of forest impacts from mountain pine beetle infestations towards the end of the century?	21. Northwest		732	14	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Delete "preventing general projections" - this is inaccurate since Chapter 6 on Agriculture devotes an entire section to general projections of how weeds, diseases, pests will change with climate change.	21. Northwest		735	22	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	"Projected increases in average temperature and hot weather episodes and decreases in summer soil moisture would reduce yields of wheat and other cereals in irrigated and rain-fed production zones." - What is the citation here? Will this happen uniformly across the Northwest region or in Washington State only (if Stockle et al. 2010 is the appropriate citation)?	21. Northwest		735	35	Text has been revised to clarify this point and to make it clear that Stockle et al. (2010), which focuses on Washington State is the source. Other parts of the region can be inferred to respond similarly, but studies are lacking
U.S.	Environmental Protection Agency	Suggest breaking these two completely different points into separate sentences, in particular because we want to ensure utmost clarity that Stockle et al (2010) find benefits from the CO2 fertilization effect only in the case of "fully irrigated potatoes." - Questions re: the first sentence, "Potential yield losses are expected to reach 25% for some crops [Can specific crops or categories of crops be identified here?] by the end of this century [under the A1B scenario?], depending upon location, relative to 1975-2005." - Recommended wording for the second sentence: "For fully irrigated potatoes, the fertilization effect of CO2 will mostly offset direct climate-related yield losses, although yields are still projected to decline by 2% to 3% under the A1B scenario (Stockle et al. 2010)."	21. Northwest		735	35	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	"self-reinforcing" - this language is a bit stronger than warranted. It would sufficient to say, "thus leading to further heat-trapping gas emissions" (preferred) or "thus leading to further heat trapping gas emissions in a positive feedback" (if you want to highlight the feedback aspect).	22. Alaska and the Arctic		770	20	The text has been revised to incorporate this suggestion.
U.S.	Environ	Does the change in CO2 uptake from shrub and tree expansion overcome the increased absorption due	22.		771	15	The text has been revised to

	mental Protecti on Agency	to the darker surface?	Alaska and the Arctic				incorporate this perspective.
U.S.	Environ mental Protecti on Agency	Do the transects have an associated latitude that could be included in the figure or legend?	22. Alaska and the Arctic	22.8	773		After consideration of this point, we still feel the existing graphic is clear and accurate.
U.S.	Environ mental Protecti on Agency	Would be useful to note here that Alaska Native peoples face some constraints on adaptation that they did not face during previous climatic changes, e.g. issues regarding property rights, permanence of infrastructure, etc.	22. Alaska and the Arctic		775	10	The text has been revised to incorporate this suggestion.
U.S.	Environ mental Protecti on Agency	A valuable addition to this chapter would be a discussion of the different drivers of Alaskan temperature change - e.g., the interaction between global trends and pseudo-oscillations such as the PDO.	22. Alaska and the Arctic		760	26	Due to the size of the topic, and the page limit for the chapter, we focused on responses to climate change. Chapter 2 (Our Changing Climate) and the Appendices presents the requested information on Alaskan climate change.
U.S.	Environ mental Protecti on Agency	This paragraph describing the vulnerability of coral reefs to bleaching events does not describe specific projections for how coral cover may change in the future (it does describe how reef fisheries may change). Projections for Hawaii using SRES scenarios are described in Buddemeier et al. 2008 - Buddemeier RW, Jokiel PL, Zimmerman KM, Lane DR, Carey JM, Bohling GC, Martinich JA (2008) A modeling tool to evaluate regional coral reef responses to changes in climate and ocean chemistry. Limn Oceanogr Methods 6:395–411. http://www.aslo.org/lomethods/free/2008/0395.html	23. Hawaii and U.S. Affiliated Pacific Islands		805	35	The text has been revised to incorporate this suggestion.
U.S.	Environ mental Protecti on Agency	Revise to: "The rise in ocean temperature observed over the last century". Also, the use of the word "chemistry" is vague- please clarify.	24. Oceans and Marine Resource s		835	14	After consideration of this point, we still feel the existing text is clear and accurate.
U.S.	Environ mental Protecti on Agency	Revise to: "reef ecosystems, while habitat in other areas and for other species will expand." If possible, please be more concrete on whether one outweighs the other (habitat loss vs. expansion).	24. Oceans and Marine Resource s		835	20	The text has been revised to incorporate this suggestion.
U.S.	Environ mental Protecti on Agency	Revise to: "coral reefs to polar waters covered by sea ice in the Arctic."	24. Oceans and Marine Resource s		836	12	The text has been revised to incorporate this suggestion.

U.S.	Environmental Protection Agency	The use of the word "common" here could be a little misleading. Please clarify whether or not common implies uniform.	24. Oceans and Marine Resources		836	17	After consideration of this point, we still feel the existing text is clear and accurate.
U.S.	Environmental Protection Agency	Please revise the phrase "and in many cases it is still difficult to discern long-term ocean trends from variability." as it is confusing and possibly misleading- especially the use of the word "many". Ocean temperature, heat storage, sea level rise, and acidification do not meet this description,so the use of the word "many" does not seem accurate.	24. Oceans and Marine Resources		836	20	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Revise to: "Cores from corals, ocean sediments, and ice records, and other…"	24. Oceans and Marine Resources		836	26	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Revise title to include the word "Observed"	24. Oceans and Marine Resources	24.1	837		The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Replace "with" with ",which leads to"	24. Oceans and Marine Resources		837	16	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Please clarify if the first sentence (lines 2-5) is referring to observations on warm days, while the second sentence (lines 5-7) is referring to climate induced warming. Please clarify if the observations of current warm days are being used as extrapolations of what future warmed days will look like.	24. Oceans and Marine Resources		838	2	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	The word "changed" is awkward- "changes ... resulting from changed inputs" - please consider changing to "new sources" if appropriate. "altered" is another option.	24. Oceans and Marine Resources		838	12	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection	Revise to: "or local conditions, such as upwelling ([provide a short definition]) and other processes as noted above."	24. Oceans and Marine		839	23	The text has been revised to incorporate this suggestion.

	Agency		Resources				
U.S.	Environmental Protection Agency	The use of the word "shrink" in the title and the phrase "become progressively smaller" are very misleading. The clams do not grow large and then "shrink" to a smaller size, they just don't grow as large in the first place. This is less about dissolved existing shells and more about the growth of new shells- please carefully clarify this.	24. Oceans and Marine Resources	24.3	840		The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Please consider noting in this section that populations that are more reliant on seafood for food and trade will be harder hit by this, in the US and in other countries (which will affect the US's food security).Please consider noting that there are both winners and losers with ocean acidification- there is some evidence that a few species may do better, but that this is far outweighed by the negative impacts of multitudes of species.	24. Oceans and Marine Resources		840	12	After consideration of this point, we still feel the existing text is clear and accurate.
U.S.	Environmental Protection Agency	Consider discussing the specific vulnerability of the Arctic, or at a minimum referring to the discussion in Ch. 22.	24. Oceans and Marine Resources		840	18	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Replace "for" in line 2 with "to obtain". It should be noted here that the process Whiskey Creek has developed is only a temporary fix- that as average global ocean acidity increases, there won't be any good times to let in water.	24. Oceans and Marine Resources		841	2	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	line 17 there is a very odd use of the word "some" and "all"- please delete the word "all" if appropriate. If not appropriate, please clarify.	24. Oceans and Marine Resources		841	17	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	delete the word "the" or "their" in the phrase "in the their"	24. Oceans and Marine Resources		842	2	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Please clarify WHO will/won't be benefiting in these sentences in terms of people, like "people in the fishing industries" or "fishermen" or at least "fisheries"	24. Oceans and Marine Resources		842	14	After consideration of this point, we still feel the existing text is clear and accurate.
U.S.	Environ	Revise to: "led to a flattening of three dimentional coral structures and a decrease in the capacity to	24.		842	25	The text has been revised to

	mental Protection Agency	provide shelter and other resources…"	Oceans and Marine Resources				incorporate this suggestion.
U.S.	Environmental Protection Agency	Revise to: "The symbiosis between coral and the algae that gives coral their brilliant colors is destroyed by higher than usual temperatures, which results in a condition called bleaching. Bleaching is where the coral is still alive but has ejected their symbiotic algae, thus leaving them devoid of all their color."	24. Oceans and Marine Resources		842	28	The text in question has been deleted in response to other comments.
U.S.	Environmental Protection Agency	Please revise to "intact fish and associated invertebrate populations"	24. Oceans and Marine Resources		842	32	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	In the caption, the term "micro-agae" is used, but this is not used in the main text on page 842. Please check for consistency.	24. Oceans and Marine Resources	24.4	843		The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Replace "of" with "in" - "...diseases in human..."	24. Oceans and Marine Resources		843	12	After consideration of this point, we still feel the existing text is clear and accurate.
U.S.	Environmental Protection Agency	Provide a short definition of echinoderms (the later definition on p. 844 should be moved here to the first use of the term)	24. Oceans and Marine Resources		843	15	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Replace "diseased" with "disease"	24. Oceans and Marine Resources		843	18	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Please clarify which pathogens are being referred to (all pathogens or some pathogens?)	24. Oceans and Marine Resource		843	20	After consideration of this point, we still feel the existing text is clear and accurate.

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U.S.	Environmental Protection Agency	Replace the word "of" with "in"	24. Oceans and Marine Resources		844	3	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Please clarify what is meant by "spatially linked". Presume that this means that spatial associations of disease outbreaks with increasing temperatures were found, as opposed to associations over time.	24. Oceans and Marine Resources		844	4	The text has been deleted.
U.S.	Environmental Protection Agency	Move the definition of echinoderms to the first use of this term (pg 843 line 15)	24. Oceans and Marine Resources		844	25	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Please clarify what is meant by "movement of living resources".	24. Oceans and Marine Resources		845	19	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	This is the first use of the term "ocean services." This should be defined, preferably early in the chapter. The discussion on p. 836, lines 15-16 seem to be a good place to introduce this term, if I understand the implied meaning of the term.	24. Oceans and Marine Resources		845	22	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	This phrasing seems backward. It would seem to me that ocean services play a large role in the economic strength of the tourism industry, rather than the tourism industry playing a role in ocean services. An alternative phrasing would be that "the tourism industry plays a large economic role among those industries supported by ocean services."	24. Oceans and Marine Resources		845	22	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Please clarify if the statistic in the first sentence here is referring specifically to ocean-related tourism or all tourism everywhere in the US.	24. Oceans and Marine Resources		845	22	The text has been revised to incorporate this suggestion.
U.S.	Environmental	Please include the term and explanation of storm surge in the text here. An example picture of Superstorm Sandy would be ideal here.	24. Oceans		845	41	The term has been added, but the explanation & picture were not since

	Protection Agency		and Marine Resources				space is limited and the surge concept widely known
U.S.	Environmental Protection Agency	Please clarify if the US Arctic Sea fisheries discussed here are new or existing (but not opened). If existing, this seems to contradict the phrasing in the following sentence, "...these potential fishing grounds..."	24. Oceans and Marine Resources		846	23	The text has been revised to reflect this suggestion as well as other comments.
Christopher	Miller	Line 5, 'impacts' is introduced with an immediate negative connotation. There are positive impacts, e.g., mention of this fact is made on p. 27-29 of this chapter and a list of positive impacts is provided on p. 206. For clarity and a balanced report, 'impacts" should be clearly defined early on. Certainly, positive impacts, as appropriate, can be qualified as being limited, short-lived, not obvious at this point in time, etc. and the predominance of negative impacts can be emphasized.	Introduction: Letter to the American People				The authors are comfortable with the existing language.
William	Koshak	On page 4, add the following paragraph after line 13:Best available evidence suggests that a warming climate would lead to an increase in lightning, especially cloud-to-ground (CG) lightning. All else being equal, more CG lightning results in more human injury/death, property damage, crop and livestock damage, power outages, and wildfires. Increases in lightning also imply increases in lightning nitrogen oxides (NOx) production which in turn can increase concentrations of ozone (a greenhouse gas). In fact, lightning is the most important source of NOx in the upper troposphere where ozone has its greatest impact on climate. The US national CG lightning detection network became an optimal tool for climate assessment analyses starting in 2003. Since then there has actually been a decrease in CG lightning over the continental US; i.e., an average of about 25.2 million CGs occurred per year in the period 2003-2007, compared to just under 22.0 million per year in the period (2008-2012)] (Ch. 6, 7, 9).	1. Executive Summary		4	13	This topic is too detailed to include in the executive summary.
William	Koshak	On page 241, change line 20 subsection title "Heat and Drought" to "Weather Extremes (Heat, Drought, and Lightning Damage)"	6. Agriculture		241	20	We added "lightning" to the heading.
William	Koshak	On page 242, add a new paragraph right after line 2 [i.e., right after the "(Mader 2003)" ref.]:In addition, a warming climate implies more lightning activity according to previous studies. Increases in lightning would in turn directly cause increases in livestock injury/death, and crop damage. Lightning-caused crop damage alone averaged $125,555 per year (2003-2011), and hit $450,000 in 2010 (Koshak and Blakeslee, 2012; Table 2). Using satellite-based observations of global lightning provided by NASA's Optical Transient Detector (OTD), Reeve and Toumi (1999) found that a change in the average land wet-bulb temperature of just 1oC results in a 40±14 % change in total lightning activity. For the Northern Hemisphere, they found even a larger sensitivity of 56±15% per 1oC change. Moreover, Price and Rind (1994) found that cloud-to-ground (CG) lightning frequencies showed larger sensitivity to climate change than cloud flash frequencies. However, actual changes in CG lightning activity over the continental US in the past decade deserve some attention. The 5 yr mean annual CG lightning count decreased by 12.8% from the period 2003-2007 to period 2008-2012 (Koshak et al., 2013). References:Koshak, W. J. and R. J. Blakeslee: Assessing Global Change Impact on the US using National Lightning Data, Technical Input Report for the National Climate Assessment, 30 pgs., 3 May 2012. Koshak, W. J., R. J. Blakeslee, K. Cummins, D. Buechler, 2013: Variability of CONUS lightning in 2003-2012 and associated impacts, to be submitted in J. Appl. Meteor. Climatol..Price, C. and Rind, D., 1994: Possible implications of global climate change on global lightning distributions and frequencies, J.	6. Agriculture		242	2	We modified the section in the report to address these comments.

		Geophys. Res., 90, No. D5, 10823-10831.Reeve, N., Toumi, R., 1999: Lightning activity as an indicator of climate change, Quart. J. Roy. Met. Soc., 125, 893-903.					
Christopher	Miller	“periods of extreme heat last longer than any living American has ever experienced.” This statement seems like hyperbole. Were there longer periods of extreme heat during the 1930s, and, if so, wouldn't some living American have experienced them?	Introduction: Letter to the American People		1	12	We appreciate the suggestion, and have modified the text. We still feel it is accurate to say that periods of unusual heat last longer than any living American has experienced.
William	Koshak	On page 267, insert the following paragraph after line 2:As discussed in Chapter 6, a warming climate implies more lightning (Reeve and Toumi, 1999; Price and Rind, 1994), which in turn would imply more lightning-caused wildfires. However, given the decrease in the 5 yr averaged annual cloud-to-ground lightning count over the continental US; i.e., 25,204,345.8 average strikes per year (for period 2003-2007) compared to 21,986,578.8 (2008-2012), it is not surprising that the mean number of lightning-caused wildfires and associated burn acreage over the continental US for these two periods show a drop of 26.7% and 12.9%, respectively (Koshak et al., 2013). Figure XX shows the geographical distribution of cloud-to-ground lightning flash density; the drought in 2012 resulted in a significant drop to only 18,192,183 cloud-to-ground lightning in that year (Koshak et al., 2013).References:Koshak, W. J., R. J. Blakeslee, K. Cummins, D. Buechler, 2013: Variability of CONUS lightning in 2003-2012 and associated impacts, to be submitted in J. Appl. Meteor. Climatol..Price, C. and Rind, D., 1994: Possible implications of global climate change on global lightning distributions and frequencies, J. Geophys. Res., 90, No. D5, 10823-10831.Reeve, N., Toumi, R., 1999: Lightning activity as an indicator of climate change, Quart. J. Roy. Met. Soc., 125, 893-903.	7. Forestry		267	2	We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include.
William	Koshak	Contact Allison Leidner, or myself (William Koshak, 256-961-7963, william.koshak@nasa.gov) for the "Figure XX" on lightning that I wish to be added to the Assessment Report.	7. Forestry	XX	267		We appreciate the suggestion, but space is limited. The author team has deliberated and agreed on the most important information/illustrations to include.
William	Koshak	On page 340, add the following subsection after line 14:Lightning As discussed in Chapter 6, a warming climate is expected to imply more lightning, which in turn implies more lightning-caused wildfires. Wildfires generate smoke (a respiratory irritant) and nitrogen oxides (NOx) which can enhance surface ozone levels. Inhalation of ozone can produce a number of ailments (e.g., cough, throat irritation, pain/burning in the chest when taking deep breaths, chest tightness, wheezing, shortness of breath). In addition, given the high temperature extremes of the discharge channel, lightning also directly produces NOx which leads to surface enhancements of ozone. For example, Kaynak et al., (2008) estimated a 2 ppb impact on surface ozone concentration from lightning NOx emissions, and Koshak et al. (2013a) showed enhancements as high as 9 ppb. Interestingly, there is even evidence that lightning is causally linked to the occurrence of migraine headaches (Martin et al., 2013). Moreover, lightning directly causes injury and death, either by direct strike or contact with an object that is struck, or by fire caused by a lightning strike. However, the mean number of lightning fatalities in the continental US was 40.00 (in the period 2003-2007) but only 28.75 (2008-2011), or a drop of 28.1%; lightning injuries dropped by 18.7% between these same periods (Koshak et al., 2013b). Finally, since lightning NOx can enhance tropospheric ozone concentrations, lightning is a positive feedback to a warming climate. In fact, climate is most sensitive to ozone in the upper troposphere, and lightning NOx is the most important source of NOx in the upper troposphere at tropical and subtropical latitudes (Lee et al., 1997; Huntrieser et al., 1998). Hence, in an insidious way, lightning can worsen all climate change related health problems. References:Huntrieser, H., H. Schlager, C. Feigl, and	9. Human Health		340	14	Thank you for your comments. The authors are very space-constrained in drafting the chapter and cannot add a new subsection. We note that these references highlight lightning's effects on ozone, rather than on wildfires specifically, which this section pertains to, and associated health risks.

		H. Holler, 1998: Transport and production of NOx in electrified thunderstorms: Survey of previous studies and new observations at midlatitudes, J. Geophys. Res., 103, 28247-28264.Kaynak, B., Y. Hu, R. V. Martin, A. G. Russell, Y. Choi, and Y. Wang, 2008: The effect of lightning NOx production on surface ozone in the continental United States, Atmos. Chem. Phys. Discuss., 8, 5061-5089.Koshak, W. J., H. S. Peterson, A. P. Biazar, M. Khan, and L. Wang, 2013a: The NASA Lightning Oxides Model (LNOM): Application to air quality modeling, Atmos. Res., http://dx.doi.org/10.1016/j.atmosres.2012.12.015.Koshak, W. J., R. J. Blakeslee, K. Cummins, D. Buechler, 2013b: Variability of CONUS lightning in 2003-2012 and associated impacts, to be submitted in J. Appl. Meteor. Climatol..Lee, D. S., I. Kohler, E. Grobler, F. Rohrer, R. Sausen, L. Gallardo-Klenner, J. G. J. Olivier, F. J. Dentener, and A. F. Bouwman, 1997: Estimations of global NOx emissions and their uncertainties, Atmos. Environ., 31, 1735-1749.Martin, G. V., T. Houle, R. Nicholson, A. Peterlin, and V. T. Martin, 2013: Lightning and its association with the frequency of headache in migraineurs: An observational cohort study. Cephalalgia, January 24, 2013 DOI: 10.1177/0333102412474502					
Christopher	Miller	verb “are” missing	1. Executive Summary		6	24	Modifications have been made to address this problem.
Christopher	Miller	“spread of waterborne diseases” – what about non-waterborne sources (mosquitoes, hantavirus…)? Finding 5 recognizes insects and food, as well as water, but this is not mentioned in accompanying text.	1. Executive Summary		8	38	The intent here is to provide a series of examples that are not intended to be inclusive. Some modifications have been made to this text.
Christopher	Miller	“There is an increasing risk of seasonal water shortages in many parts of the U.S., even where total precipitation is projected to increase” – in this Finding, the timing of water release is not mentioned as a contributor to the risk.	1. Executive Summary		9	24	This paragraph has been modified and the sentence has been eliminated.
Christopher	Miller	After corals replace ‘that’ by ‘which’. Can corals spring up (i.e., be re-established) in new, more conducive environments? This would seem to be an issue for the long-term viability of corals.	1. Executive Summary		10	15	Corals are discussed in the oceans chapter, but not this particular topic.
Christopher	Miller	Why aren’t the issues of climate surprises and extremes mentioned here since subsequently they represent two of the five thematic subsections?	1. Executive Summary		12	5	The Executive Summary has been restructured. These topics are covered under the Context and Background section.
John	Drake	Comments on 2. Our Changing Climatepage 26, line 23: the mention of ocean cycles is vague and unfamiliar. Are you talking about ENSO, THC, MOC or what? The confusion with this use of terminology might also be the difference between natural climate cycles and coupled oscillations of the system.Figure 2.1 Why not indicate a black arrow for stratospheric temperatures as this is also consistent with theory of warming?Good presentation of the CMIP5 results for the RCP scenarios. Little is made of the differences between either the SRES scenarios or the difference in results from past CMIPs. You should probably have a section	2. Our Changing Climate				1. Hurricanes: We have eliminated that phrase in the Key Message on hurricanes to avoid confusion. The supporting text for KM 1 has also been revised by eliminating the reference to ocean cycles. The revised text refers only to natural drivers, which are defined as solar forcing and volcanoes. 2. Figure in Introduction: Stratospheric temperature is a useful indicator of a changing climate especially for showing the importance of GHGs in being the primary factor in explaining the observed changes, but it is not necessarily an indicator of a warming

		explaining how these models are used in consort to give the results as well as to guage confidence in regional results. In the older national assessments, there were not even US climate models in the mix and I still see results from the Canadian and Hadley model, which disagreed on such things as whether the Southeast would get wetter or dryer. It is a point of pride to have both GFDL and NCAR models in the CMIPs and the implications that has for scientific expertise within our borders.In figure 2.10, a shift from frost free season to number of frost free days has taken place. Are these the same thing? In figure 2.13, as well as several others, there is a note that the plots will be redone with a base period shifted to 1971-2000 instead of 1900 to 1960. This would relate better to our own experience of the weather of those living today. But scientifically, I would argue that a clear greenhouse signal did not show up until 1960 and so using the older base period reflects a natural break in the data. You would be accused of over dramatizing the warming results, but if you continually shift the window you will be significantly underemphasizing the magnitude of the change.In figure 2.18, a ratio is presented that misrepresents the data. The number of lows going to infinity would only show up as a 1 to zero shift while the number of highs going to infinity would be infinite. A deviation plot would be better.Figure 2.21 is based on SRES A1B and seems out of date. Perhaps perform same analysis based on future projections from RCP2.6 and RCP8.5 as many of the other plots.page 59, lines 10-16: This acknowledgement of the fidelity of temperature variables but less confidence in others needs further explaination and quantification. First, the ability to represent storms in low resolution					world (e.g., an increase in solar output would increase global temperatures in both the troposphere and stratosphere) 3. CMIP5 vs. CMIP3: Both CMIP3 and CMIP5 model results presented in the chapter include results from the U.S. models. The Appendix on Climate Science includes a discussion of the models and associated analyses from the CMIP3 and CMIP5 studies, and shows a comparison between the different scenarios. The CMIP5 results presented here indeed include the GFDL and NCAR (CCSM4) models.4. Figure in section on frost-free season: There was an error in the caption. The figure displays frost-free season length, not frost-free days. The caption has been corrected. 5. We have added a Box on the basis for the relative periods. For projections, the NCADAC specified a base period of 1901-1960 for line plots and a base period of 1971-2000 for maps. The choice of base period is contentious for a number of reasons. Short base periods, especially for regionally averaged quantities, may be subject to large natural variations, complicating the extraction of the human component of climate change. Due to this effect, model comparisons to observations can be made to appear unfairly bad or good depending on the specific choice of base period. The authors have provided additional information in a new Box on the issue of base periods. 6. Figure on record high and low temperatures: This figure has been redone. The new version of this figure separately shows record highs and record lows. This avoids any perception that the data are being misrepresented. 7. Figure on extreme drought in the U.S. and Mexico: This figure is being moved to the Appendix but CMIP3 models are part of the

		simulations could be mentioned. Then the variability of precip both spatially and temporally. Much of the uncertainty/lack of confidence still traces to cloud modelling and the sensitivity of results to cloud processes. Perhaps, cloud resolving models will fill these gaps.page 59, line 28: typo.page 69, lines 6-13: This might be a good place to introduce feedbacks with emphasis on the uncertainty they cause in the projections. Of course, the point is not that models are uncertain, but the groudwork for a discussion of bounding the projections and the need to include possible non-linear responses in preparing adaptation strategies.General comment: at first the organization into key vulnerabilities seemed fragmented, but after further reading it began to grow on me and divide the discussion into more manageable pieces. What is missing then are some of the general discussions on the role of modeling, the quantification of uncertainty, etc, that are common to all the vulnerabilities. The confidence level ranges set up in the last sections do not describe the process behind the ratings. "NatAssessChapter1.txt" 67L, 3581C written 67,12 Bot					charter for this assessment. There are no new published analyses on this from CMIP5 models at this time. The NCA3 is an assessment of current literature and RCP based studies of PDSI are not available at this time. Furthermore, much of the NCA3 are based on SRES scenarios, as mandated by NCADAC. 8. Section on hurricanes: The entire discussion on hurricanes has been rewritten. This KM has been separated into two separate KMs, the first on hurricanes and the second on other storms. The section cited by the reviewer is now in the KM on other storms. Because models are the basis for the projected changes, this comment's concern is partially about the ability of models to capture smaller-scale features such as intense storms (tropical, extratropical, convective). The ability of models to resolve smaller-scale features (storms) is discussed at length in KM 6 of the Appendix. More generally, this section is about more than modeling -- it is also about our ability to detect trends in storms of various scales. With regard to the precipitation uncertainty (a central issue in assessing storm impacts, and one that presents similar challenges to detection of changes), this is addressed in (a) the new Regional Uncertainty box in KM 5 and (2) our responses to Comments 32236 and 32251. 9. Section on hurricanes: The text has been corrected. 10. Section on loss of ice: Text was added to the section on KM 11. 11. Uncertainty: We appreciate the comment, and have added a new box on the subject of uncertainties in KM 5.
U.S.	Environmental Protection Agency	Please check if the number is in the "millions". The southeast chapter says it gets "hundreds of millions", but the population of the coast is greater than the population of the southeast. Coordination and consistency checking is needed across chapters. It seems very unlikely that 100 times as many people visit the Southeast as visit the coast, especially since half the nation's population lives in the coastal zone, according to the coastal chapter.	25. Coastal Zone Development		869	9	Available statistics suggest that the number of coastal tourists (both international and domestic) in the first decade of the 2000s was approximately 180 million/year

			and Ecosystems				(Houston, James R. 2008. The economic value of beaches - A 2008 update. Shore & Beach 76(3): 22-26). Because overall population, particularly in coastal areas, has grown as has the tourism sector in absolute and proportional terms, it is reasonable to assume that this number has grown even further since then. However, comprehensive statistics for coastal tourism are not available, making us hesitant to speak of "hundreds of millions" of coastal tourists. Statistics found for the annual number of tourists to individual coastal states suggest they are in the millions or tens of millions per state or destination, depending on the definition of coastal (see, e.g. for the entire state of Florida: http://www.stateofflorida.com/Portal/DesktopDefault.aspx?tabid=95 (87.3 million to all of Florida in 2011); for other US states, including key coastal state destinations such as California and Hawaii and particular city destinations within those (only international visitors), see: US DOC, International Trade Administration, Office of Travel and Tourism Industries 2012. Overseas Visitation Estimates for U.S. States, Cities, and Census Regions: 2011. Washington, DC: U.S. Department of Commerce, ITA, Office of Travel and Tourism Industries). International visitors make up only a small portion (15%) of all coastal visitors (see Houston 2008). Based on these facts we have slightly adjusted our statement and sent this information on to the lead authors of the SE chapter. The discrepancy is a result of a much larger region they consider compared to what we consider.
U.S.	Environmental Protecti	There seem to be two points raised here that are more appropriately, and more effectively, addressed individually. The first is the concentration of people and economic activity and the second is the interactions of land, sea and air. Both points are important, but their importance is muted by	25. Coastal Zone		869	14	The text has been revised to better bring out the intersection of concentration of people and economic

	on Agency	combining them into a "single fact."	Development and Ecosystems				activity with the confluence of stresses coming from land, ocean and air, which is what our intent was. We are not saying there are no other concentrations of people and economic activity, but in this particular region, they are additionally placed at risk from these atmospheric, terrestrial and oceanic forces.
U.S.	Environmental Protection Agency	It may be necessary to modify this statement to include extent as well as concentration. One can certainly identify areas of high concentrations of people and economic activity (e.g., Chicago or Dallas) that are not coastal. Perhaps "no other instance of such large area of such concentration of so many...."	25. Coastal Zone Development and Ecosystems		869	16	The text has been revised to better bring out the intersection of concentration of people and economic activity with the confluence of stresses coming from land, ocean and air, which is what our intent was. We are not saying there are no other concentrations of people and economic activity, but in this particular region, they are additionally placed at risk from these atmospheric, terrestrial and oceanic forces.
U.S.	Environmental Protection Agency	The observations and projections should be in two separate bullets. The first phrase in the opening sentence ("Satellite observations point to an apparent increase in the rate of sea level rise since the 1990s") could probably be moved to the previous bullet.	25. Coastal Zone Development and Ecosystems		870	4	The text has been revised by splitting the most general point about higher sea levels from historical observations and from future projections.
U.S.	Environmental Protection Agency	This figure and caption are very unclear. We have a 3.9-ft scenario but the greatest local rise as indicated in the legend for the upper figures is 2-2.3 ft. Please reconcile.	25. Coastal Zone Development and Ecosystems	25.3	871		The title and caption have been revised to correct the time period covered by the graphic (2050 rather than 2100).
U.S.	Environmental Protection Agency	Panels c and d do not indicate whether they reflect the 1.6 or 3.9-foot rise. And if it is one or the other, why do we have both panel a and b? This figure should probably show the return times for both scenarios.	25. Coastal Zone Development and Ecosystems	25.3	871		The caption has been revised to clarify the panels.
U.S.	Environ	The caption is unclear. Does the 1983-2001 range refer to the baseline against which high water level is	25.	25.3	871		The caption has been clarified and we

	mental Protecti on Agency	compared, or does it refer to the period for observed historical high water levels?	Coastal Zone Develop ment and Ecosyste ms				have added the reference to the sea-level rise scenarios report. 1983-2001 is the period over which historical tide gauge data are used to estimate a base sea level.
U.S.	Environ mental Protecti on Agency	This sentence is a nonsequitur: Having 20 or the largest 25 cities on coastlines does not necessarily mean that saltwater intrusion will have a great impact. The great impact only is likely if the city relies on an aquifer vulnerable to salwater intrusion enhanced by sea level rise. Miami is one such city, but are any of the other major 20 cities? If the sentence included rivers, then New York and Philadelphia (ande CA's Central Valley) could be added to the list. This sentence can probably be struck without harming the paragraph. If one wants to keep the basic issue, it might be better addressed in the water resources chapter, or if space is available, in its own paragraph. Saltwater intrusion is a big deal for ecosystems, but is not addressed in a significant way here.	25. Coastal Zone Develop ment and Ecosyste ms		878	4	The text has been revised and expanded to incorporate this suggestion. Saltwater intrusion effects on ecosystems are now discussed. Saltwater intrusion into coastal aquifers is not discussed as the Coastal chapter team agreed with the Water chapter team during the drafting stage that the Water team would address the water supply issues, while the Coastal team would only focus on saltwater effects on coastal water (and other) infrastructure.
U.S.	Environ mental Protecti on Agency	Do the figures here include only systems in coastal areas, or does it represent costs on a national basis? This needs to be clarified. If these figures are national, their relevance here is questionable.	25. Coastal Zone Develop ment and Ecosyste ms		878	20	The text has been revised to clarify that these are nationwide costs.
U.S.	Environ mental Protecti on Agency	"less effectively" is not the right term. Sea level rise does indeed cause the system to drain less effectively. But here we are talking about more water, so the problem is that the existing system is overwhelmed.	25. Coastal Zone Develop ment and Ecosyste ms		878	12	The text has been revised in order to make the issues clearer.
U.S.	Environ mental Protecti on Agency	Editorial: The "unless" clause at the end of the sentence could be construed as only modifying the last half of the sentence. Because it really applies to both halves of the sentence, the clause should be moved to the beginning of the sentence.	25. Coastal Zone Develop ment and Ecosyste ms		878	26	The text has been revised to incorporate this suggestion.
Whitney	Gray	The section title “Impacts of Marine-related Climate Change” is a bit misleading. This section has already been discussing this topic. Should “to Humans” be included on the end?	24. Oceans		845	1	The text has been revised to incorporate this suggestion.

			and Marine Resources				
Whitney	Gray	Perhaps this section should include more information about food security? How much of the fisheries products are actually consumed in the US? How much of the product could be impacted? What does that mean in terms of food supply for the US or specific areas of the US like Alaska?	24. Oceans and Marine Resources		845	2	We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include.
U.S.	Environmental Protection Agency	CRITICAL COMMENT: Either this sentence should be struck, or a parallel sentence should be added explaining the difficulty of inhabiting land that becomes farther and farther below sea level. That is: The previous sentence provided an even-handed list of response options. But then this sentence focused on the difficulty of relocation, leaving the impression that communities should stay where they are. The NCA should be careful not to imply recommending protection over retreat. If the sentence is kept, some sort of caveat about the problems New Orleans faces should be mentioned, since the inevitable result of not relocating will be to face the situation that New Orleans already faces.	25. Coastal Zone Development and Ecosystems		879	12	The text has been revised to demonstrate that some infrastructure is difficult to relocate inland because it is water-dependent infrastructure. We are not prescribing one set of adaptation options over another, but that the best multi-objective strategy has to be determined in specific contexts. We are citing a case example where just such a determination has been made. We have also added a sentence indicating that even higher costs of removal may be incurred later, and that abandonment may become necessary at a later time.
Whitney	Gray	This section could include a lot more information about what is being done and the programs that are leading the way. It reads as if only a few things are being addressed. An exhaustive list may be overwhelming but the mention of more federal and state programs and how they're addressing the situation would be helpful.	24. Oceans and Marine Resources		846	3	The text has been revised to incorporate this suggestion by pointing to chapters more focused on adaptation.
U.S.	Environmental Protection Agency	This sentence seems to imply that the ports could be doing something that they are not doing. If that is the case, then the text should list some of the things that are cost-effective to do today that the ports are not doing. Compare NRC (1987) "Responding to changes in sea level" which concluded that the ports can simply react to the rise as it occurs.	25. Coastal Zone Development and Ecosystems		881	5	The text has been revised to incorporate this suggestion and a new citation includes a list of actions ports can undertake.
U.S.	Environmental Protection Agency	The reference to the Titus et al. 2009 paper would just as easily fit the following sentence, since that paper showed a continued reliance on traditional shore protection. In addition, the EPA report entitled "Rolling Easements" should be cited to support the statement on rolling easements. (James G. Titus. 2011. Rolling Easements. Washington, D.C.: U.S. Environmental Protection Agency. 176 pp.)	25. Coastal Zone Development and Ecosyste		887	14	We have added the suggested citations in our chapter assessment.

			ms				
U.S.	Environmental Protection Agency	More is needed on scenario planning. It is barely defined in one paragraph (p. 937, lines 15-22).	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				Additional text has been added to this section.
U.S.	Environmental Protection Agency	This sentence is unclear and needs to be rewritten. Does the phrase "and the capacity" refer to iterative improvements (....iterative improvements in the capacity....) or to assessments of the state of knowledge (...assessments of the state of knowledge allow for the capacity to work...)	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		938	2	The text has been modified to clarify that ongoing assessments provide opportunities to work with decision-makers to understand their needs.
U.S.	Environmental Protection Agency	The comma after "interoperable" should be removed.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		939	9	Text modified as suggested.
Christop	Miller	“distributional aspects” should be explained or re-worded for clarity.	1.		17	20	This language has been revised.

her			Executive Summary				
U.S.	Environmental Protection Agency	This paragraph needs to be rewritten. It is unclear if this is stating that the technologies exist to respond to climate, or to the processes of evaluating and preparing for those impacts as well. It would be more clear to state the second sentence as "The challenge is to extend the availability of needed technology and ensure the accessibility of relevant data, define quality criteria, and identify and fill data gaps."The statement that the technologies exist to address climate impacts is quite broad. It implies that there is no additional work needed to develop technologies for adaptation, which does not seem to be the case, particularly if one thinks of technology in a broad sense (e.g., beyond hardware to include approaches/policies to determine how and when to apply that hardware). This statement as written does not seem to be supported by the information in the box or chapter. Narrowing what is meant by technologies would help.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		939	27	Text modified to clarify and discuss challenges related to both technologies themselves and use of those technologies by decision-makers.
Christopher	Miller	“risk was defined as the product of likelihood and consequence”. Is this meant to express a mathematical relationship or just that these two elements together define risk in some way?	1. Executive Summary		17	22	These two elements define risk; the existing language is acceptable.
Christopher	Miller	(1) There are global and U.S. versions of these plots throughout the report (e.g., p. 20, 33, 1090, 1099). It would be instructive for the reader to know why the temperature numbers for the U.S. are higher than for the globe as a whole, e.g., continents warm more.(2) Caption: the SRES scenarios are associated with “the previous simulations”. Does this mean that these scenarios were not done with the most recent (most advanced) versions of the models? If true, then it is questionable to compare, and draw conclusions about, the two sets of results because the models AND the emission scenarios are both different in the respective simulation groups.	1. Executive Summary	1.1	20		Thank you for the suggestion, but we still feel the figure and text are clear and accurate. The figure illustrates relationships between historical scenarios and the ones developed in the context of recent modeling efforts. The Appendix on Climate Science has more information on global temperature trends.
Christopher	Miller	“while the intensity of flooding events has been more prevalent over the eastern parts.” Insert “an increase in” before “the intensity” ?	2. Our Changing Climate		26	17	The Key Message statement has been revised to incorporate this suggestions
Christopher	Miller	“There has been an increase in the overall strength of hurricanes and in the number of strong (Category 4 and 5) hurricanes in the North Atlantic since the early 1980s.” I don’t believe the claim is that the intensity of all hurricane classes has increased. Replace with “overall strength and number of strong (Category 4 and 5) hurricanes in the North Atlantic since the early 1980s.” ? The sentence that follows seems to support this suggested change, i.e., “The intensity of the strongest hurricanes is projected to continue to increase as the oceans continue to warm…”	2. Our Changing Climate		26	20	Thank you for your comment. The observations in the best-track, as well as the reanalyzed data from Kossin et al.(2007), Elsner et al. (2008), and Kossin et al. (2013; in review) show clear and significant trends in the mean intensity of Atlantic storms since 1982. There is also a clear and significant trend in the frequency of Cat4-5 storms. We have modified the wording of the Key Message for clarity.
U.S.	Environmental Protecti	The list of topics in this paragraph should be reordered to match the order in which they are discussed in the section below.	26. Decision Support:		940	4	The section was revised and the organization of the chapter has changed.

	on Agency		Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				
U.S.	Environmental Protection Agency	The chapter misses an opportunity to discuss communication challenges, and what we are learning about those challenges, in the context of climate. Issues such as a bias toward optimism, believing that we know more than we do, and other responses to complex decision making are touched upon only lightly if at all. The chapter also tends to ignore the role of stakeholders in the decision process. Although there are some mentions of the role of stakeholders, the majority of the discussion is focused on decision makers and researchers. Ignoring the diverse and often conflicting stakeholders impacted by decisions can easily render any decision support and support tools ineffective. A discussion of some of the factors related to research and stakeholders can be found in T.L.. Johnson et al, Environ Management, DOI 10.1007/s00267-012-9884-8 (2012).	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				We are working to consider whether we will incorporate this comment more comprehensively in the chapter (needs revision).
U.S.	Environmental Protection Agency	The step "increasing support through the USGCRP for research to develop decision support tools" needs to be removed from this section and incorporated into the Research Agenda chapter (29).	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		940	8	The step (which has been reworded) is also relevant to discussion within the decision support chapter.
U.S.	Environmental Protection Agency	The sentence that begins with "Some analysts" should begin a new paragraph.	26. Decision Support: Supporting Policy,		940	23	Sentence now occurs at end of a larger discussion of variation in different types of boundary processes, some of which are collaborative and iterative.

			Planning, and Resource Management Decisions in a Climate Change Context				
U.S.	Environmental Protection Agency	CRITICAL COMMENT: More should be said about black carbon in this chapter. Recommend that residential wood combustion and the associated emissions should be included or called out in the document as a source of CO2, methane and black carbon. Organic carbon can also be of concern (i.e., warming) over snow and ice. There are a range of measures/programs that can be taken to reduce the residential wood smoke emissions and it may be worth mentioning a couple of those. EPA's Black Carbon Report to Congress has an entire chapter devoted to residential heating and cooking. It would seem that more should be included in the NCA about black carbon and wood smoke. Suggest incorporating the "Summary of Key Messages" as appropriate (http://www.epa.gov/blackcarbon/2012report/Chapter10.pdf).	27. Mitigation				A paragraph has been added on black carbon, citing the 2012 EPA report.
U.S.	Environmental Protection Agency	Suggest changing title to LU, Forestry and Agriculture, as the first paragraph is mostly about forestry, as is the graphic on this page	27. Mitigation		960	1	We have incorporated this suggestion.
U.S.	Environmental Protection Agency	Is it accurate to say the pollutant co-benefit health impacts are always "immediate?" Perhaps say "...as the human health benefits can be more immediate and local..."	27. Mitigation		964	19	The text has been clarified.
U.S.	Environmental Protection Agency	In the section on US Emissions and Land Use Change, I would suggest adding a subsection or box to discuss the issue of indirect international emissions that can be caused by policies or economic activities in the US (sometimes termed "leakage"). For example, policies to promote biofuels or biomass in the US can reduce emissions domestically by displacing fossil fuels but at the same time increase emissions globally by resulting in market-driving land use change (e.g., conversion of high-carbon forests to plantations or cropland). Even outside of the context of a climate policy, US imports of many types of goods entail GHG emissions abroad. US emissions inventories can miss these types of effects.	27. Mitigation		959	11	Leakage is an important phenomenon, but the focus of the chapter on US mitigation means that we can't have a complete discussion of it.
U.S.	Environmental Protection Agency	Does this figure depict annual emissions? From which year(s)?	27. Mitigation	27.3	961		The figure depicts average emissions in the late 2000's, as described in the text.
U.S.	Environmental Protection	The discussion about the net impact of land use since the 2000s on climate is a bit confusing. Figure 27.3 suggests that the net impact is carbon sequestration, but the text suggests that net emissions have occurred from forests in recent years. In which year did net emissions from US forests start occurring, and is this definitively reflective of a new trend towards increasing net forest emissions (as	27. Mitigation		962	1	The section is specifically on carbon, not a broader discussion of land-use impacts on climate. We do not assert that short-term trends are necessarily

	Agency	opposed to a temporary blip on a continuing trend of net forest sequestration)?Strongly suggest closer coordination with Chapter 7 (Forestry) to ensure consistent language regarding this issue.					indicative of future long-term patterns. The text has been revised to clarify.
U.S.	Environmental Protection Agency	I suggest adding the word “can” (Actions to reduce greenhouse gas emissions can yield co-benefits...) since co-benefits are not a foregone conclusion of all mitigation. The box should also note that some mitigation options will have ancillary costs, not just benefits. An excellent example of this is the current issue of increased natural gas production and use, which has demonstrable benefits for GHG reductions, but which also has resulted in considerable controversy surrounding the potential impacts on human health in those areas where production is occurring.	27. Mitigation		964	10	The text has been revised as suggested.
U.S.	Environmental Protection Agency	Some introduction to scenarios and pathways is appropriate here. This presumes that the reader will be familiar with both, and with the reasons why we need to use scenarios and pathways. 1-2 sentences describing why scenarios and pathways are necessary would be helpful. i also suggest changing "the RCPs" to "RCPs". Although we recognize that, when discussing RCPs, we are referring to a specific set, that is not necessarily recognized by most readers.	27. Mitigation		965	1	This is done in earlier chapters in the NCA.
U.S.	Environmental Protection Agency	This discussion is quite cursory right now. It seems worth noting more explicitly that there can be complementarities (e.g., the wildlife corridors mentioned could also sequester carbon), trade-offs (e.g., in a warming climate, energy demands for air conditioning and refrigeration will likely increase), or minimal to no interaction (e.g., it’s not a priori clear whether or how breeding new heat- or drought-tolerant crops would affect mitigation), depending on the strategy being considered. This is a more complex issue than is conveyed here - some studies show that the effort to adapt may decrease the amount of mitigation needed (and/or costs, allowing one to go further) and vice versa. We do agree with the point that such actions are not currently well understood.	27. Mitigation		966	21	We agree that the discussion is terse, but we don't have space to do much more than this.
U.S.	Environmental Protection Agency	Under the Research Needs section, I suggest adding a bullet point on improved technologies/strategies for monitoring--of GHG emissions and sequestration, land use practices relevant to GHG fluxes, and of mitigation actions. There are many promising remote sensing technologies (among others), but more research is needed in this area.	27. Mitigation		967		We have added a phrase on the need for better monitoring efforts.
U.S.	Environmental Protection Agency	There is no discussion in this chapter on mitigation costs of various mitigation technologies and policies. This seems like a large omission. Several estimates are available (e.g., from EPA, EIA, IEA, IPCC).	27. Mitigation				We have added a short discussion of mitigation costs, including pointing out the variability among the many different estimates.
U.S.	Environmental Protection Agency	While a comprehensive discussion of policy options is outside the scope of the chapter, it would be helpful to include at least a brief discussion on policy instruments available and most appropriate for addressing mitigation. Such a discussion could be something as simple as reiterating some of the agreed on points from the economics literature - no one country can do this alone; flexibility over time, space, and sources is important; market-based mechanisms hold a lot of promise in this area for achieving reductions cost effectively.	27. Mitigation				We have added a short discussion of these points.
U.S.	Environmental Protection Agency	The first key message is limited to a discussion of the long time lags for carbon dioxide emissions and what that means for mitigation efforts, but it seems important to also mention other GHGs here (or in a separate key message) as well, particularly those that are not long-lived. A strict focus on CO2 misses many mitigation options for near-term climate benefits.	27. Mitigation		955	20	The chapter now gives more attention to the non-CO2 greenhouse gases. But the key finding remains, as CO2 and other long-lived gases are such a large component of the overall forcing. A sentence is added to point out the same holds for other long-lived GHGs.

U.S.	Environmental Protection Agency	The second key message that talks about needed action seems to preclude the possibility of overshooting with more severe reduction later on (it picks out scenario B1). Why is this possibility not discussed in the chapter? Such a discussion would also include any challenges such an approach would represent for meeting any particular emission reduction goal.	27. Mitigation		955	24	The chapter does a short comparison of the range of RCP's with the SRES scenarios analyzed in the impacts-related components of the NCA. The climate science chapter makes the point that future climates are strongly dependent on which emissions trajectory the world ends up on. We don't have the space to do a complete review of the potential for overshoot scenarios, delays in beginning mitigation actions, or similar issues.
U.S.	Environmental Protection Agency	The phrase "a variety of policies and means at" federal, state, and local levels is imprecise and potentially confusing. What is meant by means?	27. Mitigation		955	38	The word "means" has been changed to "measures."
U.S.	Environmental Protection Agency	CRITICAL COMMENT: There are a number of essential points about how GHGs differ from criteria air pollutants that are important to highlight in this chapter because they imply differences in the way we approach mitigation (e.g., long vs. short atmospheric lifetimes, global vs. regional nature of impacts, direct vs. indirect effects on human health; need to evaluate emissions across the life cycle).	27. Mitigation				The word "means" has been changed to "measures."
U.S.	Environmental Protection Agency	It should be noted in the text that the use of GWP to understand the importance of a gas with regard to mitigation is an imperfect tool because of the nonlinear relationship between carbon dioxide and other greenhouse gases over time. This is especially true when considering aerosols and the ability to compare their impact on climate forcing to that from long-lived GHGs such as CO2.	27. Mitigation		958	14	There are known limitations to the use of GWP's. But it seems beyond the scope of the chapter to explore this literature in detail, especially since GWP's are in such broad use to do comparisons of different emissions/concentration trajectories.
U.S.	Environmental Protection Agency	Suggest changing this sentence to "These models show that stabilizing CO2 emissions would not stabilize its atmospheric concentration, but would result in atmospheric concentrations that increase approximately linearly.It would also be useful to note that this is not dependent upon time frame - immediate CO2 emission stabilization would only reduce the rate at which atmospheric concentrations increase.	27. Mitigation		958	23	The suggested edit has been made.
U.S.	Environmental Protection Agency	It would help to put the each discussion of US emissions in context. It would be helpful to include at the beginning of each subsection (industrial, land use and agriculture) an indication of what those emissions represent as a percent of global industrial, or land use and agricultural emissions.	27. Mitigation		959	11	Space limitations preclude the addition of this level of detail, interesting though they might be.
U.S.	Environmental Protection Agency	Please provide a citation for the emission increase stated here. Also clarify the statement "Over this period" - it is not immediately apparent what period is referred to here.	27. Mitigation		959	31	This section has been redrafted to be clearer on these points.
U.S.	Environmental	The caption for this figure needs to be changed. Only one of the four plots here shows emissions, and does not show "emission patterns." This shows trends in CO2 emissions and drivers of those emissions	27. Mitigatio	27.2	960		We have replaced and clarified this figure to address these issues.

	Protection Agency	over time.	n				
U.S.	Environmental Protection Agency	I find this graphic fairly confusing. It may be easier to graph CO2 emissions and then show the various "wedges" (drivers) underneath to indicate how they contribute to the overall trend, or to parse them into a series of figures.	27. Mitigation	27.2	960		We have replaced and clarified this figure to address these issues.
U.S.	Environmental Protection Agency	What are the main sources of uncertainty when estimating these stocks and fluxes? It would be useful to discuss the estimated uncertainties in Fig. 27.3	27. Mitigation		961	2	There is extensive discussion of these uncertainties in the chapters on forestry, ecosystems, land use and land cover change, and biogeochemical cycles, and it would be repetitive to cover them again here.
U.S.	Environmental Protection Agency	It would be helpful to explain that CO2-e includes emissions of GHGs such as CH4 and N2O. This would not only clarify the components of CO2-e, it would help clarify the difference between CO2-e and CO2, which is not now distinguished.	27. Mitigation		961	2	We have a paragraph specifically on the definition and components of CO2-e in the section titled: Emissions, Concentrations, and Climate Forcing.
U.S.	Environmental Protection Agency	Is this statement ("The future persistence of the land sink depend on the relative effects of several interacting factors.....?") from an external source or is it the authors' synthesis of the presented information? If the former, please provide a citation. If the latter, it would be helpful to indicate that in some way (e.g., "Reviewing these issues, it seems clear that the future....").	27. Mitigation		962	15	We have indicated that this is the authors' judgment. The reviewer's suggested wording has been added to the statement.
U.S.	Environmental Protection Agency	What do these scenarios - you mention B1 - assume the US contribution to reductions would have to be?	27. Mitigation		962	21	We are not analyzing the full distribution of the international contributions to different emissions scenarios. This is outside the scope of the document, and is completely dependent on what policies and measures might be adopted.
U.S.	Environmental Protection Agency	This section should discuss the fact that emission reduction potential is likely overestimated due to rebound effects and emission leakage (state by state shifts as well as US vs other countries).	27. Mitigation		962	20	We do not estimate the actual emissions reduction potential, but simply list the activities. To attempt to do the former would require substantial analysis (and more) of the type suggested.
U.S.	Environmental Protection Agency	The ordering the the tables should be revised - Table 27.2 appears in the discussion of Federal initiatives before Table 27.1 that discusses state initiatives is referred to in the text.	27. Mitigation		962	40	We have re-ordered the table.
U.S.	Environmental Protecti	This textbox is missing a discussion of how decreasing SO2 emissions may lead to increases in warming. There are interactions between these GHGs and criteria air pollutants that work in both directions.	27. Mitigation		964	9	We've added a sentence on this point.

	on Agency						
U.S.	Environmental Protection Agency	the phrase "to yield the US contribution to the reductions" is problematic. Is this "contribution" limited to the model scenario? This makes it sound like the US signed onto some agreement, which is not the case. Suggest rephrasing.	27. Mitigation		964	28	We have edited the sentence to be clearer that this refers to the modeled B1 scenario, and not an international agreement.
U.S.	Environmental Protection Agency	In this section, on the potential for future mitigation action other GHGs as well as the strategy to overshoot should be discussed.	27. Mitigation		964	28	The chapter cannot recommend particular policy actions, nor prioritize one policy approach over another.
Whitney	Gray	The consequences of climate change for barrier islands should be addressed in the Coastal Chapter. Barrier islands, especially in the southeast, contain significant human investment as well as many federal, state and local parks, preserves, wildlife refuges, cultural and historical sites, and ecologically significant assets. They provide wave and wind attenuation for mainlands. Barrier islands are dynamic coastal systems, which adds to their vulnerability to climate change effects.	25. Coastal Zone Development and Ecosystems				We agree that barriers islands are very important to coastal areas. Given space limitations, the team agreed to amend the text slightly in several locations, and we have added several barrier island references. But a full treatment of them specifically is not possible given the scope of the chapter.
U.S.	Environmental Protection Agency	It would be easier to understand the need for US economy-wide action if issues such as leakage, efficiency, and transportation were discussed in more detail.	27. Mitigation		965	32	We are unable to do a comprehensive review of all the possible facets of mitigation within the space available.
Whitney	Gray	Changes in sediment transport due to climate change should be included in this chapter. Sediment transport is a natural process essential to the health of many coastal natural systems, natural resource-based economies, and land forms. While there is some mention in other chapters about the potential transport of excess nutrients and pollutants downstream with sediments, there should also be coverage of the importance of coastal sediment transport.	25. Coastal Zone Development and Ecosystems				We agree that sediment transport is an important issue. We already mention it once in the Climate Drivers section (Great Lakes bullet). But due to space limitation, we could not significantly expand it. Changes in sediment transport are discussed in the second bullet in the Climate-Related Drivers of Coastal Change section, and the discussion there is expanded. Moser et al. 2012 is already cited. Sediment supply is also mentioned in the last bullet in this section.
U.S.	Environmental Protection Agency	CRITICAL COMMENT: The chapter has a significant lack of discussion of activities that drive emissions. A major gap here is transportation, which is currently captured under "industrial emissions." To the vast majority of people, transportation is not "industrial." When turning to mitigation actions in the latter part of the chapter, the lack of discussion of energy end use activities leads to a significant disconnect when trying to tie mitigation efforts back to emissions, particularly when one considers energy efficiency and "embedded" GHGs associated with consumption.	27. Mitigation				Drawing on the 2013 EPA inventory, the discussion of emissions has been rewritten to make clear the dominant role of transportation in emissions by use category.

U.S.	Environmental Protection Agency	This section should cite Kaya, Ehrlich and Holdren, Commoner et al. as sources of the IPAT or Kaya Identity here.	27. Mitigation		959	25	The history of this accounting procedure is not really needed for this audience.
U.S.	Environmental Protection Agency	Please add that the effectiveness of city, state, and regional actions is likely more limited due to leakage.	27. Mitigation		966	35	We have not discussed the effectiveness in quantitative terms in large part because of effects like this.
U.S.	Environmental Protection Agency	Traceable account (Key message 1): I would recommend expanding the discussion of the key uncertainties that affect the estimates of how much mitigation is needed to reach a given target.	27. Mitigation				The chapter already describes the challenge of how much domestic mitigation is required vs. global mitigation - we do not think this rises to the level of a key finding in the chapter.
U.S.	Environmental Protection Agency	Traceable account (Key message 3) (p. 971): The description in "new information and remaining uncertainties" only lists economic forecasts as highly uncertain. I would add a discussion about technological change, particularly as it pertains to energy systems, to this section.	27. Mitigation				We have added a phrase to this section.
U.S.	Environmental Protection Agency	Traceable account (Key message 5) (p. 975): The description of the level of confidence based on evidence seems a bit wrong-headed. Yes, there is no uncertainty about the existence of these programs, but what is more relevant is our confidence in their effects on future emissions and interactions between policies.	27. Mitigation				We have added a phrase to characterize this point more clearly. We have removed confusing statements about the lack of uncertainty in programs described in the text and the tables on state climate and energy initiatives and on sample federal mitigation measures.
U.S.	Environmental Protection Agency	If, as mentioned in the text, more recent projections suggest slower increases in CO2 emissions to 2035, then why not just show the most recent projections in the Figure, instead of the somewhat outdated Snead and Jones (2010)?	27. Mitigation	27.2	960		We have replaced and clarified this figure to address these issues.
U.S.	Environmental Protection Agency	Why not cite the EMF22 work here too – Clarke et al. (2009) ?	27. Mitigation		965	30	We have added the EMF citation.
U.S.	Environmental Protection Agency	"effectiveness" of policy choices presumably refers to benefits. However, the term "effectiveness" often refers to technology-specific performance. Recommend using "benefits" rather than "effectiveness", which also incorporates the broader benefits that may be associated with alternative policy choices.	27. Mitigation		965	38	We added the word "benefits" to the sentence.
U.S.	Environ	The stated research needs seem to focus on improved cost-effectiveness analysis. Is research aimed at	27.		967		We have edited the bullets for

	mental Protecti on Agency	the improvement of benefits analysis, environmental effects associated with mitigation action, or other issues purposely excluded? If so, please explain why research on these other issues is not considered necessary.	Mitigatio n				increased clarity.
U.S.	Environ mental Protecti on Agency	last bullet calls for "..lowering energy cost and greenhouse gas emissions." Was this supposed to be "energy use" instead of "cost"?	27. Mitigatio n	27.2	970		The text has been revised to incorporate this suggestion.
U.S.	Environ mental Protecti on Agency	CRITICAL COMMENT: The inventory data cited in this chapter needs to be updated and from a consistent source. The use of different inventories for different purposes can raise questions about the potential "cherry picking" of inventory data to use that which is most "attractive" to the Assessment authors. Emissions data are taken from the EU inventory, Marland, EIA, Snead and Jones, Pacala et al., and USDA. None of the data appear to be from the official US GHG inventory, published by EPA and available through UNFCCC. Not only do the different sources open the door for criticism regarding objectivity, the use of such a diverse set of sources for emissions data make it exceptionally difficult to compare across sectors, given the different methods that are invariably used by different inventory developers. Although there are reasons for using different inventories, there needs to be a compelling argument for not using the official national inventory. There may be reasons for using dated inventories if they show longer-term trends; however, the Marland 2008 data does not appear to be used in such a manner in this chapter. In short, it is critical to resolve these issues in such a manner that the Assessment demonstrates consistency with other, major government reports (such as the national GHG inventory) and eliminates to the extent possible the potential for criticism regarding objectivity in data reporting. Use of the EPA inventory, which is available through the UNFCCC, also provides a good source for global inventories since other countries also report to UNFCCC. As with US inventories, there may be reasons for using other data sources (IEA, Marland, Houghton, etc.), but unless there are specific analytical reasons for using such inventories, the "official" UNFCCC inventories should be used as the default.	27. Mitigatio n				Estimates of U.S. emissions levels are all now drawn from the 2013 EPA inventory, and the section describing these data has been re-written.
Christop her	Miller	The last year represented in the figure should be explicitly cited – 2011, 2012?	2. Our Changing Climate	2.2	31		The figure will be updated to include data from 2012. The caption has been revised to clarify the date range.
Christop her	Miller	The implication of this sentence is that changes in model resolution/physics play no role in the differences seen in more recent simulations; it's just the emission scenarios (human behavior)– is this true? This conclusion is then stated explicitly in the Fig. 2.3 caption on p. 33. Another conclusion that could be drawn by the reader is that either the previous simulations are robust (not subject to change with a new model version) or the science of model development has not advanced sufficiently for significant changes to show up.	2. Our Changing Climate		32	5	After consideration of this point, we still feel the existing text is clear and accurate. CMIP3 projections are extremely similar to CMIP5 when adjusted for differences in forcing, especially at the large scales. Model resolution has increased but not to the point in CMIP5 that extreme weather is resolved. But this is not so say that the models have not improved. More physical processes are included (for example, the indirect radiative effect of aerosols). The inclusion of such processes increases the complexity of the models. Remarkably, the uncertainty in projections did not

							increase despite the addition of more degrees of freedom. For this reason, the similarity of the new projections to the old ones increases our confidence in projections of future climate change. The reader should conclude that the science of climate change at large scales is robust but also that at smaller scales requires further development.
Christopher	Miller	The regional-scale NARCCAP does not seem to play a prominent role in the results shown (I believe the only figure that acknowledges a NARCCAP contribution is Fig 4.4, p 175; there is another figure that is based on statistical downscaling, but the fundamentals of dynamic and statistical downscaling are not discussed in any detail until late in the report - p 1106-1107). There is some discussion in the text about lack of differences among model results, but are there any broader points to be made about the interplay of GCMs and regional models, e.g., do regional models provide much value-added information now or is this still in the future? If there isn't much difference among models (CMIP3, CMIP5, NARCCAP), can a statement be made that regional models don't have to be run for decision making to occur or, maybe, only run for specific situations, given all the other uncertainties that are involved in such a calculation?	2. Our Changing Climate		45	6	The regional modeling experiment NARCCAP was deliberately not included in most of NCA3 chapter 2 projections due to an undersampling of global model inputs in the NARCCAP protocols. This undersampling results in a wet bias for future projections leading to over confidence in regions of increased precipitation. Regional models play a critical role in understanding local processes, but it is difficult to sample the full uncertainty of future climate change with them.
Christopher	Miller	Is the 36% meant to represent Puerto Rico (the Caribbean in general)? The Caribbean is not mentioned much in this report. Given significant changes in systems such as corals in this area (Fig. 22 in CAQ chapter), more attention is warranted (subject to the amount of information that is currently available).	2. Our Changing Climate	2.16	50		The value is for Puerto Rico. We now explicitly note this in the caption.
U.S.	Environmental Protection Agency	CRITICAL COMMENT: The phrasing of the first key finding carries a connotation of falling short of some goal. Of particular concern is the statement that those "few measures" that have been implemented "appear to be incremental changes." This connotes that incremental changes are undesirable, when in fact, adaptation is almost by its nature an incremental process; the definition of adaptation on p. 985 uses the term "adjustment" to define adaptation. It may be valid to note that few measures have been implemented, but following that with the conclusion that such actions as have been taken "appear to be incremental" seems both unnecessary and judging progress against some unstated goal. It seems that this raises a question that needs to be considered for this opening key message. What are the needs and expectations for adaptation - are major (non-incremental) changes required in practices and policies? If so, those changes need to be much more clearly stated. If not, it may well be that incremental changes are appropriate.	28. Adaptation		983	20	The authors were contrasting incremental change with the concept of transformative change. No judgement was made about which was better only that most actions to-date have been incremental. As such, no change has been made.
U.S.	Environmental Protection Agency	This is a very bland statement. It would also seem important to have the chapter discuss how other societal goals/incentives (those unrelated to climate) may complicate adaptation responses. For instance, insurance that incentivizes people to locate along coastlines or in floodplains work in opposition to what one would want to do to adapt to climate change.	28. Adaptation		983	30	The point is addressed in the barriers section. As such, no change has been made.
U.S.	Environmental Protecti	The converse also needs to be noted - "other" societal goals can contribute to adaptation. To what extent are adaptation efforts occurring under the heading of "fulfilling other societal goals" but having an adaptation component? It seems highly likely that there are many activities underway in urban	28. Adaptation		983	30	Decisions are made for many reasons. A key matter is whether potential impacts of climate change are being

	on Agency	planning, natural resource management, emergency management and preparedness, and so on that implicitly take climate impacts into account, but for a variety of reasons, do not claim the activities as "climate adaptation." I know of instances where those interacting with the public are encouraged to AVOID discussing the role of climate change related to sea level rise or other impacts that are likely to be driven by climate change, simply to avoid controversy.					considered. It is true that some decisions will help society adapt, even if climate change is not explicitly considered. The authors did not believe this concept was relevant here, so no change was made.
U.S.	Environmental Protection Agency	When discussing "being prepared" it would be useful to add something about the potential for risk management tools to play a useful role as a way to prepare for lower probability but high impact events (avoid the term catastrophe as this is usually reserved for continent wide events).	28. Adaptation		984	12	The authors have incorporated more language around risk management and have inserted a link to the decision support chapter where risk management tools are discussed in more detail.
U.S.	Environmental Protection Agency	CRITICAL COMMENT: Some of these terms seem fairly general - such as environmental stressor and mitigation. Is there a reason why they are defined here vs. a common glossary for the entire document. Also, some of these terms are important enough to the discussion - risk, vulnerability and resilience - that they deserve to be brought into the main text and accompanied by a fuller discussion of how they come into play in the context of adaptation. For example, resilience seems like a concept you could connect to the notion of vulnerability - in the sense that it can help decrease vulnerability.	28. Adaptation		985	3	While there is a general glossary, we think these definitions are important to add context to our chapter. As such, no change was made.
U.S.	Environmental Protection Agency	CRITICAL COMMENT: There are a number of fundamental issues with this chapter that need to be resolved. The chapter provides little in the way of context or framework for thinking about adaptation. It would be helpful to have a section that discusses how to define adaptation, as definitions vary. This is also particularly important given that there are often multiple societal benefits associated with adaptation, as the authors note on p. 983. The range of adaptation measures is extremely broad, and can vary from individual actions in response to changing weather (e.g., planting earlier or switching crops) to system- or government-wide development of policies and priorities. Also missing is any discussion of how to at least think about, let alone set, priorities for action. Which impacts of climate change will be hardest to anticipate, guard against? For which are the uncertainties largest? Where do we have the best/worst information? How does the type of adaptation that might be undertaken vary by region (because of variation in the impacts)? Given that we always have limited resources, which actions should be undertaken first? These issues emphasize the need for a more coherent approach to thinking about adaptation from a national perspective. As currently written, however, the chapter appears to be largely a cataloging of the status of Fed, state, local government adaptation plans. The chapter would benefit greatly from a review of any literature regarding observed and projected adaptation by sector (e.g., agricultural practices?) and households (e.g., increased AC use, migration?). This appearance is not helped by the current ordering of the chapter's sections. It seems out of place to discuss actions taken on adaptation before discussing the adaptation process. Switching the order will help with giving the chapter a more coherent frame and better position the reader to understand the context in which the adaptation activities are developed and implemented. It would also help to set the stage by discussing ways in which policies and programs can "incentivize or inhibit" adaptation. Are there examples that can be provided that show instances in which adaptation	28. Adaptation				Thank you for your comment. The chapter does define adaptation, using the IPCC's definition. We don't include any material about prioritizing adaptation actions as that is something that has to be locally contextualized. We don't have the space to look at adaptation by sector and that is what is being looked at in the various chapters of the NCA. We agree with the commenter that these are important issues, but they are beyond the scope of our chapter.

		is inhibited (coastal flood insurance?) or enhanced? There have been significant efforts (Flood Insurance Reform Act of 2012) that have been undertaken with an understanding of the need to support adaptation. Do they provide models for future policies, or do they illustrate what should NOT be done?					
U.S.	Environmental Protection Agency	Although the definition of mitigation comes directly from the IPCC AR4, it may be better to use the more lucid: "The reduction of greenhouse gas emissions and enhancement of sinks, through policies that encourage technological change and substitution."	28. Adaptation		985	9	We thank the commenter for the comment. The IPCC definition for mitigation is what we used in our chapter. In addition, the NCA chapter on mitigation also defines mitigation simply as actions that reduce the human contribution to the planetary greenhouse effect. Mitigation actions include lowering emissions of greenhouse gases like carbon dioxide and methane, and particles that have a warming effect. Increasing the net uptake of carbon dioxide by land-use change and forestry can make a contribution as well. As such, we have kept the definition as originally written.
U.S.	Environmental Protection Agency	Suggest changing to, "… and improving public communication and education" or similar to clarify the intended audience of the communication and education efforts.	28. Adaptation		986	9	We thank the commenter of this suggestion and have revised the text slightly to address these concerns.
Kyle	Whyte	Legal issues are mentioned throughout the paper, however, with the exception of the documentation of legal issues surrounding relocation, the list of problems listed on these lines should include legal issues generally (including institutional and policy issues too), and these articles should be cited, as they outline general patterns of unfairness in climate change policy in the U.S. and environmental policy more generally in the U.S. regarding tribes (focusing on federally-recognized tribes). Whyte, Kyle Powys (2013) Justice Forward: Tribes, Climate Adaptation and Responsibility in Indian Country. Climatic Change. doi: 10.1007/s10584-013-0743-2Whyte, Kyle Powys (2011) The Recognition Dimensions of Environmental Justice in Indian Country. Environmental Justice 4(4): 185-186. doi:10.1089/env.2011.4401.	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources		443	5	The text has been revised to incorporate this suggestion. We have added in the suggested references, as well as an additional new paragraph in the introduction with many more citations, for which we have provided as reference for more in-depth discussion.
U.S.	Environmental Protection Agency	CRITICAL COMMENT: Please ensure that Table 28.1 identifies most recent information for each agency. For EPA, please update and revise to account for the following: (1) Climate Ready Estuaries and Climate Ready Water Utilities are EPA adaptation programs, not working groups. (2) The "draft water program adaptation strategy" is now final. (3) Through a cooperative agreement with the Institute for Tribal Environmental Professionals at Northern Arizona University, EPA has supported development of a national climate change adaptation planning training program and online resources for tribes to prepare for the expected impacts of climate change. (4) EPA develops technical capacity to support community-level green infrastructure solutions for pollution control and climate adaptation strategies.	28. Adaptation	28.1	987		We thank the commenter for the suggestion, but space is limited. As such, we are asking the INCA to reconcile table 28.1 such that each agency has 6 lines to fairly and accurate represent illustrative adaptation actions within the various federal agencies.

U.S.	Environmental Protection Agency	"inhibit" seems to be a very strong word choice in this context. Is this accurate? More explanation may be warranted.	28. Adaptation		989	18	We thank the commenter for the question. In reviewing our references, our assessment is that states have become important actors in the adaptation context. Their actions can encourage or discourage adaptation. We will incorporate the words "encourage or discourage" into the text (revision needed).
Christopher	Miller	Does the 2011 and 2012 heat wave situation apply to a small portion of the country or the whole country – a specific location is not given? “largest area” seems to imply something in-between. Clarify “largest area” – largest compared to the entire historical record?	2. Our Changing Climate		52	6	Geographical details have about the record heat of 2012 have been inserted.
U.S.	Environmental Protection Agency	Suggest revising the opening sentence to clarify that the actions described in the following bullets include recommendations as well as current activities. Some of these items have significant implications for policy directions and resource commitments that may not now be in place, and could require legislative action to implement.	28. Adaptation		989	1	We think this is evident from the context provided in the chapter. Earlier in this section, we describe activities that are already in place. This is meant to be a generic list that 'could' help, and we didn't want to prescribe whether legislation was needed or not. As such, no change was made.
Christopher	Miller	Figure would benefit from more discussion, e.g., what is the plot for gpcp and its significance?	2. Our Changing Climate	2.21	57		Note that this figure using PDSI has been moved the appendix and a detailed discussion of the limitations of this drought index added. The new discussion about drought in chapter 2 focuses on soil moisture projections in the western US (a similar calculation for the entire country being yet unavailable) and Consecutive Dry Days. Both of these measures suggest increased drought risk for much of the US.
Kyle	Whyte	For this sentence, this article can be cited, which provides a theory supporting the claims in the sentence that is directly discussing climate change (especially section 2.1): Whyte, Kyle Powys (2013) Justice Forward: Tribes, Climate Adaptation and Responsibility in Indian Country. Climatic Change. doi: 10.1007/s10584-013-0743-2	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources		445	11	We have added the suggested citation in our chapter assessment.

Christopher	Miller	Plots don't display data up to 2009. The two data sources in the plots should be described.	2. Our Changing Climate	2.23	61		The data appears to go up through 2006, so the caption needs to be corrected. The satellite based data source is described in the Kossin et al. 2007 reference given in the caption. The longer records shown are conventional Best Track data originating from the U.S. National Hurricane Center.
U.S.	Environmental Protection Agency	In some cases, it is clear why these are federal roles, but less clear for other cases. It would be useful to discuss the appropriate level for responsibility at the federal, state, and local levels before beginning to identify specific actions.	28. Adaptation		989	1	We thank the commenter for the suggestion, but space is limited. We hope that by inference, readers will be able to understand how the Federal agencies can help. We have included many references to which the reader can go to read more detail about why these have been identified as Federal roles. No change was made.
Christopher	Miller	"proxy" should be explained as well as types of proxies used.	2. Our Changing Climate		63	10	The proxy data have now been described more explicitly.
Kyle	Whyte	In this list of citations, the following citation should be added, as it also affirms and documents physical and political boundaries regarding tribes in the U.S., especially in section 2.3 of the citation: Whyte, Kyle Powys (2013) Justice Forward: Tribes, Climate Adaptation and Responsibility in Indian Country. Climatic Change. doi: 10.1007/s10584-013-0743-2	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources		668	31	We have added the suggested citation in our chapter assessment.
U.S.	Environmental Protection Agency	Suggest changing to "take steps to avoid unintended consequences." Although there are numerous instances in which unintended consequences can be (and should have been) foreseen, it is impossible for policy makers, regardless of the flexibility they seek to incorporate during the development of policies, to foresee all unintended or ensuing consequences, positive or negative.	28. Adaptation		989	14	We thank the commenter for the suggestion. This change has been made.
Christopher	Miller	The "historical" runs should be mentioned in the caption.	2. Our Changing Climate	2.29	68		Caption has been modified; now states that gray shading and dashed black line are for historical simulations.
U.S.	Environmental Protection	Provide more explanation for the importance of flexible regulatory frameworks and adaptation efforts, particularly in the context of the need to ensure specific policy goals that meet the requirements of legislation.	28. Adaptation		989	11	The authors did not want to talk about specific policy goals as that is beyond the mandate of the assessment. As such, no change was made.

	Agency						
Christopher	Miller	Suggest providing a definition for “runoff”. It can be a vague concept to a general audience.	2. Our Changing Climate		107	18	This comment is on the Water Resources chapter. A glossary will be provided with the final report.
Christopher	Miller	In the caption, the “ensemble of scenarios” is not identified. Also, there is no mention of which model(s) was used, nor a citation.	2. Our Changing Climate	3.2	112		This comment is on the Water Resources chapter. A citation and an identification of the number of models included in the ensemble has been added to the caption.
Christopher	Miller	Is the “groundwater depletion rate” the amount withdrawn (gross) or the difference between the recharge and the amount withdrawn (net)?	2. Our Changing Climate		114	32	This comment is on the Water Resources chapter. A glossary will be provided with the final version.
Christopher	Miller	(1) in the soil moisture/runoff plot caption, change “Comparison of monthly simulated soil moisture and runoff for 50 historical (1960-2009) and future years (2050-2099) to “Difference between monthly historical and simulated soil moisture and runoff for 50 historical (1960-2009) and future years (2050-2099)”; also the model used for the projections is not identified (2) in the frequency exceedance plot the various curves need to be identified (including the horizontal red line)	2. Our Changing Climate	3.8	128		This comment is on the Water Resources chapter. Thank you for the suggestion. Changes have been made to the figure in the Water chapter to incorporate these responses.
Christopher	Miller	In the caption, it would be useful to know what the crops are responding to over time in the crop models, e.g., CO2, temperature… This information is implied in the figure title “Crop Yield Response to Warming…” but temperature is not singled out explicitly; in other words, does warming mean temperature only or does it mean all the effects that occur concurrently with warming?	6. Agriculture	6.4	232		Thank you for your comment. The caption has been modified without becoming unwieldy.
Christopher	Miller	There should be some statement made about why solar radiation has been decreasing – is it something happening on the sun or in the Earth’s atmosphere; is it natural or human-influenced?	6. Agriculture		235	11	We have added a sentence to incorporate this suggestion.
Christopher	Miller	In the caption, change “historic” to “historical” (do a global search in the report and make this change when appropriate)	7. Forestry	7.5	273		The text has been revised to incorporate this suggestion.
Christopher	Miller	Caption: “In August and September 2012, sea ice covered less of the Arctic Ocean than any time since at least 1979, when the first reliable satellite measurements began”. This sentence implies that the sea ice extent in 1979 was less than in 2012, which is presumably not the intent of the statement – suggest re-wording.	7. Forestry	12.4	450		The text has been revised to incorporate this suggestion in the Tribal Chapter. We reworded the sentence to read as follows: “In August and September 2012, sea ice covered less of the Arctic Ocean than any time since the beginning of reliable satellite measurements (1979).”
Christopher	Miller	This paragraph describes a number of actions that respond to climate change but it convolves the concepts of adaptation and mitigation. These concepts are not mutually exclusive, but in anticipation of the chapters on Adaptation and Mitigation some clarity of definitions would be helpful here.	13. Land Use and Land Cover Change		472	8	We agree with the general need expressed by this comment, and edits have been made.
Christopher	Miller	This figure does not give the complete picture; areas showing projected increased unfavorability in July may show the opposite trend in other months of the year. People now vacation year-round and will shift the timing of vacations to match favorable weather conditions wherever they occur.	14. Rural Communities	14.4	501		We appreciate the comment, one which indicates the socio-economic complexity of many climate impacts. As it stands, the graphic is accurate. It shows conditions as described. The figures show the traditional summer

							season for tourism. The Tourism Climatic Index does not account for winter sports, so it would not work for ski areas and thus the diagrams would be less instructive. Summer made sense from an industry perspective (when most people travel).
Christopher	Miller	Caption needs to be expanded to identify sea level rise used and define “social vulnerability index”.	16. Northeast	16.9	563		This figure has been reconfigured and no longer uses the vulnerability index. The SLR has been clarified in the caption.
Sidney	Oldberg	The title and text are misleading, for climate change "science" is not and cannot be a science in lieu of the statistical population underlying this field of inquiry's models. Please refer to my comments on the whole report for details.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				Comment raises questions about quality of climate science and is addressed in "Climate Science" chapter.
Sidney	Oldberg	The title and text are misleading, for climate change "science" is not and cannot be a science in lieu of the statistical population underlying this field of inquiry's models. Please refer to my comments on the whole report for details.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z				The discussion in this chapter entirely relies on observations of the Earth's climate system, the understanding of how the climate system works that comes from analyses of these observations, and the further knowledge models of the physics, chemistry and biology provide that integrates that understanding. This scientific process is the basis for all statements relating to science in the chapter. The concern raised by the reviewer was also addressed in our response to comment 7861, on the whole report.
Sidney	Oldberg	The title and text are misleading, for climate change "science" is not and cannot be a science in lieu of the statistical population underlying this field of inquiry's models. Please refer to my comments on the whole document for details.	Appendix: The Science of Climate Change				The discussion in this chapter entirely relies on observations of the Earth's climate system, the understanding of how the climate system works that comes from analyses of these observations, and the further

							knowledge models of the physics, chemistry and biology provide that integrates that understanding. This scientific process is the basis for all statements relating to science in the chapter.
John	Drake	Energy Supply and UseThe adaptation actions for resiliency, Table 4.2, is very helpful. It may be hard to prioritize such a grab all list, but at least a discussion should be started in this document of how one would start to develop a prioritization.Page 180: The point of view is of an energy modeler and the takeaway message seems to be that there are too many options to evaluate. I would encourage you to expand this section with some case studies. In particular, please discuss the beneficial and harmful aspects of the natural gas replacement of coal. Also I think a careful look at the RCP4.5 scenario assumptions would be informative. Is there any discussion of coburning as a means of removing carbon from the atmosphere. Also Carbon Capture and Store must be discussed a little to cover the concerns of the day. This section on Future energy is thin and needs to give some more quantitative information on carbon options and emerging technologies.	4. Energy Supply and Use				Thank you for the accolade. As discussed throughout this chapter, energy supply and use decisions are primarily made on a local basis based on numerous factors. Therefore, the variations in conditions across communities makes it hard, if not impossible, to prioritize the most valuable adaptation actions or examine optimal energy choices in this chapter due to page length constraints and the complexities of local contexts. The reference studies identified in the discussion of the "Future Energy Systems" provide a more detailed examination of energy system scenarios.
John	Drake	The sea level rise threat tends to get overplayed. I think it is here as well, though connecting with severe weather events and their incrementally more severe nature is correct. Heat stress and its direct health effects is relatively underplayed. The change in over 95 degree days doesn't give an idea of the change in heat wave intensity and what that would mean.If you need results from the new scenarios (RCPs) take a look at Y Gao, J S Fu, J B Drake, Y Liu and J-F Lamarque, "Projected changes of extreme weather events in the eastern United States based on a high resolution climate modeling system", Environmental Research Letters, 7 (2012) 044025	17. Southeast and Caribbean				We disagree that, for the SE, the emphasis on SLR is overplayed. The suggested reference has two problems: (1) it is results from a single RCM simulation so it does not adequately represent the range of futures and (2) it uses the RCP8.5 scenario whereas the NCA report uses SRES.
Christopher	Miller	In the caption, more context could be provided, e.g., which physical plant is being discussed - Goddard?	16. Northeast	16.11	565		The text has been revised to incorporate this suggestion.
Christopher	Miller	“occurred every 60 years during the recent 1978-2007 period”. For those not versed in statistics, this may seem like an odd statement, i.e., how could an event occur every 60 years in a 30-year period? A	16. Northeas		565	22	The text has been revised to incorporate this suggestion.

		more understandable way to express the risk of a 100-year event is to state that it is an event with a 1% chance of occurring in any given year [and a 60-year event has a 1.7% chance]. The 100-year risk statement could be made earlier in the document since it comes up often in the report. Suggest either re-wording the statement here for clarification or introduce the percentage risk concept. It is especially confusing to the public when more than one 100-year event occurs over a relatively short period of time.	t				
Christopher	Miller	The photo caption for 2008 would benefit from some additional words on how this photo differs from the 1963 photo, i.e., what was the specific damage, degradation?	17. Southeast and Caribbean	17.2	586		The figure and the caption have been improved as requested.
Christopher	Miller	Some of the cited emissions sources do not show up in the pie charts (presumably because they are very small or zero). Suggest noting this in caption	20. Southwest	20.3	692		We thank the reviewer for the helpful suggestion. We have revised and corrected the figure.
Christopher	Miller	Define MLLW (i.e., Mean Lower Low Water)	20. Southwest	20.5	696		Thank you for your comment. We have deleted "MLLW" from the photo captions, as the term and its definition is not important to include in the chapter.
Christopher	Miller	Do all the conclusions in this paragraph correspond to the A1B emissions scenario? The scenario should be stated in the text.	21. Northwest		724	1	The text has been revised to incorporate this suggestion.
Christopher	Miller	Change “Likelihoods” to “Likelihood”. Change where it appears elsewhere in document.	21. Northwest		725	7	After consideration of this point, we still feel the existing text is clear and accurate. Plural refers to multiple outcomes each of which has a likelihood
Christopher	Miller	The intensity of the storm creating the surge contribution is not specified – is it a routine storm or an extraordinary storm?	21. Northwest	21.4	729		Figure caption and traceable account have been revised and now cite Zervas (2005).
Christopher	Miller	In the third caption, the probability numbers should be explained, e.g., what does +0.4 mean – a 40% increase in probability?	21. Northwest	21.7	733		The figure legend was altered to directly show the probability.
U.S.	Environmental Protection Agency	The tables and figures are not well connected to/referenced in the text.	28. Adaptation		990	1	We thank the commenter for this suggestion. We have been given a slightly expanded word limit to the chapter and have been allowed to add back figure and table referencing text. As such, this change has been made.
U.S.	Environmental Protection Agency	This figure needs a much more descriptive title. At first glance, it appears to have been simply dropped into this section with little reason. The figure would also be much more valuable if it were to be explicitly mentioned in the text in the discussion between 994/3 and 995/8.	28. Adaptation	28.2	995		We thank the commenter for this comment and have added back the in-text reference to Figure 28.2, which was removed from the draft due to word limitations.
U.S.	Environ	The entry for Munich Re should point out that the company plays a major role in providing information	28.	28.5	996		We thank the commenter for the

	mental Protecti on Agency	and guidance to others' efforts to develop and implement climate adaptation plans. It is currently described as though they are focused only on their internal corporate strategy.	Adaptati on				comment. If the commenter reads the Munich Re entry closely, then it is clear that Munich Re regards "advocacy" as a core part of its strategy. Therefore, Munich Re does indeed provide information and guidance to others, including governments. With the word limit imposed on each chapter, we are comfortable with this table and the Munich Re entry. As such, no change was made.
U.S.	Environ mental Protecti on Agency	This figure seems to lay out a formal process to plan for adaptation. It would significantly improve the message of the figure and the text if there were included some broad discussion of the process before explaining each of the steps.	28. Adaptati on	28.3	998		Text added to clarify that the next sections amplify on the figure. "However, as shown clockwise in Figure 28.3, the process generally involves characterizing vulnerability, developing options, implementing actions, monitoring outcomes, and re-evaluating strategies. Each of these is described in more detail below."
U.S.	Environ mental Protecti on Agency	As noted in the overarching comment regarding this chapter, it would be very helpful to move this section toward the front of the chapter to help put the lists of actions in context.	28. Adaptati on		998	1	Because the audience of the National Climate Assessment is Congress, the president, and the broader public, the authors think the way it is structured is simpler and more accessible. As such, no change was made.
U.S.	Environ mental Protecti on Agency	Within the section on "Planning, Assessing, and Selecting Options," a short discussion of the current understanding of the costs of adaptation measures is warranted (i.e., how can we plan for adaptation without even a basic understanding of how much it will cost?). A recent paper assesses the current state of knowledge on the magnitude of adaptation costs in the United States, and makes recommendations to make future adaptation cost studies more accessible and relevant to policy and decision makers. Sussman, F., Krishnan, N., Maher, K., Miller, R., Mack, C., Stewart, P., Shouse, K., Perkins, W. (In Press). Climate Change Adaptation Cost in the United States: What Do We Know?. Climate Policy. [PDF can be provided if needed]	28. Adaptati on		999	1	Thank you for suggesting this reference. It has been added to the chapter.
U.S.	Environ mental Protecti on Agency	Please review the statement that "Many of these" frameworks, tools, and approaches are "not easy to use", etc. "Easy to use" can be relative, and it is important to indicate that some tools may not be easy to use by the intended audience/end users. Also, consider replacing "many" with "Some of these."	28. Adaptati on		999	21	Thank you for your comment. The authors have changed to "some" and 'by the intended audiences' as suggested.
U.S.	Environ mental Protecti on Agency	The section, "Climate Adaptation Map", overlaps significantly with and is largely redundant of other sections. It seems like another way to itemize information already presented in the section on adaptation activities in the U.S. The relevant sections should be combined, and should not be separated by the intervening discussion of the adaptation process.	28. Adaptati on		1001	1	We think the map helps readers see the geographic breadth of adaptation activities. It is an alternative tool in the chapter to help people access examples of adaptation efforts. As such, no change was made.

U.S.	Environmental Protection Agency	"Barriers [to adaptation] are distinguished from physical or ecological limits to adaptation, such as physiological tolerance of species to changing climatic conditions that cannot be overcome (except with technology or some other physical intervention)." This statement addresses the limits of the natural world to adapt on its own, which can be overcome with human intervention. However, the more interesting question is the ultimate limit of human adaptation to climate change, which is based on a combination of the technological capacity and the cost of (willingness to pay for) the particular technology. Thus I would change the sentence to the following: "Barriers are distinguished from limits to adaptation, the point beyond which the chosen adaptation approach ceases to provide further benefit. These limits depend on the physical, technological, and cost characteristics of the damage and adaptation system." It would be useful to discuss some of these barriers in some detail in the text. How and when they may come into play, why they may impact adaptation, for example. It would also be useful to point out if there are particular policies or goals that are likely to make adaptation more difficult.	28. Adaptation		1004	2	We thank the reviewer for their comment. Barriers include more than physical characteristics, technology, or cost. Perception and culture are among examples of other types of barriers. Space constraints limit our capacity to expand the discussion on barriers, so no change was made.
U.S.	Environmental Protection Agency	What are the references in the last column? Do these sources give specific examples of places that experienced each of the barriers list in the previous column? Is there a more useful way to show this information, or can you refer to the Table in the text, explaining what it is a bit more? Perhaps describing a few examples in the text in this section would help. Also, are the parentheses necessary in the last column?	28. Adaptation	28.7	1005		Thank you for your comment. The authors developed the table because of word limitations. Doing what the commenter suggests would add a lot of text and exceed our word limits. The citations support the bullet points. As such, no change was made.
U.S.	Environmental Protection Agency	Section IV is so thin, perhaps it would be better to combine it with Section V on next steps. These 4 partnerships can be noted as examples of excellent starts to organizing within and across sectors and regions to collectively overcome barriers and adapt to climate change. The section is largely a very small collection of examples instead of a broader discussion of major barriers and priorities/strategies for overcoming them. The examples are not used to generalize approaches or provide insights into how to begin to prioritize and strategize more broadly.If this section is retained, it would be more effectively titled, "Overcoming Barriers to Adaptation", "Overcoming Barriers to Successful Adaptation", or "Successfully Overcoming Barriers to Adaptation". Including "adaptation" in the title does a much better job of tying it to the previous discussion on the barriers and to the chapter as a whole.	28. Adaptation		1006	1	The authors have merged section III and IV to create a more holistic section on barriers and illustrative examples of how to overcome them.
U.S.	Environmental Protection Agency	"adaptation to climate change is at a nascent stage." It is unclear what the authors mean by this (and why defining adaptation more precisely is important) - do you mean adaptation planning at an institutional level?	28. Adaptation		1006	23	Thank you for your comment. The authors mean the practice of adaptation is in the early stages. As figure 28.3 shows, adaptation involves 5 key steps and most activities in place only encompass a subset of these to date. We do not mean to imply that 'defining adaptation more precisely' is necessary. We appreciate your comment, but no change to the text has been made.
U.S.	Environmental Protection Agency	"important opportunities are being overlooked" - which ones are being overlooked? What are they and why are they important?	28. Adaptation		1006	30	Thank you for your comment. The authors added clarifying text: "important opportunities available during the normal course of planning and management of resources."
U.S.	Environ	The word "useable" or "usable" is used in both these lines, but spelled differently. Although both are	28.		1007	25	We thank the commenter for this

	mental Protecti on Agency	correct, using just one would provide consistency	Adaptati on				comment. We will make the change to "usable."
U.S.	Environ mental Protecti on Agency	The term "costs of inaction" is thrown around in policy discussions a lot. I suggest the authors be precise by what they mean by these phrase - is this the cost of climate change impacts without any adaptation or mitigation at all?	28. Adaptati on		1007	3	Thank you for your comment. The authors had explicitly identified what was meant by the cost of inaction in the next steps section.
U.S.	Environ mental Protecti on Agency	It seems like local circumstances would matter here to understand whether another jurisdiction could effectively transfer and apply methods to their own situation.	28. Adaptati on		1007	4	Thank you for your comment. The authors have added material indicating that "context matters" and the reference cited expands on that.
U.S.	Environ mental Protecti on Agency	There needs to be some recognition with regard to the proposed Compendium that a significant fraction - likely the vast majority - of adaptation measures will necessarily require interaction or compliance with local, state, and/or federal regulations and laws. It is presumed that the compendium is intended to provide guidance on best practices, which may or may not transfer across jurisdictions, even when environmental and demographic conditions are similar. Such a compendium could also create significant legal issues for those who may not be aware of the regulatory requirements applicable to their specific instance. This illustrates one of the major barriers to comprehensive adaptation, which is touched upon in the chapter, but not well developed.	28. Adaptati on		1007	4	The reference cited notes that there is no 'one size fits all' and that adaptation actions will need to be developed in the appropriate local context. We could not elaborate on all of this given the space limitations.
U.S.	Environ mental Protecti on Agency	The discussion of the Federal role (on p. 989) seems like a better fit for this section. Move it here and combine with what you have here already.	28. Adaptati on		1007	17	Thank you for your comment. The authors have re-arranged the info in this last section to combine the paragraphs on the Federal role. This section focuses on moving forward on needed research so it needs to be the concluding section.
U.S.	Environ mental Protecti on Agency	"barriers to effective implementation continue to exist" - such as?	28. Adaptati on		1007	30	Thank you for your comment. The authors have added a link back to the barriers section to address this comment.
U.S.	Environ mental Protecti on Agency	Can you note the spatial and temporal scale at which this information is most needed to help overcome barriers?	28. Adaptati on		1007	2	Thank you for your comment. We have added more material about the cost of action versus inaction. However, the authors are unclear about what is being requested regarding spatial and temporal scale.
U.S.	Environ mental Protecti on Agency	Why is the first case study broken out with an assessment of keys to success but these generic factors not consistently discussed for the other case studies?	28. Adaptati on		1008	1	Thank you for your comment. NIDIS is the one that is the most mature and comprehensive activities we evaluated, so we had more material to include. The others are more nascent and not as big. Therefore, we had less

							material to include about how they overcome barriers and what their key successes are. As such, no change was made.
U.S.	Environmental Protection Agency	Please define WGA. It is defined on p. 1010, l. 22, and also used in its full form (Western Governors Association) on p. 1008, l. 25. Please define on l. 3 and use the abbreviation thereafter.	28. Adaptation		1008	3	We thank the commenter for this editorial correction and have corrected this.
Barry	Heimlich	There is an imminent threat of increased inland flooding during heavy rain events in low-lying coastal areas such as southeast Florida since just inches of sea level rise will impair the capacity of storm water drainage systems to the ocean (Heimlich et al, 2009). Drainage problems are already being experienced during seasonal high tides and storm surge events. Adaptation requires redesign and enhancement of storm drainage canals, flood control structures, and storm water pumps in the near future.Heimlich et al, 2009 is already a reference in this chapter.	17. Southeast and Caribbean		590	1	The text has been revised to incorporate this suggestion.
Barry	Heimlich	The link in the following reference in this section needs to be repaired:SFWMD: Climate Change and Water Management in South Florida. Interdepartmental Climate 8 Change Group report November 12, 2009. South Florida Water Management District. [Available online at https://my.sfwmd.gov/portal/page/portal/xrepository/sfwmd_repository_pdf/climate_change_and_water_management_in_sflorida_12nov2009.pdf	17. Southeast and Caribbean		614	8	After consideration of this point, we still feel the existing link is accurate.
Christopher	Miller	In the caption, B2 looks like a mistake - replace with B1 or A2?	17. Southeast and Caribbean	17.11	600		After checking this point, B2 is accurate.
Christopher	Miller	it is not entirely clear if the 20%-30% contribution by glacier shrinkage to global sea level rise (relative to the Greenland Ice Sheet contribution) refers only to Alaska and British Columbia or to all the world's glaciers. A simple re-wording would eliminate any confusion (e.g., replace "this shrinkage" by "the shrinkage in Alaska and British Columbia") since wording later in the chapter indicates this key statement refers to just Alaska and British Columbia.	22. Alaska and the Arctic		759	18	The text has been revised to incorporate this suggestion.
Christopher	Miller	I wonder if this statement is true. There has been some government-supported relocation. The 6/20/2008 USAToday has an article on a Mississippi River town that was relocated after the 1993 floods, quote: "Valmeyer's rebirth a mile away was funded through the Hazard Mitigation Grant Program, a FEMA project to help communities in flood-prone areas relocate to higher ground. The program, born in 1988 and expanded after the floods of 1993, pays 75% of the cost of moving structures or buying them for demolition. The other 25% must come from matching state and local funding. Since the floods of 1993, FEMA has distributed more than $1 billion in grants to fund the removal or relocation of about 12,000 structures in flood-prone areas across the Midwest, most of them along the Mississippi and its tributaries." The current status of this federal program should be confirmed.	22. Alaska and the Arctic		766	8	After consideration of this point, we still feel the existing text is clear and accurate, as discussed in the cited reference (Bronen 2011).
Christopher	Miller	In the caption, the above-freezing patterns for A2 and B1 are similar on the large scale – this is worth noting to the reader.	22. Alaska and the Arctic	22.5	768		We appreciate the suggestion, but space is limited. The author team has deliberated and feels that readers will note the large changes at the end of the century, without additional

							comment
Christopher	Miller	Replace “the their” with “their”	22. Alaska and the Arctic		772	3	The text has been revised to incorporate this suggestion.
Christopher	Miller	I would suggest not using the phrase “western science” – it makes the Native culture seem somehow alien and out-of-step with the mainstream.	22. Alaska and the Arctic		775	14	After consideration of this point, we still feel the existing text is clear and accurate.
Christopher	Miller	Identify ERSST	24. Oceans and Marine Resources	24.1	837		The figure has been clarified.
Christopher	Miller	Replace “principle” with “principal”	24. Oceans and Marine Resources		843	8	The text has been revised to incorporate this suggestion.
Christopher	Miller	What “coastal” means should be defined, e.g., is it all land affected by tidal waters, or land in the watershed of a large body of water, or land within a certain distance of a coast? The figure seems to reflect a fairly liberal definition of “coastal”.	25. Coastal Zone Development and Ecosystems	25.1	868		We agree that a definition would be helpful, and have added it in the caption to Figure 251. We used NOAA's definition of coastal watershed counties. The spatial unit is well-defined (methodology available online at: http://coastalsocioeconomics.noaa.gov/coast_defined.html).
Christopher	Miller	The caption needs revision to be understandable. Suggest re-working the caption to make the following points clear: (1) identify what “intermediate low” and “intermediate high” refer to – the ‘absolute’ SLR values of 1.6 and 3.9 feet cited in the caption? (the value in the caption of 3.9 foot is not shown in the figure) (2) explain why the SLR values differ along the coastline – is this because it is ‘relative’ sea level rise that is affected by land subsidence/uplift or does it also reflect regional ocean circulation and wind pattern effects? (3) does the 100-year level in c) incorporate SLR; what is the source of these region-specific 100-year storms, i.e., how were they determined? (4) in d) it is probably more accurate to use “Change in 100-year Event Return Time” or something equivalent (5) why is there such a large spread of values in d) – the alongshore spread in SLR is modest? Is it related to regional storm changes?In other words, providing the reasons for the results shown is important.	25. Coastal Zone Development and Ecosystems	25.3	871		The caption, figure title, and labels inside the figure have been revised to eliminate confusion.
Christopher	Miller	Caption a): it is difficult to relate a composite social vulnerability index to climate, e.g., is there an interpretation of what a high index (e.g., due to poverty) means in a climate context; Caption b): is this more than the historical erosion rate – is there built into this estimate some	25. Coastal Zone Develop	25.4	872		The caption has been clarified. Caption of 25.4 a) has been modified to provide interpretive help. The probability of shoreline erosion is

		probabilistic projection based on worsening conditions over time?	ment and Ecosystems				based on historical conditions and does not include acceleration of erosion due to sea-level rise. Edit to clarify this has been added to caption of Figure 25.4 b)
Christopher	Miller	Replace “aerial” with “areal”	25. Coastal Zone Development and Ecosystems		880	4	The text has been revised to incorporate this suggestion.
Christopher	Miller	The connection between how many people migrate to the coast as a function of the emissions scenarios (B1 and A2) should be explained, i.e., what are the drivers and how were the population numbers arrived at?	25. Coastal Zone Development and Ecosystems		882	26	The text has been revised to incorporate this suggestion. In summary, EPA’s ICLUS modeling effort (see citation) relies on a cross-walk between economic story lines in the IPCC SRES scenarios noted in the text (which give rise to the B1 and A2 emissions scenarios) and several assumptions about housing density, coupled with modeling of population migration. The key factors that drive the EPA modeling are fertility, domestic and international migration, household size, and travel times from the urban core. These are inferred from the SRES storylines. Originally, the draft text gives the impression that the differences in population projections are related to emissions - the revised text corrects this false impression. Note that the details of the EPA modeling approach are provided in the citation.
Christopher	Miller	Is the financial liability of the NFIP larger than Medicare?	25. Coastal Zone Development and Ecosystems		888	11	The statement – taken from NOAA – can be traced back to a coastal management textbook (Beatley, Brower and Schwab (2002). Introduction to Coastal Zone Management. Washington, Island Press, p.125). No reference to underlying data showing this is provided there, however. Total federal exposure of the NFIP in 2012 is nearly $1.3 trillion (see:

							http://www.fema.gov/policy-claim-statistics-flood-insurance/policy-claim-statistics-flood-insurance/policy-claim-13-12) which would be larger than Medicare, yet annual financial reports from the US Treasury (http://www.fms.treas.gov/finrep12/fr_index_new.html) show it as a smaller liability than Social Security and Medicare (unclear how liability is established). Given the contradictory or inconclusive information, we have rephrased the passage altogether.
Christopher	Miller	In addition to not addressing the ocean acidity issue, engineering the climate raises a host of ethical, legal, and regulatory issues about unintended consequences of climate modification. A NOAA Climate Engineering Fact Sheet available on the NOAA homepage (one of a series of science-oriented Fact Sheets) speaks to this issue, albeit in an abbreviated form. Climate engineering has the potential to undermine legitimate mitigation efforts. Some words inserted here to precede/intoduce the geoengineering description on p. 958-959 would be appropriate.	27. Mitigation		956	11	We do mention these issues briefly in the Geoengineering box.
Christopher	Miller	Spell out units on vertical axis.	27. Mitigation	27.1	957		The text has been revised to incorporate this suggestion.
Christopher	Miller	What does “CO2 per energy unit” mean – does a lower number mean a more energy-efficient system overall? Suggest defining it.	27. Mitigation	27.2	960		We have replaced and clarified this figure to address these issues.
Christopher	Miller	Does “Agency” refer to DOE?	27. Mitigation	5	963		The text has been clarified..
Christopher	Miller	The figure on this page is not identified, has no caption	27. Mitigation		1004		Not a figure in this chapter. The figure in the Adaptation chapter will be clarified for the final version.
Christopher	Miller	Are there current, active efforts to share experiences (successes/failures) – a clearinghouse? [see second bullet on p1007 that identifies this as a research need and p1038, Line 3 as a research priority]	27. Mitigation		1006	35	Not a figure in this chapter. The figure in the Adaptation chapter has been revised.
H	WITTE	Page 1121 Figure 1. The Greenhouse EffectThere is considerable academic research from a variety of disciplines about visual and graphical communication that could provide some very useful constructs for improving climate literacy: Cognitive Learning Theory Dual-coding Theory Cognitive Multimedia Learning Theory Visual Leaning Theory	Appendix: The Science of Climate Change	1	1121		We have used a different figure to represent the greenhouse effect. However, it is a cartoon and not meant to be a realistic representation.

		Neuroscience Learning Theory Short-Tem Memory Theory Foveal Vision Theory E. Tufte's Principles of Graphical Presentation D. Kahneman's Fast and Slow ThinkingThis figure could use some attention to detail. The IPCC is not known for the strength of their visual messages (they don't have the staffing.) 1. The sun is NOT above the North Pole 2. The atmosphere is too thick. It is not an infinitely deep dumping ground for our CO2 pollution. It is a very thin layer 3. The "Key Message 1" is man is altering the atmosphere. But the key message from this figure is what is in the center of the image: the sun. The real key message is about the ATMOSPHERE and what man is doing to it. Recall that at the surface the energy from the atmosphere is ~twice (2x) that of the sun. Suggestion: Delete the sun (you can mention the role of the sun in the caption of this figure. Make this figure the story of the a. atmosphere, b. man's CO2 pollution going into the atmosphere c. re-radiation of energy from CO2 molecules d. delete the globe view and ZOOM in to a 10 mile x 10 mile x 10 mile cube of the atmosphere to give sense of scale MESSAGE: small changes in the composition of our very thin atmosphere lead to significant heat budget changes.					
H	WITTE	Page 1122 Figure 2, Carbon Emissions Cognitive Multimedia Learning Theory would suggest a small and simple change: Delete legend (cement, gas, oil, and coal) and instead place those labels within the appropriate color regions of the figure.	Appendix: The Science of Climate Change	2	1122		We thank the reviewer for the helpful suggestion, which has been incorporated into the figure.
H	WITTE	Page 1123 Figure 3: Heat-trapping Gas Levels Small suggestion: This figure implies that CO2, CH4, and N2O are equivalent in their "heat-trapping effects". However late on onn page 1127, figure 5, we see that they are very different.	Appendix: The Science of	3	1123		This figure just shows the atmospheric concentrations of these three gases and how they have increased over time. It implies nothing about their

		Perhaps the plots in figure 3 should depict the relative nature of these three gases?	Climate Change				radiative effects as greenhouse gases.
H	WITTE	Page 1124, Figure 4: Atmospheric Carbon Dioxide Levels Small suggestion of ease of reading for the general public: perhaps change the vertical " Atmosphere Concentration (ppmv)" to a HORIZONTAL label	Appendix: The Science of Climate Change	4	1124		After consideration of this point, we still feel the existing figure is clear.
H	WITTE	Page 1127 Figure 5 Warming and Cooling Influences Nice job on the red and blue coding. Perhaps for a sense of scale put in the caption that the back radiation from the atmosphere is 333 watts/m2 Man is altering the back radiation in a small but significant way. Perhaps put in the caption what 1 watt/m2 is equivalent to in watts per square yard, or square foot?	Appendix: The Science of Climate Change	5	1127		We have redone the figure and the caption. Good ideas.
Charles	Kuster	A section summarizing the connections between water and energy would be very effective in this chapter. This could be a brief section stating the key points of this concept with a reference to chapter ten which would help draw attention to the interdependency of water and energy and the necessity of conserving both resources.	3. Water Resources				We appreciate the reviewer comment. This subject is important and has been considered as a separate chapter; thus, we refer the reviewer to Chapter 10. Also, in the revised version of our chapter, in the section discussing water withdrawals, additional information has been provided on the geographic distribution and vulnerability of water withdrawals for thermoelectric use.
George	Matz	Oxygen SequestrationCan oxygen sequestration by CO2 buildup in the atmosphere become a threat to terrestrial fauna in places already on the verge of atmospheric stress? The concentration of O2 in the atmosphere is nearly three orders of magnitude greater than the concentration of CO2 and it would seem as if any increase in CO2 via global warming would be insignificant. But is the devil in the details? Given the double whammy of the sequestration of O2 when carbon fuels are burned and converted mostly to CO2 as well as the loss of O2 replenishment via photosynthesis due to forest clear cutting, agriculture etc. in order to provide the food and materials demanded by a growing and more affluent human population, can this amount of O2 depletion be critical in some “hot spots” where O2 levels are already marginal; such as city that has a large carbon footprint (i.e., oxygen sequestration), high concentrations of pollutants that compound oxygen depletion, relatively high elevation, and a barren landscape with little nearby photosynthetic activity?The thought of O2 depletion in some areas and its consequences (asphyxiation) may seem far-fetched, but the current reality is that there now exists large areas of dead sea (e.g., Gulf of Mexico) due to anaerobic conditions. This was beyond imagination not that many years ago. Can hypoxic conditions on land be next? Although acceptance of risks due to global warming is a mixed bag because some see warming as a benefit (particularly after a harsh winter) and tend to overlook the broader consequences, no one should see oxygen depletion as a benefit. Perhaps the threshold where O2 depletion might become a threat to some urban areas would be more tangible and convincing than some seemingly abstract CO2 level. Since nature is a balance (thought not a delicate one), perhaps the fulcrum we need to be looking at more closely, at least in potential hot spots, is when the CO2 released by the local burning of all carbon fuels (including wood) equals or exceeds the local production of O2 from photosynthesis. While there are other losses of O2,	15. Interactions of Climate Change and Biogeochemical Cycles				Thank you for your comment. While human impacts on the concentration of O2 in the atmosphere can be seen with the precise analyses perfected by Ralph Keeling and others, the overall human impact on the oxygen cycle is too small to be relevant to this chapter. Even the instantaneous combustion of all the organic matter on land (globally) would make only a small dent in the atmospheric concentration of O2. See Schlesinger and Bernhardt (2013).

		that also should be accounted for to achieve a more accurate index, at least the burning of carbon fuel is one that humans have some control over. I would like to see the Federal Advisory Committee Draft Climate Assessment Report address O2 sequestration and the possible consequences.					
Christopher	Miller	(1) What about recommendations from the 2009 assessment report? Have any of these received the attention requested. Do the 2013 recommendations repeat/amplify/adjust the 2009 recommendations? Has progress been made since 2009? (2) The 2013 recommendations no doubt reflect some prioritization process (many other priorities not specifically cited are mentioned in passing – p1035, line 32 – "There are many additional USGCRP priorities for climate change and global change science more broadly that are not reflected here."). However, there are still quite a few recommendations listed and all are identified as high priority. Is further prioritization warranted in the report or should that be a subsequent task for the USGCRP? The totality of the ones that are mentioned (as well as the ones not specifically mentioned but looming in the background) is fairly comprehensive – the reader is left reeling a bit! A statement ("take-away message") at the beginning of the Research section about the balance between the scientific understanding already achieved and the need for further investment in the science would serve to place this section on firmer ground. Investments in the past have allowed us to make firm conclusions about key aspects of the climate system. The breadth/scope of the research agenda reflects the largeness and the complexity of the natural and human systems we seek to understand.	29. Research Agenda for Climate Change Science		1035	15	We have now discussed past assessments including the 2009 research recommendations and have reduced the number of overall research goals and recommendations. We have added a section on how to prioritize.
Christopher	Miller	In the Sustained Assessment section, Line 17: The statement is made: "...researchers from many fields have observed significant climate change impacts in every region of the U.S. The accelerating pace of these changes, as well as scenario-based projections for future climate changes and effects, is articulated in this third national climate assessment."The accelerating pace has been articulated in an inconsistent way. Some individual examples can be gleaned from the text (e.g., sea level, sea ice), but if acceleration is a key message of the report as stated, then there needs to be more of a focus on it. Examples of acceleration cited have not been given much context, e.g., has the rate of change increased since the previous assessment or within the last couple decades? Also, "acceleration" needs to be formally defined somewhere – is it the change in the rate of change or, more loosely, just a large change over time (or is the definition non-uniform, as it appears to be over the chapters)? [A non-inclusive list has the word 'accelerating', or "acceleration", appearing on p.6, line 39, p.68, line 15, p.116, line 1, p.235, line 13, p. 269, line 8, p 528, line 16, p.959, line 18, p1100, line 22]. Acceleration is an extremely important feature of the climate system because society will not be responding to the gradual increase in global mean temperature but to all the attendant effects that will occur on a variety of space and time scales. There will be abrupt changes, as well as unforeseeable events, i.e., "unknowables". [Note: An argument for observed and projected acceleration information is also an argument for a sustained assessment process.]					Description of tipping points and surprises has been added to the Executive Summary. Description of accelerating change is provided throughout the chapters, including the Climate Science chapter. The statements for the executive summary and introductory materials are built on the chapters.
Tom	Wood	General Comments: I concentrated on Executive Summary, Midwest, Mitigation, Adaptation, Sustained Assessment, Commonly Asked Questions from A to Z, and The Science of Climate Change. I skimmed other text and figures. The report does a lengthy/thorough job of covering the subject, with notable repetition of the same points between sections and within sections, likely caused by different experts writing different sections – someone must read the entire final report to put it in "one voice" and reduce these repetitions. (The predictions from the 1990 IPCC Report, 23 years ago, are generally occurring as expected – except the effects are getting worse, faster – particularly in the Arctic). Although the Draft is dated 11 Jan 2013, I see no data older than 2011; I hope data from 2012 will be added. As a Systems Engineer and 45-year environmental scientist/writer, I'm among the 97% who are greatly concerned with the need for rapid action on Climate Change. However, I'm not clear who your target audience is; those who already accept reality, or the Skeptics/Doubters? If the former, it's comprehensive, but they don't need convincing. If the latter, I doubt they will read it - a General	1. Executive Summary				Thanks for your comments, which are very broad in scope. There are multiple audiences for this report, but it is legally required to be delivered to the President and Congress. It does contain information up to April 12, 2013. It does not contain policy recommendations since it is a scientific assessment. The interconnectedness of systems is a major theme in this report. There is significant discussion of methane in the climate science

		Audience is unlikely to read 1193 pages of what they'd consider high-density science. MAY I ASK FOR ONE CHANGE? While Milanković-type solar insolation cycles may have induced 100,000 ice-age cycles in the distant past, since the Industrial Revolution mankind's effects overwhelm the minute changes in the sun's energy. Your own Figure 12, pp 1075 makes that clear. Every time you imply that solar changes "might" be involved, you weaken the truth. Please stop this hedging – it causes nothing but confusion. I'll mark every occurrence with a "↑"In any case, I believe THE REPORT FAILS TO DEAL WITH FOUR ESSENTIAL ISSUES: 1. Executive Summary, page 8, lines 2-4 says it all: "Global climate is changing, and this is apparent across the U.S. in a wide range of observations. The climate change of the past 50 years is due primarily to human activities, predominantly the burning of fossil fuels." BUT THE REPORT DOESN'T FOLLOW THROUGH ON THIS. If it's primarily due to humans burning fossil fuels - What Should We Do? Obviously, stop burning fossil fuels! Why don't we? Because the Energy Slaves we use to improve our lives (e.g., electricity, cars, home heating and cooling, hot water, appliances, farms growing our food, and all the "toys" we've come to expect of "modern civilization") would have to stop using fossil fuels (i.e., switch to renewable energy sources: solar, wind, geothermal [but, please, not nuclear]), and that's a tough fight. Who is most against it? The Fossil Fuel Corporations, of course – the richest, most profitable, most powerful entities on Earth (and all the politicians they control) are against any change that affects fossil fuel's Short-Term PROFITS with Long-Term DAMAGE. But if we don't break our addiction to fossil fuels, Climate Change will steadily grow worse and less possible to deal with successfully. Humanity seems willing to Doubt, Deny, and Delay dealing with this problem until it's too late (particularly with the help of the Doubts spread by Deniers working directly/indirectly for the Fossil Fuel Corporations). The Fossil Fuel Corporations are fighting for their short-term profits, at the cost of destroying the Earth's ability to support life (Just as the Tobacco Corporations were willing to kill their customers for More Profits, for 50 years after the truth about lung cancer was scientifically known). We have the ability to change the answer to the question "Is there intelligent life on Earth?" to "No." Can we – the last generations probably able to save a workable future – choose to accept a little short-term "pain" for the benefit of our children, their children, and – ultimately – Life on Earth (pretty much every kind)? Only time will tell. 2. Climate Change is NOT limited to increasing air temperature (and the document talks about this to a degree). In the Earth's Web of Life, the first thing you see is that "Everything is Connected." Every change in anything creates ripples, large and small, good and bad that reverberate among every form of life. We've been "civilized" so long that we no longer understand how much our daily lives depend upon the successful functioning of the Natural World. We only depend upon it for Clean Air, Clean Water, Fertile Soil, Nutritious Food, Safe Shelter, and all the things it's always given us for free – that is, Everything. While we can damage the system by altering ONE thing – which damages everything else - it often requires that we fix EVERYTHING to repair the damage. We've gotten ourselves deeper into trouble than one person in a thousand realizes. 3. There is inadequate discussion of the one "Doomsday Trigger" we already know of (and no-telling-how-many others). Global Warming has thus far been primarily driven by excessive emissions of the greenhouse gas, carbon dioxide (CO_2). However, there is another that – over a time span of 20 years – has a 72 times the Global Warming Potential of CO_2: Methane/Natural Gas, (CH_4). We know the Natural Gas "fracking" success of the last few years. On the surface it appears great. However, in the					chapter. The relative length of the adaptation vs. the mitigation chapter should not be taken as a sign of the relative importance of these topics.

		drilling, transport, and delivery of Natural Gas, it leaks away very easily because of its tiny molecular size. In addition, oil drilling often releases pockets of Natural Gas – which are allowed to leak away if small, or flared (= burned at the well head) to get rid of it. Unfortunately, Natural Gas leaks slowly but steadily from every well and coal mine we've ever made. And there's a trigger here: 24% of the Earth's land area is covered by Permafrost (plus shallow Arctic seas), which formed over what was, in the distant past, often swamps or waterlogged land. Over the centuries, some of the vegetation trapped under the permafrost has slowly decayed, releasing Methane as a breakdown product. Fortunately, the permafrost has kept this methane in. However, as the atmospheric temperature rises, the permafrost is beginning to melt all over the world (think northern Canada, Alaska and Siberia), which allows the previously frozen ground to leak growing amounts of methane, to contribute to more global warming (which cause more methane to be released, etc…). That is a dangerous feedback loop, and we don't yet know what we don't yet know. Unfortunately, once enough Methane escapes, it can overwhelm the effects of the CO2 we could have controlled, and Global Warming then increases, totally beyond our control. Thus far, there's been nary a word about methane in the public media. Why? (Would the Fossil Fuel Corporations have anything to do with that?) 4. Two sections: Mitigation (= 26 pages) and Adaptation (= 51 pages) display a significant, unacceptable bias. The Fossil Fuel Corporations have repeatedly stated: "Global Warming – Just Adapt to it." This allows them to rake in more profits longer, but leaves the Earth in much worse condition when we are finally forced to fix the problems. Clearly, the Earth, humanity, and the potential to survive the problems we've created via the growing emissions of CO2 from burning fossil fuels would be easier to solve (and increase our odds for success) if we concentrated on eliminating the problem as quickly as possible (= Mitigation), instead of ignoring the root problems for now and try to work around them (= Adaptation). Thus there should be a much greater emphasis on Mitigation than Adaptation. This is easily checked by looking at the number of pages devoted to each subject. We would hope that the Mitigation discussion was taken much more seriously than the Adaptation discussion – thus more pages devoted to Mitigation than Adaptation. Strangely, it is exactly the opposite: 51 pages vs. 26 pages = nearly twice as many pages on Adaptation than Mitigation. One must Wonder IF (no, actually Know), that there was and is excessive influence by the Fossil Fuel Corporations. For them to succeed in swaying this Report's emphasis and conclusions to such an obvious extent is absolutely NOT acceptable. THE REALITY OF THIS BIAS (and its visibility in paragraphs throughout the report) DAMAGES THE CREDIBILITY OF THE ENTIRE REPORT. The report must NOT play down the problems ahead, it MUST tell the truth as clearly as possible. This should be encouraging action to STOP Climate Change instead of ever pretending that we have time to waste .					
Tom	Wood	In "Appendix: NCA Climate Science – Addressing Commonly Asked Questions from A to Z" Question "A," pp 1057: ↑ (I will use this symbol to refer readers to the end of the second paragraph in my General Comments – throughout these comments.) The problem is first noted here, which I'll leave in this once ◊ Twice in the discussion of this answer you confuse the readers with "or natural changes such as variations in the energy from the sun" type comments. This is a common ploy used by Deniers to make people think Climate Change is "just a natural change." It isn't, and it's disappointing that the report supports an idea that has been disproven time and again. The report's Figure 12, pp 1075, shows that Global Temperatures and Variations in the Sun's Energy move in opposite directions, which makes it obvious that Solar Variations are NOT the cause. If it must be discussed, tackle Milanković cycles head-on, driving the ancient glacial cycles. Otherwise, please drop this – it's irrelevant and confusing to people who are trying to understand what IS happening now. Is the report attempting to explain and deal with Climate Change or provide cover for the Fossil Fuel Corporations? Seriously, I think the report should do it's best to make the answers clearer, not add to the present confusion.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z				The comment contains several factual errors. For instance, solar variations are an important factor in explaining part of the observed climate change, although as the human contribution increases it becomes less and less important. In Question H, we have added more information on solar variation. The commenter is reading far too much into simple words like "shift" and is missing the entire point of the CAQs that the climate system is a complex system composed of both

		Question “C,” pp 1062: In line 7 you refer to “periodic variations” in the Earth’s orbit. That’s correct. In line 12 you say “shifts” in the orbit, which implies an orbital “jump,” which is incorrect. Please use “periodic variations.” In lines 14 – 16 the report discusses “much warmer” temperatures than scientists expect “over this century.” There’s nothing special about “this century” – if we don’t act NOW, there may not be many humans left by the end of this century. We are steadily becoming mired ever deeper in a swamp of Delay. Please reword. In Figure 4, pp 1063 (and Figure 32, pp 1110): Since it’s ultimately CO2 that causes warming, multiply the Y axis by (16+16+12)/12 = 3.6667, to convert the weight of Carbon to the weight of Carbon Dioxide. This would change the 8000 million metric tons of C, to 29.333 Billion metric tons of CO2. Redoing the Y scale in increments of 5 billion tonnes CO2 (to a maximum of 35) would then be appropriate, more relevant and direct. Include more recent data. We must not try to sugar coat the mess we’re making for ourselves. In Figure 5, pp 1064: The “Medieval Warming Period” is marked, but doesn’t really fit the data. This is the same problem that “Mann et al. 2008” had; this period was not worldwide, and affected different areas at different times. Question “D,” pp 1065: ↑ See note above. Analysts (such as the B.E.S.T. Study) report that solar forcing doesn’t actually appear to contribute to observed global warming of the past 250 years. Below Figure 8, pp 1068: The report says: “The lack of warming in the Southeast and in the Midwest and Great Plains summers is unusual in a global context, and has been dubbed the ‘warming hole.’” I live in the Midwest now (after living all over the U.S.), and 2011 and 2012 were extraordinarily hot and dry. Residents of Missouri, Nebraska, Kansas, Colorado, Arizona, New Mexico and Texas suffered record-breaking, extreme heat and drought, and wildfire-outbreak summers. We are not in a “warming hole.” [Actually, this graphic doesn’t match similar graphics from other sources; it doesn’t even agree with Figure 9, pp 1069. Please use more recent and accurate data.] Figure 9, pp 1069: This report is coming out in 2013. Please update this graphic through 2010. (It also confirms that there was no lack of hot weather anywhere except perhaps the Southeast.) Question “F,” pp 1070-71: Please either drop the pictures of the five climate scientists or include a short explanation of what they did to add to our understanding of Climate Change. Question “G,” pp 1072: It’s already been said that CO2 is only 0.028% of the atmosphere. Explain that CO2 is a strong greenhouse gas instead of trying to make it “feel big” by comparing it to “16 billion blue whales,” etc. Figure 11, pp 1073: The Natural and Human-Enhanced graphics are misleading and confusing (Is CO2 really spreading from the stratosphere into the troposphere? No.). Question “H,” pp 1074, line 2: ↑ and ↑ “Changes in energy from the Sun were an important driver of the Earth’s climate in the past – before humans overwhelmed natural causes.” Line 8: I believe “…the Sun can explain less than 0.1% of the increase…” is far more accurate, certainly since 1980. Question “I,” pp 1076: Why not tell them how it’s actually done; the changing balance between the two isotopes of carbon: 12C and 14C? Biologically-sourced CO2 contain a mixture of 12C and 14C. However, 14C is radioactive with a half-life of 5,730 years. 14C decays out within ≈ 60,000 years; thus the CO2					natural and human forcing factors. No action is taken from this comment. The weight of CO2 vs. Carbon is irrelevant to its impact; emissions are typically expressed in units of Carbon. E: Figure on temperature trends (Question E): While conditions in a given year may be dramatic, climate change is typically defined as long-term trends occurring over multiple decades. The temperature trends shown in the figure and related text are based on data recorded over the length of time listed in the figure caption. Figure of regional time series of decadal average temperature change: the graphic has been updated to the latest data. F: The figure with images of scientists has been corrected, the title changed, and a caption added. G: Text revised for better clarity. We also modified graphics for the stylized representation of the greenhouse effect, and revised the caption. H: This statement from the commenter "the Sun can explain less than 0.1% of the increase..." is far more accurate, certainly since 1980." is simply wrong. Consult the literature. We have added more information on variation in cosmic rays caused by changes in the Sun. Text of CAQ L has been revised, and the sentence has been removed. I: We appreciate the suggestion, but space is limited. Isotopes and their use in climate science is a complicated topic. We do not feel it is necessary to explain this topic to answer this frequently asked question. J: The figure has been replaced. The new figure now compares the natural and human contributions to climate change, so very different from previous figure but easier to comprehend. We believe that the use

		from burning multi-million-year-old fossil fuels contains NO 14C. The massive amount of fossil fuel-sourced CO2 we've added (that has no 14C) lowers the atmospheric balance of the 14C/12C mixture, providing an estimate of the amount of fossil fuel burned. Question "J," pp 1080: If the carbon isotope process is too hard to explain, why do the "peer review" discussion to "explain how scientists are (Trained? I didn't know I was being "trained," I thought I was free to look for the truth) able to ultimately find the truth. Also, Reality is very good at weeding out Mistakes. Figure 15, pp 1081: I think this is a "snow-job" graph. Do you really think a General Audience is going to learn anything from this? There's way too much scientific "density." And please don't use SW and LW – use Visible light and Infrared (heat) radiation. Line 4, pp 1082: Does the report always (Need Source)? The writers of this report are intelligent people, capable of independent thought – I don't believe it's necessary to "Source" every word. They are not writing a journal article. Question "L," pp 1085, line 6: It clear what needs to be said, but "Because sea ice is simply frozen seawater" isn't true – it's freshwater frozen out of the sea – harder to explain. Maybe use the ice cube floating in a glass of water analogy – then you could stick to the truth. Unfortunately, the upper/circular part of Figure 18, pp 1086 will be meaningless to most, and please skip the GRACE explanation of measuring the quantity of ice by measuring the change in gravity – too obscure. Figure 20, pp 1090: Every researcher I know works in °C. Perhaps you're using °F because it's more familiar to an American audience. It expands the apparent temperature rise (which I think is good, but this report seems to lean toward making things "not look too bad"). If you go with °F, please be consistent (Figure 8, 14, 16… are in °C). Figure 21, pp 1092: Perhaps this is a good time to discuss the faster warming over the poles. This greatly reduces the temperature difference driving the weather "heat engine" [the difference in temperature between the equator (where the hot air rises) and the poles (where the cold air falls)]. With less energy driving them, jet streams are weaker and swing sloppier (taking warm air farther North, and cold air farther South), and may stall for longer periods than in the past. Question "R," pp 1096: Computer "models" used to design airplanes are totally different than weather models. Hot potato; hard to explain, and unlikely to be believed (Even I don't believe the explanation – and drop the "solar variability" ↑ – it's irrelevant in the human-induced heating we have today). And it's followed by Figure 24 that seems to prove (by the differences in color/areas to a casual observer) that models don't work. If computer models are so great, why has the model of Arctic September Sea Ice Extent Melt been horribly wrong since 1978, yet still broken? Question "S," pp 1098: "It is impossible to predict the future with absolute certainty." Very profound, but a little heavy. How about: "Predictions are never perfect, but they serve as an excellent guide." ↑ This finally discusses the mechanism for the Methane Feedback Runaway that could overwhelm the CO2-induced Climate Change that humans can potentially handle; a Doomsday Trigger, and we don't know at what temperature it trips (or has it already?). Figure 25, pp 1099: This graph of Global Average Temperatures (8.5 °F max by 2100), is very similar to					of "training" to describe the imparting of technical skills (or even scientific expertise) will be understood by most readers. Comment on sourcing: Detailed sourcing is required as per the NCA process. Figure on evaluating ice loss (Question L) has been replaced by new figure showing time series of ice mass loss from the two major ice sheets.. Figure of U.S. temperature projections (Question N): It was decided early on in the assessment to use American units as the standard so that the report can be more readily read by the American public. Figure on blocking of jetsream (Question O): has been replaced. R: We agree regarding the reviewer's comment about airplanes and have replaced that text. However, the impact of solar variability is an important aspect of climate that is evaluated by models; we are retaining that text. S: After consideration of this point, we still feel the existing text is clear and accurate. Figure on average global temperature projections (Question S): Mid-latitude land surface areas are projected to warm to a greater extent than the global average. Uncertainty ranges have been added to the figure. Figure on tipping points (Question T): We have revised the caption for clarity of this stylized map. Also, methane is not the only concern from permafrost melting. The figure already has permafrost and tundra loss. The reviewer was asking for more detail than deserved for something so uncertain. Figure of risk matrix for climate tipping points (Question T): This figure has been eliminated and the text expanded to discuss a few key tipping

		Figure 20, U.S. Average Temperatures (11.3 °F max by 2100); I wonder why the U.S. Average is 2.8 °F higher than the Global Average, but that isn't discussed. The Red/Yellow/Green curves are for different scenarios (e.g., how much emissions are lowered, and when), but 2 of the 3 are hotter with the recent models, than with the older models (i.e., the older Red scenario [dashed line] reached 7.1 °F, while the latest [solid line] model reaches 8.4 °F; an extra 1.3 °F anticipated as we understand the process better); another time that Reality is worse, faster, than first estimated. Figure 26, pp 1100: I believe that "Permafrost and Tundra Loss?" should be changed to "Methane Leaks from Melting Permafrost and Tundra Loss." There is a dependable Ozone Hole over Antarctica, a smaller Hole over the Arctic "sometimes," but there is NO Ozone Hole over southern Scandinavia. Figure 27, pp 1102: Where is the "Runaway Methane Feedback" Tipping Point? Since Methane is already leaking, Temperatures keep rising, and this can overwhelm our control of Climate Change, it belongs in the upper right corner. Question "U," pp 1103: Because if allowed to increase, this could destroy most life on planet Earth. In Figure 27, pp 1102: You specifically mention "Permafrost and Tundra Loss?" in Figure 26. This is the perfect place to discuss the effect of methane leaking through melting permafrost (and the strong feedback loop). The GWP (Global Warming Potential) of methane is now recognized as 72 times that of CO2, considered over 20 years. With CO2 currently at 392 and Methane at 1.8 ppmv: The effective CO2 GWP of Methane = 1.8 x 72 = 129.6, thus 129.6/(392 + 129.6) = 24.8% of the combined GWP is already from Methane, and rising. A recent, more comprehensive analysis of permafrost soils (Tarnocai, et al., Global Biogeochemical Cycles, 27 June 2009: Vol. 23 Issue 2, DOI: 10.1029/2008GB003327, "Soil organic carbon pools in the northern circumpolar permafrost region") found much more carbon trapped in and under permafrost than previously recognized; 1400 to 1700 GtC (Gigatonnes of Carbon). This trapped carbon represents more carbon than currently exists in all living things, and twice the carbon already currently in the atmosphere. Clearly, if/when this methane escapes faster, Climate Change from CO2 that humanity does control could be overwhelmed by methane released due to the higher temperatures we allowed. If/when that happens; we can do nothing to stop the temperature rise. In Figure 32, pp 1110: You show six wedges to consider for CO2 mitigation (based on the 7 wedges originally discussed by Pacala, Socolow, Kuuskraa, et al., 2004). A recent article in Science (Eli Kintisch, Science 11 January 2013:Vol. 339 no. 6116 pp. 128-129, DOI: 10.1126/science.339.6116.128, "Climate Study Highlights Wedge Issue") discusses the probable need for 19 to 31 wedges to actually accomplish this reduction now.					points. U and Figure on tipping points: There remain major uncertainties about the amount of methane and carbon dioxide that will be released from melting. Figure on stabilization wedges (Question X): the stabilization wedges figure has been updated.
Tom	Wood	In "Appendix: The Science of Climate Change" Line 26, pp 1117: Change the end to:"… heat-trapping gases, smog, and soot." In Figure 3, pp 1123: Considering the recognition of the Melting Permafrost/Escaping Methane feedback loop (and your sentence on line 5-8 of pp 1125 ("Atmospheric amounts of methane leveled off from 1999-2006 due to temporary decreases in both human and natural sources, but have been increasing again since …") it seems worthwhile to mention the much stronger effect of methane (and its increase starting in 2007) than it might at first appear. A recent, more comprehensive analysis of permafrost soils (Tarnocai, et al., Global Biogeochemical Cycles, 27 June 2009: Vol. 23 Issue 2, DOI: 10.1029/2008GB003327, "Soil organic carbon pools in the northern circumpolar permafrost region")	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z				These comments are all from the Appendix on Climate Science, not the Commonly Asked Questions.. Many responses have been provided on specific comments made on Chapter 2 and to both Appendices that address these concerns.

		found much more carbon trapped in and under permafrost than previously recognized; 1400 to 1700 GtC (Gigatonnes of Carbon). This trapped carbon represents more carbon than currently exists in all living things, and twice the carbon already currently in the atmosphere. Clearly, if/when this methane escapes faster, Climate Change from CO2 that humanity controls could be overwhelmed by methane released due to the higher temperatures we allowed. The report also notes that CO2 is increasing 0.5%/year – it's actually 0.52% AND ACCELERATING. Line 9, pp 1126: You say: "Methane lasts for approximately a decade." Not true. It has a half-life of 7 years, but never ceases to exist. It's still 25 times as effective a green-house gas as CO2 over a 100 year period. Somewhere the report should discuss the recently recognized fact that the increasing temperature is not due to the "Rate of CO2 Emissions" but (because CO2 takes hundreds of years to break down) is due to the Cumulative CO2 We've Added." It should also discuss the differences between the Northern Hemisphere and the Southern. (Lag time in gas transfer.) In Figure 6, pp 1128: While I suspect this graph lacks a vertical scale because it would alter the icon placements, it seems appropriate to include an Altitude Scale if possible. But perhaps the clarity is worth the missing scale. Page 1153: Please don't attempt to explain GCM models unless you're going all the way. As it is, this is very confusing to anyone unfamiliar with the techniques/uncertainties and it leaves one wondering why bother? In Figure 34, pp 1175: Please use different Colors/Line-Width/Intensities to clearly identify the Data with its Source. The Arctic graphic also has inadequate resolution and discussion. Neither is currently readable (although the rising permafrost temperatures are critical warnings that deserve further discussion). Pages 1181 thru 1193: This makes me seriously question whether the purpose of this report is to educate, or to have one's papers referenced. There is a time and place for 13 pages of 155 references, but is this it?					
Tom	Wood	In Chapter 18, Midwest (where I live); the report states under Key messages: 1. [In the next few decades, longer growing seasons and rising carbon dioxide levels will increase yields of some crops], though {those benefits will be increasingly offset by the occurrence of extreme events such as heat waves, droughts}, and floods. In the long term, combined stresses associated with climate change are expected to decrease agricultural productivity, (especially w/o significant advances in genetic and agronomic technology). My comments: In the lines above: The comments in "[ ]" are completely irrelevant, compared to the effects of extreme temperatures in "{ }" seen throughout the growing season, and especially at critical times (such as pollination – with no pollination, there is no grain). And this is here NOW, not In the Long Term. The comments in "( )" offer – at best – false hope. Yes, the seed companies are pushing "drought-resistant" seed, but these grains are no better at handling the extreme temperatures – the plants still literally cook in the fields. And if the temperature isn't high enough to cook the plants in the	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z				After consideration of this point, we still feel the text is clear and accurate. 1. USDA data suggest increased yields of virtually all crops over the last 60 years - with technology (in the broadest sense) being a driver, but the increase in growing season and CO2 fertilization effects can not be discounted. In the longer term - as we state - the benefits of longer growing season and CO2 fertilization may be offset but we can not discount the possibility of further technological advances. Thus we feel our phrasing is

		fields yet, give it a few more years. This is not going to stop, or slow down. In fact, it will rise faster (i.e., the rate of temperature rise is accelerating!). 4. [The Midwest has a highly energy-intensive economy with per capita emissions of greenhouse gases more than 20% higher than the national average]. {The region also has a large, and increasingly utilized, potential to reduce emissions that cause climate change}. My comments: Yes, the Midwest does use more fossil fuels than other areas because this is where the bulk of the farm food production takes place, which supplies most of the food eaten in the U.S., as well as many other areas of the world. In fact, our farm yields are so high because we use huge amounts of chemicals (mostly petrochemicals made from some type of fossil fuel): For farm machinery to work the soil and seed; plow, disk, plant, cultivate, harvest, dry, and transport; For Fertilizers; For Pesticides and Herbicides; Etc. If you count it up fairly and comprehensively, about 90% of our food depends indirectly upon the burning of fossil fuels. If you take away the fossil fuels (directly and indirectly) used in producing food, nearly 90% of the world's population would starve. (As we run out of cheap oil, coal (and tar-sands oil) we can't afford to burn because it adds so much more CO2 when it's burned, and natural gas (which sounds great if you ignore the 72 x CO2 GWP [Global Warming Potential] and the leakage of methane from every step; drilling, fracking, transport and burning). The fact is we are in deep trouble. We sure shouldn't be wasting time arguing about whether Global Warming is real. IT IS. But the Fossil Fuel Corporations and all their customers (= Us) don't want to change anything. But maybe, just maybe, humanity can get their act together in time to keep from changing the answer to the question "Does Earth have any intelligent life?" to "NO." Saying "{The region also has a large, and increasingly utilized, potential…}" is an outright lie. Geez, I hope I'm wrong, but pretending something magical (ethanol?*) is going to come along and provide a fossil fuel replacement is a great pipe dream, but I don't see it, at all. I'm an engineer, and they always work from a "worst-case scenario" to try to eliminate or minimize the coming problems. And corn ethanol is definitely a worst-case product. * If one does a full/comprehensive/thorough/honest assessment of creating corn ethanol, it takes more oil that it produces equivalently, and leaves the atmosphere in just as bad a shape (if not worse) than burning the oil would have done. Unfortunately, the people making money off the stupid but politically useful ethanol idea are financially unable to make an honest assessment – their bank accounts forbid it. Without "free government money" it would quickly die.					appropriately cautious. This matter is of course also discussed in the agriculture chapter (see key message #1 of that chapter).On point 4, we state the Midwest is a key agricultural region, and that does contribute to the relatively high GHG emissions, and food security is addressed in Chapter 6. On the matter regarding renewables, we would respectfully disagree. We refer not only to ethanol but also, for instance, to wind energy. Data from the American Wind Energy Association indicate that in Indiana alone has 1.4 GW of installed capacity. The equivalent number of homes Indiana wind farms powered at the end of 2012 was 325,000, and the wind energy deployment means approximately 2.3 million metric tons of carbon dioxide emissions are avoided annually.
U.S.	Environmental Protection Agency	Editorial: The word "an" should be inserted between "of" and "ongoing", or "forum" should be plural.	28. Adaptation		1009	4	We thank the commenter for this editorial comment and have incorporated it.
U.S.	Environmental Protection Agency	Wasn't the Colorado River basin water allocation agreement just renegotiated to allow for increased flexibility across dry and wet years? Seems worth discussing here.	28. Adaptation		1010	7	We thank the commenter for this comment. The point of the case study is that it has provided the right venue, right format, with the right stakeholders and decision makers to make the flexibility happen. From our understanding, the Colorado River Compact has not been renegotiated

							among the seven U.S. states in the basin, per se, but two recent policies have addressed the issue the reviewer raises about allocation of Colorado River water during drought: the 2007 Interim Guidelines on Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead, and the 1944 Water Treaty with Mexico recent amendment via Minute 319 in the 2012 pact with Mexico on new rules for water sharing. We have added these to the list of other adaptations at the end of the page case study.
U.S.	Environmental Protection Agency	In this entire sub-section "Volpe National Transportation Systems Center" is cited often, and should be abbreviated and/or have the citations consolidated to avoid repeats.	28. Adaptation		1013		Thank you for your comment. Volpe National Transportation Systems Center reports are cited properly and often here. To retain clarity, we feel that it is fine to leave the citation name in full. As such, no change has been made.
U.S.	Environmental Protection Agency	"(Pilot Project)" is redundant and should be deleted.	28. Adaptation		1013	10	Thank you for your suggestion. The authors have removed the redundancy.
U.S.	Environmental Protection Agency	Change "...greenhouse gas (GHG)" to "GHG" - defined previously.	28. Adaptation		1013	18	We thank the commenter for this editorial correction and have corrected this.
U.S.	Environmental Protection Agency	CRITICAL COMMENT: All the traceable accounts indicate that the new information and remaining uncertainties and assessment of confidence in the evidence are not applicable. This is a serious problem that needs to be rectified. While the key messages here do not involve quantitative data that can be evaluated for uncertainty and confidence intervals in the usual analytical manner, leaving these blank implies one of two things - that the findings here are beyond question based on available information, or that they are opinion and therefore not subject to evaluation of certainty or confidence.Each of the issues here are present to different degrees; not all adaptation efforts face the same level of impediments, not all are equally difficult to evaluate, not all provide the same level of "other" societal benefits. There is, therefore, necessarily some level of uncertainty (even if it cannot be quantified) associated with these key messages. At a minimum, these sections should explain that such differences exist, but that the weight of evidence supports the key messages with a level of certainty that warrants their inclusion.Regarding the issue of "new information," it must be recognized that, although previous NCAs have not included an adaptation chapter, there have been advances in developing approaches to design, evaluate and implement adaptation strategies. As currently written, this suggests that there has been no new information on adaptation in the period since the previous	28. Adaptation				Thank you for your comment. The authors already acknowledged that this is an active area of research. The chapter and the key messages conclude that adaptation planning has begun, and some actions taken, although a comprehensive evaluation of "success" cannot yet be made. Metrics of success have not been defined. Based on the available information about adaptation planning and actions, the authors are attempting to describe these actions in detail and give a sense of the extent of these actions across the Nation. As

		NCA, which is not correct.					such, no change has been made.
U.S.	Environmental Protection Agency	CRITICAL COMMENT: The key message here (KM4, p. 1017) does not seem to be clearly supported in the text. The traceable accounts do not clearly demonstrate the connection between the key message and the information presented in the chapter. This needs to be improved considerably.There are likely to be conflicts among the different societal goals that can be addressed via adaptation measures. Such complexities are critical to successful implementation of adaptation approaches, but there is really no clear section in the chapter in which to make this point, which highlights the lack of a clear connection between the key message and the underlying text.	28. Adaptation				Thank you for your comment. The text on the Northwood forests and NIDIS case studies support this key message and there is supporting text in the chapter. As such, no change was made. Regarding the second recommendation, text was added to the section on "planning, assessing and selecting options".
U.S.	Environmental Protection Agency	An additional reference that should be included in Table 28.7 is Jantarasami, L. C., J. J. Lawler, and C. W. Thomas. 2010. Institutional barriers to climate change adaptation in U.S. national parks and forests . Ecology and Society 15(4): 33. [online] URL: http://www.ecologyandsociety.org/vol15/iss4/art33/. Results of this study are apply to the first four barriers listed in the table.	28. Adaptation	28.7	1005		Thank you for suggesting this reference. It has been added to the chapter.
Christopher	Miller	“enhandling” should be “enhancing”	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z	32	1110		We have updated this figure and corrected misspellings in the legend.
U.S.	Environmental Protection Agency	This chapter lays out 7 research goals that are fairly comprehensive and given enough specificity to be useful. The chapter could 1) better clarify the extent to which the rest of the draft NCA is informing the research gaps and goals stated in this chapter; and 2) discuss and clarify more who the audience is intended to be for the stated research objectives (e.g., USGCRP, individual federal agencies, the academic research community, all of the above).	29. Research Agenda for Climate Change Science				Chapter now focuses on research for assessments, directed to USGCRP and others.
Christopher	Miller	Unfortunately, the discussion of geoengineering avoids the issue of whether certain research should even be done due to ethical considerations (e.g., the dubious ethics of large-scale climate engineering field experiments) but simply calls for additional research to explore feasibility. Certain research should not be condoned and this will require international and institutionalized oversight to determine. This type of governing framework does not exist now. If climate change does further accelerate, there will be intense pressure for a quick, engineering "fix", which itself could be disastrous.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1113	29	The commenter makes a value judgment that is for elected representatives to decide, not the technical authors of the NCA3.
U.S.	Environmental	This question of how rapid current climate change is compared to historical climate change is an important one, but the language is not always used very precisely: distinguishing between global and	Appendix: NCA		1062	22	We have clarified the difference between the current rate of

	Protection Agency	regional, between the past 100 years and the next 100 years, and acknowledging the uncertainty in reconstructed temperatures are important. Our understanding is that rate of current global temperature change is very unusual in the context of the past several thousand years, but may or may not be unprecedented, whereas the rate of projected climate change over the next century would almost definitely be unprecedented - clarify text, particularly about this nuances. (note that the comparison to the average rate of change post-glacial maximum is not perfect, as presumably there is uneven warming over that span so that some centuries of that warming would have been faster than the average)	Climate Science - Addressing Commonly Asked Questions from A to Z				temperature increase (which is unusual, but has likely occurred in the past), projected future rate of temperature increase (higher, if carbon emissions continue on their current pathway), and the rate of movement of carbon from the geologic sink to the atmosphere (through extraction and burning of fossil fuels) at a rate which far exceeds natural rates.
U.S.	Environmental Protection Agency	Please be clear about global vs. U.S. comparisons - this paragraph seems to mix the two. Also, "this decade was characterized by the warmest winter…" - does that mean that the average winter over the decade? And the sentence, "On an annual basis, the 2000s were the warmest..." doesn't make sense - shouldn't that be "On a decadal basis"?	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1065	20	The topic sentence of the paragraph was revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Can this chart use updated data through 2012, since it seems fairly simple to produce with available data?	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z	7	1066		The figure depicts decadal averages, so it would be logically inconsistent to include data for just 2012. The last bar is for the period 2000 to 2010.
U.S.	Environmental Protection Agency	Please note the period over which the average temperature was determined.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z	7	1066		The caption was revised to incorporate this suggestion.
U.S.	Environmental Protecti	Our impression was that most of the scientists who prefer "climate change" to "global warming" do so because climate change involves more than just temperature. There is a warming of global average surface temperatures, which is what "global warming" implies: even in areas which have not seen	Appendix: NCA Climate		1067	2	We thank the reviewer for the observation. We added an additional sentence to make the point suggested

	on Agency	warming in the past century, it is likely the contribution of GHGs has been a warming one that was counteracted by natural variability or aerosol emissions.	Science - Addressing Commonly Asked Questions from A to Z				by the comment.
U.S.	Environmental Protection Agency	Please double check that it is accurate to assign a "likely" rating to "some decadal periods will be cooler than the preceding decade". Is there any analysis (for example, based on CMIP3 or CMIP5 runs) to back this up?This is particularly important since this was not discussed in the body of the Assessment or in the Climate Science appendix.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1067	13	The sentence has been modifed. The NOAA Technical Report series, NESDIS 142, provided an analysis of decade-to-decade changes for the CMIP3 models. We have included this as a reference at the end of the text. However, we have also removed the "likely" language as we have not quantified the probabiities.
U.S.	Environmental Protection Agency	Please reconsider this figure: on the left, it looks like GHGs are limited to the very top band of the atmosphere, while on the right they are distributed throughout the height of the atmosphere. This gives a very misleading picture of the changes in atmospheric concentrations of GHGs.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z	11	1073		The graphics have been redrawn and the caption revised.
Christopher	Miller	These Key Messages differ from those in the Our Changing Climate chapter. Further explanation would be helpful. Together, the Report Findings and these two sets of Key Messages constitute a lot of (somewhat overlapping) take-home messages – difficult for the casual reader to sift through. Putting these messages in some sort of collective context, or at least explaining what each set uniquely contributes, would smooth report navigation and elicit the correct reader response.	Appendix: The Science of Climate Change		1118		The appendix has its own key messages relating to the discussion in each of its sections. The appendix is intended to add to what was discussed in Chapter 2, not generally to cover the same materials. Some of the key messages are indeed overlapping with those in Chapter 2, especially where we felt that further explanation was needed about key issues.
U.S.	Environmental Protection Agency	Please add the modifer word 'only': e.g., "...were only controlled by natural factors…"Also note the error in verb form: "...global temperature over the last 50 years were controlled by..." Either "temperature" should be plural or "were" should be "was".	Appendix: NCA Climate Science - Addressing Common		1074	25	The text has been revised to incorporate this suggestion.

			ly Asked Questions from A to Z				
Christopher	Miller	It is not clear what the message is on the paleo records. Is it that the maximum temperature change experienced over the entire paleo record is only 0.9 deg F (which is not true and is obviously not the point intended) or that the rate of change has been less than what we are now experiencing? If it is the latter, 0.9 deg F over several decades (admittedly, there have been periods of abrupt change in the paleo record) is actually faster than the rate experienced over the last 100 years. So, as written, the statement does not support the intended point about the uniqueness of recent changes.	Appendix: The Science of Climate Change		1133	1	We have heavily revised the paragraph relating to paleo analyses and added additional information to address reviewer questions and concerns.
U.S.	Environmental Protection Agency	It might be useful to note that the "W/m2" regarding "Energy from the Sun" is not directly comparable to "W/m2" from GHGs. It is our understanding that the former is W/m2 from the sun at a point in space at the distance of the Earth, which, to be comparable, should be divided by 4 and multiplied by 0.7 as that is the actual radiation absorbed per m^2 of the Earth's surface.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z	12	1075		We have redone this figure. We thank the reviewer for the ideas.
Christopher	Miller	The authors should describe the difference between external and internal natural variability when making a statement about internal variability over thousands of years.	Appendix: The Science of Climate Change		1134	14	Text has been inserted to distinguish external and internal sources of natural variability.
U.S.	Environmental Protection Agency	What about short-lived climate forcers? A large change in sulfate or black carbon emissions could potentially alter the course of climate change over the next couple of decades in a way that CO2 emission changes cannot.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1089	9	Reductions in short lived climate forcing agents could lessen the increasing temperatures over the next decade or so. However, because they are short lived, the effect is only temporary and the long lived greenhouse gases dominate after a few decades. More information has been added to the section for clarification. We have also added more information to Question Z on the potential to reduce the rate of temperature rise by reducing emissions of methane and black carbon.
Christopher	Miller	The period for the new climate normals is incorrectly stated as 1981-2000, instead of 1981-2010.	Appendix: The Science of		1164	16	This is a typo. The text has been revised to correct the date.

			Climate Change				
U.S.	Environmental Protection Agency	The caption claims that these are two examples of "reductions of 80% below 2000 levels by 2050" and yet there must be some kind of cumulative emission constraint as well, since the 2050 emissions are not, in fact, the same between the two scenarios. Please clarify.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z	33	1112		Yes, there is a cumulative emissions constraint. The figure caption has been modified to include that information.
Christopher	Miller	“Elsner et al (2008)” should be “Elsner et al 2008)”	Appendix: The Science of Climate Change		1168	18	This has been corrected.
U.S.	Environmental Protection Agency	Do the emissions discussed here include both gases and aerosols? If so, please clarify.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1113	2	The sentence clearly states that "emissions" refer to "carbon dioxide and other heat-trapping gases". We have added more information to Question Z on the potential to reduce the rate of temperature rise by reducing emissions of methane and black carbon.
Christopher	Miller	The goal of adaptation is characterized in the report as (p 984): "can society manage the unavoidable and avoid the unmanageable." It is certain that there will be both unavoidable and unmanageable aspects of climate change. Model projections underestimate observed change. The report contains a lot of good information but the information is dispersed over many chapters. It requires some effort to bring it together for a "complete picture" of change as it evolves over space and time. Fig 29 in the CAQ chapter is an attempt in one diagram to summarize, at least qualitatively, expanding impacts as temperature rises.It is difficult to define what is dangerous interference in the climate system. I can anticipate a stakeholder asking the simple question: What will happen if the average U.S. temperature increases by 5-6 deg F by 2050 (A2 scenario)? The answer cannot be precise but a ballpark estimate can be provided of how this tremendous injection of energy ripples, or crashes, through the physical and biophysical systems. It would be instructive to show at least two scenarios/snapshots: (1) what does the U.S. look like in 2013? and (2) according to the A2 scenario, what will the U.S. look like in 2050 (which is not that far away – one generation)? The picture that emerges will have many components: temperature and precipitation extremes, intensifying storms, coral bleaching, forest degradation/migration, agricultural stresses and displacement, sea level rise/land submergence, erosion, water scarcity and competition, sea ice reduction with little understood consequences for regional and remote weather and climate, arctic fish and animals and their changing and challenging					Thank you for the suggestions. We have attempted to summarize the information in the report in a clear way in the Executive Summary and Key Findings. The final report will also be accompanied by a Highlights document that should provide a clear snapshot for a reader on different regions, sectors, and crosst chapter issues. The report summarizes observed climate information (2013) and projects impacts in the future under the A2 and B1 scenarios.

		habitats, the spread of wildfires, disease emergence.					
H	WITTE	Page 1127 Figue 5: Warming and Cooling InfluencesJust a tip to help in ease of reading and avoid foveal vision confusion: rotate the figure one quarter turn clockwise: That puts the 12 labels for the "influences" in a horizontal reading position.	Appendix: The Science of Climate Change	5	1127		We have redone the figure and the caption. Good ideas.
H	WITTE	minor suggestion: a reference to figure 15 might help here?	Appendix: The Science of Climate Change	6	1128		Not clear what advantage this would provide to the discussion. No change to text.
H	WITTE	Perhaps of ease of reading, place an "F" with the numbers? That labeling makes it unnecessary to have the vertical text along this y axis.1.5F 1F 0.5 F 0 F -0.5 F -1 F -1.5 F	Appendix: The Science of Climate Change	7	1129		This figure has been replaced. The new figure is consistent with NCA standards for figures.
H	WITTE	page 1130 Figure 8 Temperature Trends: Past Century, Past 30 YearsThe text above the figure, lines 1-6, are not very clear: "some parts of the U.S. Southeast"... figure shows a tiny blue square over Louisiana. Maybe qualify what "some parts" means?The caption: "Surface temperature trends...." Maybe this is a place to suggest WHY there has been an acceleration of temperatures? Maybe a short note to explain why there was "no data", or why we have more extensive data for the last 30 years (satellite observations?) Why are we seeing these changes?	Appendix: The Science of Climate Change	8	1130		The grid box scale of this map is too coarse to see the details for the southeast U.S. However, Fig. 2.7 (Observed U.S. Temperature Change) in Chapter 2 has much higher resolution and shows this more clearly. We have referred to Fig. 2.7 at this point in the text. We have added a phrase noting that the acceleration of temperature increases is a result of the acceleration of increases in greenhouse gas concentrations. Also, the issue here is one of methodology. The MLOST product involves infilling which substantively smoothes the trends. So, the cooling of the SE US gets modulated / smoothed in MLOST

							vis-a-vis the USHCN (land only) gridding method. The revised figure has two blue gridboxes - one also in TX - and shows SE trends to be insignificant but this is a real methodological artefact / issue at play. We have added to the caption explanation that the coarse resolution of the maps does not capture small-scale details associated with, for example, coastlines or mountains. On the data gaps - the MLOST dataset smoothes within a reasonable (about 1500 mile radius) distance of a data constraint so the data is incomplete where there is no data within a reasonable distance.
H	WITTE	Page 1131, Figure 9 This is a very important and useful figure with all of the "fingerprints" shown. Seems a shame to cram all this informative detail into such tiny and hard to read graphics. Perhaps use two full pages. And perhaps repost, or at least reference, figure 15, page 1140, which is visual representation of the variables. This would make use of effective left and right brain learning techniques. The weblink, http://www.ncdc.noaa.gov/bams-state-of-the-climate, is perhaps more information than a user would browse through: 218 pages of a full climate report. Perhaps there is a middle path: a 1-4 page contextual description of the 10 indicators?	Appendix: The Science of Climate Change	9	1131		The report will be published as an interactive pdf document. This will have a feature that one can click on a particular graph and it will provide a pop-up display of that graph for better visibility.
U.S.	Environmental Protection Agency	Suggest that there should be a clearer distinction between regional changes and global changes, since the human dominance is clearer on longer timescales and larger geographic scales. And natural variability that involves shifting heat back and forth can be larger than natural variability that changes the net heat content of the planet.	Appendix: The Science of Climate Change		1120	2	The text has been revised for better clarity.
U.S.	Environmental Protection Agency	It seems to be a stretch to say that Fourier's discovery of the greenhouse effect was "validated by observations" by Tyndall. A better phrasing might be along the lines of, "experiments an 1859 showed that carbon dioxide had the right properties to be a greenhouse gas."	Appendix: The Science of Climate Change		1120	16	The sentence has been rewritten for clarity.
U.S.	Environmental Protection Agency	Please reconsider the phrase "radiate much of the energy back." Saying "half of the energy" would work better, or replace it with some language about slowing the release of heat to space. Also clarify "They" - "These gases..." would be clearer.	Appendix: The Science of Climate Change		1120	19	The sentence has been revised.
U.S.	Environ	Is Lacis et al. really "observational"? Our understanding is that the relevant conclusion from that paper	Appendix		1121	6	The review comment is correct. The

	mental Protecti on Agency	was based on GISS ModelE. Also, please be more precise regarding whether "heat-trapping gases" includes or excludes water vapor. E.g., "heat-trapping non-condensing gas" or "long-lived heat-trapping gas" or even an explicit "heat-trapping gases other than water vapor account for between 26 and 33%..."	: The Science of Climate Change				lead-in to the reference has been modified for clarification.
U.S.	Environ mental Protecti on Agency	Would it be possible to use a figure which includes land-use carbon? When looking at human influences over the past 300 years, land-use is significant (if more uncertain than fossil).	Appendix : The Science of Climate Change	2	1122		We appreciate the suggestion, but space is limited. We have added this point in the caption (it is already discussed in the text of the section).
U.S.	Environ mental Protecti on Agency	CRITICAL COMMENT: It would be very helpful here to note why we are concerned with increasing levels of GHGs. The current description seems to indicate that warming is a good thing, keeping the planet from becoming "a frozen ball of ice." The phrase, "causing the planet to warm" is quite benign-sounding. A note about evolution of natural systems and design of human systems within fairly narrow temperature bands and the rate of change in the climate would be very helpful here to put the warming in some context.This point does not seem to be included in the key messages for this appendix, so would be best included in this early discussion.	Appendix : The Science of Climate Change		1120	1	A sentence has been added to the text to make this point clearer. In addition, a paragraph has been added to discuss the general concerns about a changing climate.
U.S.	Environ mental Protecti on Agency	Our understanding is that Khalil et al. only addresses methane in the 80s. What are the sources for the other two gases as well as the more modern methane measurements?	Appendix : The Science of Climate Change	3	1123		The reference was miscopied from what we had originally. This has been corrected.
U.S.	Environ mental Protecti on Agency	Does "mainly" refer to agricultural emissions alone, or is it also intended to include activities related to fossil fuel use and waste disposal? Please clarify.	Appendix : The Science of Climate Change		1125	1	The sentence has been revised for clarification.
U.S.	Environ mental Protecti on Agency	70% seems high: the draft IPCC AR5 chapter on biogeochemistry estimates that 45 to 65 percent of atmospheric methane emissions are from human activities.	Appendix : The Science of Climate Change		1125	4	AR5 is not yet published. We have revised the text to show a range of 55-65% based on the previously published IPCC AR4 and Dlugokencky et al. (2011). We also add a reference to Rigby et al. (2008) about the detected increase in CH4.
U.S.	Environ mental Protecti on Agency	Matthews and Zickfeld looks at eliminating both heat-trapping gases AND aerosols… sentence should be adjusted to be consistent with that.	Appendix : The Science of Climate Change		1143	22	Thank you. We have revised the sentence.
U.S.	Environ mental Protecti	The RCP atmospheric concentration figure could be significantly clarified. As currently shown, it indicates distinct boundaries in concentration ranges between the different pathways. Is this appropriate? It seems as though there is likely to be some overlap. Perhaps a set of bars showing the	Appendix : The Science	17	1146		We have revised the figure to show lines rather than areas.

	on Agency	final concentrations with uncertainty ranges could be included to the right of the CO2 concentration figures. Otherwise, for example, it is difficult to know what the actual range of possible concentrations in 2100 is for RCP 6.0 except that it must be at least as large as the visible yellow area (and possibly a lot larger). It is helpful that in the SRES figure, some of the stacked bars are translucent, but in the RCP figure none of the bars appear translucent. This approach would also add more information to the temperature figures, where the sensible decision was that showing only 2 scenarios was as much information as could be included.	of Climate Change				
U.S.	Environmental Protection Agency	These figures make it appear as if RCP8.5 is similar to A2, and RCP6.0 is similar to A1B: however, if one looks at Rogelj et al. 2012 (https://edit.ethz.ch/iac/people/knuttir/papers/rogelj12natcc.pdf), looking at temperatures it would be more appropriate to compare RCP8.5 to A1FI and RCP6.0 to B2 (see Table 3 in the paper).	Appendix: The Science of Climate Change		1148	1	This comment is inconsistent with the current state of the science on this topic. RCP6.0 is closest at 2100 to SRESA1B. RCP4.5 is closest to SRESB1. RCP8.5 is indeed close to SRESA1FI, except that A1FI is undersampled. Hence, the most accurate statement is that RCP8.5 is on a higher trajectory than SRESA2 (which is adequately sampled).
U.S.	Environmental Protection Agency	Note double comma after "Instead"	Appendix: The Science of Climate Change		1152	6	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	We recognize that this paragraph is trying to debunk the notion that models are "tuned" to reproduce historical climate trends and to differentiate from statistical fitting approaches… but there are a number of parameterizations in models to describe sub-grid-scale processes that do not derive directly from the laws of physics. Suggest modifying the wording here somewhat to try and better capture that nuance. In fact, the sentence two paragraphs down notes that such sub-grid-scale parameterizations are based partly on observations, but this almost directly contradicts the sentence that states that processes are simulated without any assumptions derived from observations. The discussion needs to clarify when such parameterizations are used and why.	Appendix: The Science of Climate Change		1152	13	Deleted one of the statements that created the perceived contradiction. Also added some additional examples of parameterized processes.
U.S.	Environmental Protection Agency	"relative number of extreme events": Repeating a similar comment regarding figures 2.14 to 2.17 in Chapter 2: There are 2 ways to increase extreme precipitation: one is to increase precipitation year-round (eg, the annual total doubles, and any given day's rain also doubles). The other is to concentrate precipitation into fewer events (eg, the annual total is the same, but the rain falls twice as hard on half as many days). It would be great to distinguish between these two. Also: the Appendix should cite the underlying Chapters where there is overlap between the two (and vice versa)	Appendix: The Science of Climate Change	29	1167		The published research provides mixed results regarding changes in the entire precipitation distribution, while changes in the extremes tail of the distribution are qualitatively unambiguous across many studies. These results are an expansion of the figure on observed U.S. trends in heavy precipitation in Chapter 2. We now note this in the caption.
Christopher	Miller	The relationship between the Report Findings and the Key Messages in the chapters should be explained. Are the Findings reflective of the most significant key messages or a compression of all the key messages into a smaller number of overarching statements?					The Report Findings distill important results that arise from the National Climate Assessment. They do not represent a full summary of all of the chapters' Key

							Messages, but rather a synthesis of particularly noteworthy conclusions. Text has been added to the Overview and Report Findings to explain the relationship between the Report Findings and the Key Messages of the chapters.
U.S.	Environmental Protection Agency	The title of Figure 5.1 is somewhat misleading because the graphic depicts only potential vulnerability of transportation infrastructure under one possible future SLR scenario. A more appropriate title would be “Possible Future Flood Depths along Mobile Bay with Rising Sea Level” or something along those lines. The Figure is an interesting example of future risk, but does not provide support for section’s Key message that climate impacts “are reducing the reliability and capacity of the U.S. transportation system” in the present. The caption should also make clear that the map indicates the typical water depth above ground elevations (assuming that this is what ADCIRC Depth Range means) since flood maps usually show the surge relative to sea level. The map legend is in meters but the caption talks about a 30-inch rise, making it difficult to know which is the relevant map color to focus on. Finally, the caption should acknowledge that not all roads would be flooded if they merely run through low areas since some are built above flood levels.	5. Transportation	5.1	199		We have added qualifying language concerning low-lying roads.
U.S.	Environmental Protection Agency	The caption (“Note”) for Table 5.1 should be revised. First, it refers to Table 1 instead of Table 5.1. More importantly, it should also more clearly state how these categorizations of likelihood and magnitude were determined. Are they merely “Illustrative Risks” of national impacts that were extrapolated from one regional study of NY/NJ (McLaughlin et al.) by either the NCA authors or by the McLaughlin et al. group (or some other group)? Are they based on some other underlying peer-reviewed studies cited in McLaughlin et al.? (If so, those should also be cited here) Without appropriate caveats or explanation, a reader could misconstrue this table as definitive conclusions from McLaughlin et al. regarding future impacts.	5. Transportation	5.1	206		Thank you. We have clarified the substance and form of the matrix.
U.S.	Environmental Protection Agency	The first column of adaptive "strategies" should include incorporating climate change into maintenance cycles. That is different from new facilities or retrofit (e.g. different blend of asphalt). Are we sure that these examples are "strategies"? They appear to be tactics or options.	5. Transportation	5.5	207		We have included maintenance in the list and made a change to the title. Thanks for the good suggestion.
U.S.	Environmental Protection Agency	"This sentence asserts the maximum projected forest biomass as a percent of consumption. It does not state the timeframe for this projection to take place. Also, it is in the context of total US energy consumption, though that number is not given, so these percentages are not useful in terms of magnitude. Without absolute numbers given, percents have no context and thus telling your audience that our biomass consumption could replace 30% of our petroleum use lets us know that the potential is large (knowing US petrol consumption is large), but still not relative to any actual numbers for context. Lastly, this is based on one study only, do others have the same estimate (or similar estimate can be derived from other studies)? For example, does the range of estimates in the USFS 2012 (RPA 2010), cited elsewhere in this chapter, line up with this? Perhaps a range of estimates of future bioenergy potential (rather than as a percent of curret emissions) from a variety of studies would be more useful/better here. "	7. Forestry		274	8	We can report the actual number and years for this projection. The Smith et al (2012) paper from which this estimate derives does not report the percentage but rather gives the actual numbers. The Billion Ton Update (BTU or Perlack et al. 2011) involved hundreds of researchers and several workshops. The BTU was designed to displace 30% of the U.S. energy consumption by providing one billion tons annually (from 2012 to 2030) of feedstock from the contiguous U.S. This is equivalent to 16 billion gallons per year (BGY) of cellulosic biofuels and 4 BGY of advanced biofuels. The

							USDA was a major contributor to the BTU and so its numbers are consistent with the report (Perlack 2011). Specifically the BTU used the 2007 forestry RPA 2012-2030 timeline (as noted on page 4 of the BTU). The BTU does give the results of several scenarios (for example figure ES-1 on page xxii of the BTU gives estimates based on three different prices for forest biomass), and we have included those ranges in this report.
U.S.	Environmental Protection Agency	There does not seem to be any discussion of the potential for changes in precipitation patterns to influence species other than fish. It would be appropriate to include any studies that do address impacts of changing precipitation patterns on vegetation and other animals, and on ecosystems more generally.	8. Ecosystems, Biodiversity, and Ecosystem Services		297	19	No change. We do not have any refereed studies to support this assertion.
U.S.	Environmental Protection Agency	The sentence states that the NE experienced "almost no snow" during the winter of 2011-2012, but says parenthetically that there was a costly storm around Halloween. Is the Halloween event included as part of the 2011-2012 season totals? This sentence overlooks the opportunity to discuss the need to understand both annual totals as well as extreme events.	16. Northeast		550	18	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	Are citations available within the peer-reviewed literature rather than citing two articles from the New York Times. If these do not exist, does the information meet information quality standards for this assessment?	16. Northeast		555	1	The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	This sentence is awkward - "The combined effects...are the primary threats..." This seems to say that the combined effects forms the primary threat. Using the plural, "threats", seems to imply that the three effects form the primary threats individually as well as in combination. Please revise to clarify. Perhaps: "The primary threat to...ecosystems is formed by the combined effects of...."	18. Midwest		622	11	After consideration of this point, we still feel the existing text is clear and accurate.
U.S.	Environmental Protection Agency	The discussion of IAMs should also include policy interactions (range of policies at the federal, state, and local levels) as considerations in IAMs. As suggested in the following sentence, it is also important to study the costs and effectiveness of mitigation and adaptation efforts in tandem instead of as two separate policies. This point may be worth stating more explicitly.	27. Mitigation		966	16	We have edited the text to incorporate these concerns.
U.S.	Environmental Protection Agency	It would be good to note the role of insurance and reinsurance companies here. These companies may also play a role in state and local government adaptation planning. If possible, it would be ideal to include examples of private sector adaptation efforts and influences. There is at least anecdotal evidence that one state is purchasing reinsurance to enable the state (Alabama) to more effectively distribute risk.	28. Adaptation		994	3	We thank the commenter for this suggestion. We noted the detailed example of Munich Re in the Table 28.5. Due to our word limitation, we are not able to include more examples.

H	WITTE	Page 1132, Figure 10: Precipitation TrendsPerhaps add a sentence or two about the context of the two versions: what do we see in the 1979-2011 image that is significant. What does this pairing mean? Readers are looking how to make meaning of their world. What is one take-away here?	Appendix: The Science of Climate Change	10	1132		The trend periods are chosen to match those in the preceding temperature plot so readers can directly compare the two. We have assessed trend significance in the revised figure. The text has also been revised.
U.S.	Environmental Protection Agency	The statement below is not entirely correct based on the graph shown in Figure 9.2. The highest value in the U.S. is 24 days and values above that actually occur in Canada not the U.S. “Ragweed pollen season length has increased in central North America between 1995 and 2011, by as much as 13 to 27 days in parts of the U.S., in response to rising temperatures.” Consider revising as: “Ragweed pollen season length has increased in central North America between 1995 and 2011, by as much as 13 to 27 days in parts of the U.S. and Canada, in response to rising temperatures.”	9. Human Health	9.2	336		The authors agree with this comment and have revised the text as suggested.
H	WITTE	Re: El Nino Seems like a great opportunity to add a short additional perspective to the mis-understood ENSO. Why are the changes in ocean temperature distribution "usually associated", "increasing the amount of wind shear", "associated with dry conditions", "typically associated" (lines 27-32)? Is it the warm waters or the effects of the warm waters? Perhaps add a sentence or two about the teleconnective shifts in large convective areas and resulting jetstream patterns? Perhaps use figure 11, page 1135: La Nina and El Nino Patterns with additional elements?	Appendix: The Science of Climate Change		1134		Added an explanation of the heating/circulation coupling in Key Message 3.
H	WITTE	Page 1135, Figure 11 La Nina and El Nino PatternsThe graphic (in western cultures) reads from left to right: La Nina, then El Nino. But the caption reads the graphic from right to left. (minor , but unnecessary awkwardness) A meteorologically attentive reader probably understands the symbolism of jet and rain cloud, but perhaps a short explanatory sentence in the caption would help others?	Appendix: The Science of Climate Change	11	1135		Figure caption has been changed to conform to the usual left-to-right progression.
H	WITTE	Page 1136, Figure 12: Warming Trend and (EFFECTS) of El Nino/La Nina(conditions)Seems like this could be drawn for easier comprehension. How do we make this a faster mental process? What is "Index" in the title "GISTEMP Land-Ocean Index"? Isn't is a temperature anomaly? If we look at the yearly plot of the world's temperature, what effect do we see when there is an El Nino? La Nina?Leaving the squares, triangles, diamonds in, connect these dots with a continuos line to	Appendix: The Science of Climate Change	12	1136		Figure and caption have been modified. "GISTEMP Land-Ocean Index" has been removed. We have revised the caption to incorporate this suggestion.

		show that this is a plot of actual annual temperatures anomaly (see figure 7, page 1129, NASA GISS plot, or figure 13, page 1137) and then draw in dashed (- - - -) red and blue lines the trends for El Nino and La Nina. And then add the caption what this figure shows: For an El Nino year the average increase in the world's temperature is 0.x degrees.					
H	WITTE	Page 1137, figure 13: Long-Term Warming and Short-term variation. Caption: Would it be helpful to list within this caption a few of the short term variables that contribute to the flatness of the temperature plots: ENSO, PDO, etc?Question for the caption: What is the time period length generally needed for climate trends detection? 30 yrs? 5o years?	Appendix: The Science of Climate Change	13	1137		A sentence has been added to the caption stating that natural modes of variability such as ENSO often account for the differences between short-term trends and the underlying long-term trend.
H	WITTE	Page 1140, figure 15 Key Message 4: Human-induced increases in atmospheric levels of heat-trapping gases are the main cause of observed climate change over the past 50 years. Human Influences Apparent in Many Climate VariablesPerhaps add a second line to each variable about the observed trend to give context? Upper Air Humidity Glaciers Sea Level Ocean Heat Content increasing melting rising increasingRichard Mayer's Cognitive Multimedia Learning Theory posits that the sun, the seal, the fish, trees, and deer are distracting elements: not necessary or relevant to the figure, especially the sun. Doesn't the title, "Human Influences Apparent in Many Climate Variables" imply direct influences? Are humans influencing the precipitation, or are they influencing the atmosphere, and the warming of the atmosphere results in changes in precipitation? Do we need little more attention to word-smithing the title? Perhaps: "Changes in Climate Variables as a Result of Humans Altering the Atmosphere"	Appendix: The Science of Climate Change	15	1140		The figure has been replaced for greater clarity. However, the observed trend will not be included on this figure – it would make this way too complicated. Regarding the title of the figure, the authors still feel that the text is clear and accurate as written.
U.S.	Environmental Protection Agency	It would be helpful to have a list of acronyms and abbreviations.					A glossary is provided with the final report.
U.S.	Environmental Protection Agency	The document can benefit from further coordination among chapters, so as to avoid duplication					Thank you for the suggestion. While we have attempted to revise the report to reduce duplication and provide links between chapters, we still think there is some value in some repeat material, because readers may not review the entire report.
U.S.	Environmental Protection	It is unclear how to distinguish between climate change impact and loss of service in the built environment. The report appears to attribute the notable failures as the result of climate change, without examining the fundamental causes in planning and engineering standards or in a higher level management policies. Proper discussion is necessary, because the loss of service can be a result of					Thank you for the comment. We have attempted to highlight risk-based framing and the importance of decisions throughout the report.

	Agency	climate change, improper/outdated practice, or a combination of them.					The report discusses that vilnerability is influenced by many factors.
U.S.	Environmental Protection Agency	CRITICAL COMMENT: Although we recognize that this report has not yet gone through a formal peer review and that process may address the following issues, we would like to emphasize the importance of review editors ensuring that factual assertions have been verified to ensure that (a) referenced sources do indeed say what the public review draft says that they say, and (b) the referenced source is a reliable source for the type of information for which it is being cited (e.g., the methods used to derive the information are clearly explained and reviewed). In several cases, a specific fact is asserted in the report, referencing a long report as the source, but without a page number. In some cases it is impractical for a reviewer to determine whether the cited report cited actually says what the public review draft says it says. Another consideration is that in some of these cases, it is clear that the report is a secondary source for the information, and possibly not a reliable source because it is focused on a different topic. A third consideration is that when one is able to find the page where the assertion is made, it sometimes turns out that the number is based on an unpublished study without any explanation about assumptions of whether it is reliable, or presentation of the methods by which it was derived. Overall, attention should be paid to ensuring that USGCRP is not citing from an unpublished manuscript or from a different report that in turn relies on that same unpublished manuscript. A final consideration is that in some cases, the public review draft appears to misquote the document it is citing. Details are provided in each chapter as needed.					Thank you for providing detailed comments in the chapters. In addition to the full public review, the NCA was reviewed by a panel of the National Academies. The authors of the NCA Report have written it based upon a variety of sources, all of which were assessed under Guidance on Information Quality Assurance to Chapter Authors of the National Climate Assessment: Question Tools (2/21/2012), to assure for each source (1) utility, (2) transparency and traceability, (3) objectivity, and (4) integrity and security. All sources were assessed for IQA compliance.
U.S.	Environmental Protection Agency	Please consider "Estimating Monetary Damages from Flooding in the United States under a Changing Climate," C. Wobus, M. Lawson, R. Jones, J. Smith, and J. Martinich, J. Flood Risk Manage (2013) in revision of the chapter. Manuscript provided to NCA Office.	3. Water Resources				Reference included.
U.S.	Environmental Protection Agency	Please consider "Climate Change Adaptation Cost in the United States: What Do We Know?" F. Sussman, N. Krishnan, K. Maher, R. Miller, C. Mack, P. Stewart, K. Shouse, and B. Perkins, Climate Policy (Accepted 2013) when revising the chapter. Copy of the accepted manuscript has been provided to the NCA Office.	28. Adaptation				Thank you for your suggestion. This reference has been added.
H	WITTE	Since the "skeptics" often use the world temperatures span of 1998 to 2012 (cherry picking to be sure) perhaps a sentence or two relating this particular trend might be helpful?	Appendix: The Science of Climate Change		1137	8	A sentence about this period has been added to the caption of the figure on long-term warming and short-term variation.
H	WITTE	Page 1141, figure 16 Only Human Influence Can Explain Recent Warming.This is a very interesting detailed set of graphics. Too bad thay are all squeezed in onto one page.	Appendix: The Science of Climate Change	16	1141		The report will be published as an interactive pdf document. This will have a feature that one can click on a particular graph and it link to a version with better visibility.
H	WITTE	small point: "over the past few centuries"would "few" be 2,3 or 4?	Appendix: The Science of		1143	6	Text changed to incorporate this suggestion.

			Climate Change				
H	WITTE	page 1144 line 9-17: Clouds, Albedo, Carbon dioxideMight it help give context to give a sentence or two about how about 70% of the earth is covered by clouds at any one time; and how high clouds act to warm by absorbing outgoing radiative energy from the earth and that low clouds as as parasols that reflecting the warm solar energy and act in general to cool the earth. Albedo: perhaps add a little context with a mention of what is happening to the Arctic sea ice?	Appendix: The Science of Climate Change		1144	9	Additional context has been added to the text as requested.
H	WITTE	Have we explained the variables used in these graphs somewhere? A16, A18, A2, 8.5,4.5, 2.6 etc Do these numbers have units, definitions? Maybe put in caption?	Appendix: The Science of Climate Change	17	1146		The caption has been expanded to include more information.
H	WITTE	page 1148 figure 18Do we need to reference a spot where readers can find definitions of the variables: SRESA2, A1B, RCP 8.5, 6.0, 4.5, etc	Appendix: The Science of Climate Change	18	1148		A sentence has been added to explain that the scenarios are discussed under Key Message 5 and in the figure on Emissions, Concentrations, and Temperature Projections.
H	WITTE	page 1135, figure 21 good figure showing complex variables (maybe use a little large text for ease of reading.perhaps the addition of Trenberth's radiative budget of the earth would be helpful here?	Appendix: The Science of Climate Change	21	1135		This comment does not refer to that figure.
H	WITTE	page 1157, figure 23Not sure what the volume of slanting columns represent, or why they are slanting. A descriptive phrase or two in the caption might help understanding.	Appendix: The Science of Climate Change	23	1157		Added statement to caption explaining the changes in volume.
U.S.	Environmental Protection Agency	Recommend that the report acknowledge the revolution currently underway in the U.S. in the oil and gas extraction sectors with hydraulic fracturing and horizontal drilling technology (commonly referred to as "fracking").	4. Energy Supply and Use		180		Increased natural gas production and the hydraulic fracturing energy production technique are discussed in detail in Chapter 10: Water, Energy and Land Use.A statement on the resiliency benefits of diversification of natural gas sources has been added to the chapter.
U.S.	Environmental Protection Agency	In order to provide a clearer summary message concerning the time frame for sea ice disappearance, key message should note that projections of seasonally ice-free Arctic waters could occur considerably earlier than 2050 (ice-free Northern waters by the 2030s, p. 762). The present statement that "Summer sea ice is receding rapidly and is projected to disappear by midcentury" fails to signal the fact that a range of estimates exist and that under some scenarios, the ice could disappear much earlier.	22. Alaska and the Arctic		762	8	The text has been revised to incorporate this suggestion.

U.S.	Environmental Protection Agency	Recommend that the implications of ice disappearance for commercial shipping and resource extraction be summarized in greater detail.	22. Alaska and the Arctic		764	9	While the comment suggests a good specific example, the authors feel the existing examples are appropriate and adequate.
U.S.	Environmental Protection Agency	The report would be enhanced if the release of methane and CO2 as a consequence of permafrost loss were described in greater detail. It would be helpful to note the potential volume of carbon release in terms of anthropogenic emissions, not just in terms of atmospheric levels (which may be perceived as small since we measure them in ppm).	22. Alaska and the Arctic		771	6	Due to the size of the topic, and the page limit for the chapter, we focused on broad trends rather than delving too deeply or providing such a level of specificity.
U.S.	Environmental Protection Agency	Where appropriate, the text should note that melting of the permafrost could release pollutants, such as mercury, that had been sequestered.	22. Alaska and the Arctic				The text has been revised to incorporate this suggestion.
U.S.	Environmental Protection Agency	It would be useful if the Executive Summary described in summary detail the various climate change scenarios that appear in the body of the report, beginning in Chapter 2.	1. Executive Summary				There is a section on scenarios in the Context and Background section of the Executive Summary.
U.S.	Environmental Protection Agency	It would be useful to note the pace at which sea ice decline is occurring, particularly the projections that the Arctic could be seasonally ice-free by the 2030s (see Ch. 22).	1. Executive Summary		4	14	The word "dramatic" clearly implies a change of pace, so no change is needed here.
U.S.	Environmental Protection Agency	When saying "emissions," it would be useful here to add a sentence or two to identify the types of emissions referred to. At times, it appears that only carbon dioxide is being referred to rather than the full suite of emissions, particularly BC and other short-lived climate forcers. Also consider whether it would be useful to insert word "anthropogenic" before "emissions."	1. Executive Summary		6	17	For a public audience, the word anthropogenic is not helpful; however, the point about multiple kinds of emissions is well taken. Information has been added about other types of emissions in two places in the Exec. Summary.
U.S.	Environmental Protection Agency	This sentence could be strengthened by noting that it is not just coastal ice that is melting but the entire ice cap on a seasonal basis. And a result is opening up the potential sea lanes that can be used for tourism and commerce.	1. Executive Summary		9	12	This sentence is focused on infrastructure, so the existing language is appropriate.
Whitney	Gray	Rising temps and loss of ice are well described in the sections above. Colder temps are not described (not directly anyway, there is discussion of thermal layering, loss of mixing, etc). I think this impact (lingering cold bottom temps) needs to be clarified in the “Rising Temp” section above.	24. Oceans and Marine Resources		841	40	The chapter focused on broad trends for the topic. We refer those interested in a deeper treatment of the topic to the provided citations.
Whitney	Gray	Clarify - is this in an attempt to find colder water?	24. Oceans		842	9	The text has been revised to incorporate this suggestion.

			and Marine Resources				
Whitney	Gray	Loss of coral cover does not automatically mean a loss of three dimensional cover. It takes time for the reef framework to disintegrate. Maybe a timeframe or better description needs to be included here	24. Oceans and Marine Resources		842	25	After consideration of this point, we still feel the existing text is clear and accurate.
Whitney	Gray	I think it needs to be clarified that bleaching is a condition brought on by stress. High temps are one stressor that can cause bleaching, but not the only cause. Extremely low temps, poor water quality, etc can also cause bleaching.	24. Oceans and Marine Resources		842	28	The text has been revised to incorporate this suggestion.
Whitney	Gray	Needs clarification. The text should state the term “zooxanthellae” and elaborate a bit on the relationship (i.e. explain “partner”; eg. “Zooxanthellae, a symbiotic algae which lives in the tissues of corals and provides nutrients to the coral…”). Bleaching occurs when the coral expels its zooxanthellae. The zooxanthellae have color which is what makes coral look colorful.	24. Oceans and Marine Resources		842	28	The text has been revised to incorporate this suggestion.
Whitney	Gray	Clarify how bleaching kills corals- Bleaching kills corals because they essentially starve to death. Bleaching also causes them to be more vulnerable to disease which can cause their demise. Also, corals often recover from bleaching. In Florida, we typically have seasonal bleaching events which do not cause mass mortalities.	24. Oceans and Marine Resources		842	30	The points the comment raises are beyond the scope of this chapter.
Gerd	Wendler	Key messages 3Methane and CO2 gases are released when permafrost melts, leading to additional warming. However, this same warming leads also to enhance biological activity (greening of the tundra) and more growth of brush has been documented. While is does not affect the methane budget, it is of importance for the CO2 balance, as additional CO2 is absorbed due to enhanced growth.Chapter: Observed Climate ChangeThe time period on which the global warming is based on in the document is 60 years. Bowling (1991) was the first to report on the sudden temperature increase in 1976/77 of some 3°F, which cannot be directly caused by an increase in the greenhouse gases. Later, Hartmann and Wendler (2005) showed that the change was due to a change in the circulation as could be expressed by the PDO index, which caused the sudden temperature increase (see figure): http://climate.gi.alaska.edu/ClimTrends/Change/StateWide_Change_1949-2011_F.pngA sentence should to be added, that the semi-logarithmic temperature increase, which is to be expected from an increasing greenhouse gases, can be modified by by decadal or multi-decadal variations due to circulation changes (e.g Overland et al 1999). Hence, I do like your figure (22.1) which gives the modeled conditions for longer time periods (30/60 years) for which decadal variations become less important. These relatively short term temperature variations are also the reason, why the original SNAP temperature projections for the first decade of this century carried out for many places in Alaska were not only wrong in magnitude, but even in direction for 90% of the stations.The value given for warming of more than twice the global value is about correct for Northern Alaska (Wendler et al 2010),	22. Alaska and the Arctic				Due to the size of the topic, and the page limit for the chapter, we focused on broad trends rather than delving too deeply or providing such a level of specificity. The text has been revised to incorporate suggestions about temporal and spatial variability, with additional details provided in the climate chapter (Time period selected for assessment of climate change; patterns of variation within and beyond this time period). The AK chapter is intended to focus on the consequences of these changes. Carbon sequestration is addressed in the ecosystems chapter (carbon balance) and in this chapter. Some of the suggested references are cited in

		it is about twice the global values for Interior Alaska (Wendler and Shulski 2009), but substantially less for the Southeast, where we have the longest measured temperature observations at Sitka starting in 1828. Maybe when discussing the temperature trends, you might mention that the general increase due to increased greenhouse gases can be modified on decadal or multi-decadal scales. For example, the 1980's were very warm, warmer than the 1990's and the first decade of the new century (Wendler et al. 2012). Multi-decadal variations can be long, e.g. the last cold spell lasted from the forties to the second half of the seventies, more than 3 decades.Projected temperature changeFor the length of growing season the SNAP program is cited. This program calculates the mean monthly temperatures for future years. From these predictions, the shift of the date of the freezing point is calculated. Hence, it represents the time period with a mean temperature above the freezing point . This can be very different from the length of the growing season. One late frost in spring or one early frost in fall is of much higher importance than mean monthly temperatures.Disappearing Sea IceThe sea ice decrease in the Arctic Ocean is incredibly important, especially considering the new minimum there last September. However, the new maximum sea ice extent in April fro the Bering Sea of the same year bears some mention, as it too is important to the fisheries and native population.Living on Front Lines of Climate ChangeErosion is a major problem, and with less sea ice erosion will happen quicker due to more wave action with the loss of ice, even with unchanged wind speed. Nevertheless erosion has been happening at a substantial rate even before the majority of recorded warming. Subsea permafrost extents in areas over tens of miles from the coast, and as permafrost cannot be formed under water, erosion or sea level rise (or most likely both) has occurred in the past as wellNative communities: The Red Dog Mine in Northwest Alaska substantially improved the living conditions in Kotzebue, which might be mentioned.References:Bowling S.A. 1991: Problems with the use of climatological data to detect climatic change at high latitudes. Proceedings International Conference of the Role of Polar Regions in Global Change, 11-15 June 1990, Vol.1, 206-209Hartmann B. and G. Wendler 2005: On the significance of the 1976 Pacific climate shift in the climatology of Alaska. J. Climate 2005; 18: 4824-39.Mantua N, Hare S, Zhang Y, Wallace J, Francis R. A pacific 1997: Interdecadal climate oscillation with impacts on salmon production.Bull Am Meterol Soc 78: 1069-79.Overland J, Adams J, Bond N. 1999. Decadal variability of the Aleutian low and its relation to high-latitude circulation. J Clim ; 12:1542-8.Wendler, G., M. Shulski and B. Moore 2010: Changes in the climate of the Alaskan North Slope and the ice concentration in the adjacent Beaufort Sea. Theor. and Appl. Climatology. 99, 67-74Wendler G. and M. Shulski 2009: A century of climate change for Fairbanks, Alaska. Arctic, 62 (3): 295-300.Wendler, G, L. Chen and B. Moore 2012: The First Decade of the Century: a Cooling Trend for Most of Alaska by . The Open Atmospheric Science Journal, 6, 111-116 =-= Gerd Wendler, Director | Geophysical Institute Alaska Climate Research Center | University of Alaska Fairbanks Fax: (907) 474-7290 | 903 Koyukuk Dr., PO Box 757320 Tel: (907) 474-7378 | Fairbanks, AK 99775-7320 USA I =-=					the central climate chapter (2).
Michelle	Zilinskas	Overall, I thought that the Coastal Zone Development and Ecosystems Chapter provided credible and useful information on the challenges that coastal zones in the United States will face due to climate	25. Coastal				We thank the reviewer for the helpful suggestion of including more

		change. However, I think the chapter might benefit from inclusion of more information on opportunities and strategies for addressing these challenges. While some examples are provided, most are abstract, and in many cases, the economic and technical difficulties for adaptation to climate change impacts are discussed in detail, but potential solutions are only briefly mentioned. As information processors, people are driven to learn and build upon their existing mental maps of concepts. Concrete information is easier to understand and integrate than abstract information, so examples of successes in sustainable development and planning of coastal areas would be extremely useful. In addition, people are more likely to tackle difficult problems that are shown to be solvable. That being said, the integration of links to related chapters throughout is a strong, and could help alleviate this problem somewhat. For example, the section on Adaptation Possibilities for Coastal Infrastructure would benefit from placing a greater emphasis on adaptation possibilities, as the title suggests, rather than focusing on the fact that current infrastructure is inadequate and mentioning that adaptation is necessary. A few more examples of successful adaptation efforts or strategies would be worthwhile. Figure 25.5 and the caption describing the renovation of the bridge in coastal Louisiana helps the reader envision what some of these abstract changes may look like. A few more relevant examples, and links to the Adaptation chapter would help. I also would have liked to see more information in the Ecosystem Restoration section. I think the literature on the topic deserves more than a half of a page. Coastal ecosystems in particular provide many ecosystem services, and restoration can be extremely cost effective. This section briefly mentions that natural infrastructure, in combination with built infrastructure, is a viable option, but it does not give any examples of what natural infrastructure looks like. Elaboration on this topic would give coastal planners and policy makers ideas for alternative options that they may not have been previous exposed to.Similarly, I think that in the Coastal Ecosystem services section (pgs 884-885), it is extremely important to stress how valuable ecosystem services really are. They do not take the form of traditional built infrastructure, so their role in human and natural communities often goes unnoticed. It may be helpful to spend a little more time discussing this topic, as well as emphasizing the huge economic losses that are occurring due to coastal ecosystem degradation. I would also suggest including some information on possibilities for ecosystem restoration, as well as success stories that have resulted in healthier (for humans and coastal organisms alike) and more economically prosperous coastal ecosystems. Finally, I noticed that coastal resilience was mentioned a number of times, and the term comes up a lot in climate change discussions. I think that defining “resilience” would be clarifying for readers.	Zone Development and Ecosystems				information on opportunities and strategies for addressing the challenges that coastal zones in the U.S. will face with climate change. We have incorporated this suggestion throughout the chapter now, with additional or more concrete examples (e.g., in coastal infrastructure section, ecosystem section, economics section).We have expanded our discussion of ecosystem impacts in the Climate-related Drivers of Coastal Change section and added in several places throughout the chapter the importance of ecosystem services, their importance for human welfare (without becoming too anthropocentric), and the challenge of including climate changes into ecosystem restoration projects to ensure that they will be effective for a long time to come.We have added a comment on the varying definitions of resilience and our broad understanding of it in this chapter in a box, with relevant references.
Michelle	Zilinskas	Climate change increases RISK exposure...	25. Coastal Zone Development and Ecosystems		867	17	The text in this Key Message has been revised in subsequent drafts such that this phrase no longer exists.
Michelle	Zilinskas	A caption would be helpful.	25. Coastal Zone Development and	25.1	868		The caption has been clarified with a pointer to the definition of coastal.

			Ecosystems				
Michelle	Zilinskas	This sentence is very difficult to read with multiple citations built into the sentence. Consider splitting the sentence up.	25. Coastal Zone Development and Ecosystems		870	4	The text has been revised to incorporate this suggestion.
Michelle	Zilinskas	The average lay reader may be confused about why precipitation is expected to increase in some areas and decrease in others. Perhaps some elaboration or a reference to another chapter could be helpful.	25. Coastal Zone Development and Ecosystems		870	18	We appreciate this suggestion, but as space is limited, we have included a reference to Chapter 2 for those seeking additional detail.
Michelle	Zilinskas	Inconsistencies in the use of the “sea level rise” term. Every box uses “sea level rise,” while the Gulf Coast box uses “SLR” and “sea-level rise.”	25. Coastal Zone Development and Ecosystems		874	1	The text has been revised throughout the figure to be consistent with the use in the report text (sea level rise).
Michelle	Zilinskas	Mid-Atlantic box-words are cut off	25. Coastal Zone Development and Ecosystems		875	1	The graphic has been revised to fix this problem.
Michelle	Zilinskas	Change “The more than 60,000 miles” to “More than 60,000 miles”	25. Coastal Zone Development and Ecosystems		877	8	After consideration of this point, we still feel the existing text is clear and accurate and that the suggested rephrasing would introduce a different meaning than we intend.
Michelle	Zilinskas	With 20 of the 25 largest cities of the U.S. 4 located along coastlines, saltwater intrusion in coastal aquifers will have widespread impacts 5 (Solecki and Rosenzweig 2012). What are the impacts? Impacts on whom?	25. Coastal Zone Develop		878	4	The text has been revised to incorporate this suggestion - we have struck that sentence and expanded upon the impacts of saltwater

			ment and Ecosystems				intrusion.
Michelle	Zilinskas	Due to the number of citations throughout this sentence, this long, multi-clause sentence is difficult to follow. It would help to break it into two.	25. Coastal Zone Development and Ecosystems		878	11	The text has been revised to incorporate this suggestion - the sentence was broken up and citations were placed more appropriately.
Michelle	Zilinskas	This is one instance where providing examples of adaptation possibilities or links to the Adaptation chapter would be helpful.	25. Coastal Zone Development and Ecosystems		878	20	The text has been revised to incorporate this suggestion by including examples.
Michelle	Zilinskas	"Relocation of large coastal infrastructure can be very expensive, however, and even the addition of new infrastructure in high-hazard zones is sometimes viewed as a more cost-effective option than siting elsewhere. The use of "however" in the middle of the sentence creates some confusion, as the reader might expect the second clause to be contradicting the first clause, while in this case, it is supporting it. I would suggest changing the sentence to: "However, relocation of large coastal infrastructure can be very expensive, so even the addition of new infrastructure in high-hazard zones is sometimes viewed as a more cost-effective option than siting elsewhere."	25. Coastal Zone Development and Ecosystems		879	12	The text has been revised to demonstrate that some infrastructure must stay at the coast, and that flood-proofing can be more cost-effective than relocation. It has also been modified to emphasize that we are not prescribing one set of adaptation options over another, but that the best multi-objective strategy has to be determined in specific contexts. We are citing a case example where just such a determination has been made. We also added a sentence that recognizes that cost of relocation/removal at a later time may be even more expensive, and that infrastructure may become abandoned.
Michelle	Zilinskas	It is important to express the fact that most ports have not undertaken climate adaptation efforts, but perhaps mentioning an example or two of specific ports that have taken action would demonstrate that adaptation is indeed possible. It may seem like an overwhelming problem, but proving that it has already been done in some cases may reduce the feeling of hopelessness which can lead to avoidance of the problem.	25. Coastal Zone Development and Ecosystems		881	5	The text has been revised to incorporate this suggestion and a new citation has been added for additional examples.

Michelle	Zilinskas	"cost-benefit ratios don't favor public expense": Readers may find this unclear.	25. Coastal Zone Development and Ecosystems		883	18	The text has been revised to incorporate this suggestion.
Michelle	Zilinskas	Unique Challenges for Coastal Tribes Box: Although this section is linked to the Tribal Lands chapter, I think that it may deserve a slightly more thorough discussion than just three sentences.	25. Coastal Zone Development and Ecosystems		883	24	The text has been revised and expanded to incorporate this suggestion to the extent possible within space limitations. For further detail we point to the Tribal chapter.
Michelle	Zilinskas	I recommend changing the caption to "Projected Land Loss from Sea Level Rise in Coastal Louisiana." Readers that are unfamiliar with the geography of the United States may have trouble identifying the Louisiana coast immediately, so an identifying caption would be helpful. Identifying New Orleans on the maps may also help readers relate.	25. Coastal Zone Development and Ecosystems	25.9	885		The graphic has been revised to incorporate this suggestion.
Michelle	Zilinskas	"The presence of physical barriers…will further exacerbate the ecological impacts of climate change and limit the ability of these ecosystems to adapt, as in the case of marshes attempting to migrate landward with sea level rise." The example of marshes attempting to migrate landward will sea level rise is not very intuitive. I would suggest explaining this phenomenon briefly or using another example.	25. Coastal Zone Development and Ecosystems		886	12	We appreciate the suggestion, but space is limited. The author team has deliberated and agreed to retain the example given its wide familiarity and strong support in the literature. However the sentence was split and slightly expanded to help the reader imagine the process more easily.
Michelle	Zilinskas	"There is only limited evidence of more substantial ("transformational") adaptation occurring." Are the only examples of transformational adaptation occurring in Alaska and the Arctic, as the link to that chapter implies? If not, please consider providing an example.	25. Coastal Zone Development and Ecosystems		887	15	Due to the size of the topic, and the page limit for the chapter, we focused on broad trends rather than delving too deeply or providing such a level of specificity. The references point to the coast of Alaska and Louisiana, and the more conceptual description of different types of transformative adaptation in Kates et al. We only have room here to point to one type of transformative change but mention both locations.
Michelle	Zilinskas	Mentioning the cost of damages from Superstorm Sandy may have a greater impact than just using the descriptor of tens of billions of dollars.	25. Coastal		881	1	At the time of initial drafting, loss estimates for Sandy were partial and

			Zone Development and Ecosystems				vague. We were able to replace the initial estimate with more specific ones, but they are still only partial.
David	Peterson	Page 265, Figure 7.1. This is an odd figure that does not contain sufficient description to make it meaningful. There is no indication of the temporal domain of the disturbances indicated. The Modis Global Disturbance Index is not described. What is meant by “land clearing fire”? What is the difference between “drought/wildfire” “wildfire/drought” and “wildfire”? Why are “insects/logging/wildfire” considered to be a group? How can a percentage be greater than 100% (see legend [red])?Pages 266-267 The discussion on these pages is a poorly structured narrative that goes back and forth between the direct effects of increasing temperature and the indirect effects of altered forest disturbance. It is very hard to follow. Most scientific syntheses on the effects of climate change, including a seminal paper by one of the lead authors (Dale et al. 2001), concur that disturbances dominate forest response to climatic variability and change. However, this chapter emphasizes temperature increase. The National Climate Assessment Forest Sector Technical Report emphasizes the importance of increasing frequency and magnitude of large-scale disturbance, but again, the chapter emphasizes the effects of temperature. Why does the chapter diverge from the report and choose such a narrow focus on temperature when cause-effect evidence for temperature effects is rare? This approach misrepresents the weight of scientific evidence available on the effects of climatic variability and change on forest ecosystems.Page 266, lines 11-13 This sentence is either poorly stated or counterintuitive. Surely forest disturbances such as stand-replacing fire are easier to detect than a response to “changes in average conditions.”Page 266, lines 14-28 This is a poorly composed paragraph that appears to promote “forest die-off” as a universal phenomenon, when in fact it is not. This is a significant divergence from inferences stated in the National Climate Assessment Forest Sector Technical Report. Some of the same references are cited, but the conclusions are different. Why?The inference about rates of tree mortality increasing is stated as if it were an accepted fact, but there is no general agreement on this topic. van Mantgem et al. (2009) focused on a few older stands with short time series, inferring mortality “increases” of around 1%. Is this biologically significant? It should be noted that challenges were published in response to this study, but they are not mentioned here. In fact, with the notable exception of pinyon pine in selected areas of its distribution in the American Southwest, this study and others have little cause-effect evidence for increased tree mortality. The whole line of thinking in this paragraph does not consider the vast majority of forest landscapes in the United States where temperature-related changes in forest condition and mortality have NOT been observed. How do forest composition and forest structure (line 21) cause mortality? What is the evidence for air pollution (line 22) causing mortality?Page 266, lines 29-37 What is a “projected underlying trend”? (line 30)No evidence is provided for “past forest dynamics have been driven primarily by drought only.” This statement is almost certainly not true, when one considers the effects of normal stand dynamics, management, insects, other forms of herbivory, fungal	7. Forestry				With respect to the figure 7.1 comment, the text has been revised to incorporate this suggestion. The text has been revised to add information on the nature of the disturbance index, the technical term removed, and the dates over which the disturbance index was estimated. With respect to comments for page 266-267, the disturbance section has been extensively revised, particularly to improve the clarity of the discussion. With respect to comments on the forest productivity section, the text does state that forest growth in eastern forests may increase under elevated CO2 and temperature and we have added three references, including Vose et al. 2012, the Forest technical report. With respect to page 266, lines 11-13, the text has been revised to clarify that forest disturbances with large ecosystem effects occur relatively infrequently and in response to climate extremes, but detecting changes in climatic extremes is more difficult than detecting changes in average climate conditions because they occur so much less frequently. With respect to page 266, lines 14-28, the text has been revised to incorporate this suggestion. As stated, additional impacts of changing climate in absence of extremes is covered in the section on "Changing Carbon Uptake". We appreciate the suggested additional references, but feel the current references are appropriate and adequate given the chapter’s space limitations. With respect to the comment about evidence for air pollution (line 22) page 266, the text

		pathogens, and invasive species.The reasoning in lines 32-35 is very difficult to follow and is based on a single reference. It attempts to support a direct relationship between climate and tree mortality, seemingly a tunnel-vision approach to the topic of forest dynamics and climate change.Page 267, lines 3-5 The scientific literature and the National Climate Assessment Forest Sector Technical Report specifically state that growth increases are possible in the eastern U.S. and in high-elevation forests.Page 267, lines 12-14. The sentence about “die-offs” in Eastern forests is overstated, based on one reference from one of the lead authors, and diverges from inferences in the National Climate Assessment Forest Sector Technical Report. Page 267, lines 15-17 Again, this states a focus on single-factor causation, even though other stressors are mentioned just a few lines above. This single-factor interpretation is not supported in the broader scientific literature.Page 268, Figure 7.2 How does this illustrate or support anything in the text?Page 268, line 6 Why are English units used here?Page 269, line 11 What trends? None have been specified, and if there are any, they would almost certainly be relevant only to certain regions and forest species.Page 269, line 12 What is meant by a “projected case study”?Page 269, lines 14-16 This statement disagrees with what was stated on page 267.Page 269, lines 16-18 “Forests” and “vegetation types” will not “shift.” However, the distribution and abundance of individual species may change.Page 271, line 8. An “acceleration of harvesting” seems dubious, especially on public lands where harvesting has decreased greatly and will likely remain low.Page 271, Figure 7.4 Why are data from 2004 used when more recent data are available?Page 272, lines 13-15 What is mean by “increasing prevalence of extreme conditions”? Many people disagree with the exaggerated interpretations in Westerling et al. (2011).Page 276, lines 4-6 This sentence is awkward and needs to be reworded.Page 276, lines 37-38 What is meant by “adaptation of new species”?Page 277, line 1 “Aid in impacts” is an awkward phrase.Page 279, Assessment of confidence based on evidence It is curious that confidence is “very high” for increased frequency of large, intense fire, but that no confidence rating is indicated for the effects of higher temperature on tree mortality, a dominant theme in the first section. Furthermore, the sentence “This is based on…” suggests that Adams et al. (2009) and Williams et al. (2012) support the fire inference, when in fact they discuss primarily the					currently cites Dietz and Moorcroft (2011), no change to text was made. With respect to the comment on lines 29-37, page 266, the text has been revised to clarify this issue: Future disturbance rates in forests will depend on changes in the frequency of extreme events as well as the projected underlying changes in mean climate conditions (Jentsch et al. 2007; Smith 2011). With respect to comment on page 267, lines 12-14, we have considered this comment in the context of other comments that state the risks for eastern forests are being understated and have modified the text to match our assessment of the current best understanding of the situation. We have also added the Dale et al. 2010b citation to this sentence earlier in the chapter. We have also included a new figure to emphasize the focus on warmer temperatures and drought effects. With respect to page 267, lines 15-17; With respect to page 268, Figure 7.2, how does this illustrate; We added a citation to the figure in the text in the sentence that begins "Given strong relationships between climate and fire, even when modified by land use and management (Figure 7.2)". With respect page 268, line 6 and English units, the decision was made by the NCADAC to use English units. No change to the text. With respect to page 269, line 11, what trends; The text has been revised to incorporate this suggestion. Additional text added to address these changes. With respect to page 269, line 12, this statement; The text has been revised to incorporate this suggestion. Clarification of the changes in growing season was added and the text mentioned here deleted. With respect to page 269, lines 14-16,

		hypothesized temperature-mortality connection. Finally the inference about increased frequency of large fires says nothing about the magnitude of fire events, a topic for which abundant scientific literature is available. Literature Cited This section contains many errors and incomplete citations.					After consideration of this point, we still feel that the existing text is clear. The text originally on page 267 has been extensively revised. With respect to page 269, lines 16-18; the text has been revised to incorporate this suggestion. This text was deleted and replaced with a reference to the Chapter on Ecosystems where species shifts are described. With respect to page 271, line 8; After consideration, we still feel that the text is clear and accurate. No mention of ownership is made in this list of economic factors that will affect the future carbon cycle. With respect to page 271, Figure 7.4; The text has been revised to incorporate this suggestion. The temporal period is 2000 to 2006 and the methods are from Running et al. 2004. With respect to page 272, lines 13-15; We stand by our statement With respect to page 276, lines 4-6; We reworded the sentence With respect to page 276, lines 37-38; The text was revised to incorporate this suggestion With respect to page 277, line 1; The text has been revised to incorporate this suggestion. 'aid in impacts' has been revised to 'mitigate impacts' With respect to page 279, Assessment of confidence, the text has been revised to incorporate this suggestion. 'aid in impacts' has been revised to 'mitigate impacts' With respect to the Literature Cited, this text has been revised by the editors.
U.S.	Environmental Protection Agency	To what baseline period is the estimate of ground-level ozone and asthma?	16. Northeast		557	10	The text has been revised to incorporate this suggestion.

U.S.	Environmental Protection Agency	CRITICAL COMMENT: The traceable accounts in most chapters do not include enough detail or explanation to meet the objectives outlined for them in the Executive Summary (page 17, lines 27-35). In particular, there is very little discussion about the quality of information used; it is left up to the reader to look at the references cited and draw their own conclusions. Strongly recommend that each chapter team revisit their traceable accounts to ensure a commensurate level of detail/explanation across chapters and to clarify their rationale for choosing the confidence levels.					The final versions of traceable accounts will be revised based on the final chapter content and to improve consistency and detail in traceable accounts across chapters. The authors of the NCA Report have written it based upon a variety of sources, all of which were assessed under Guidance on Information Quality Assurance to Chapter Authors of the National Climate Assessment: Question Tools (2/21/2012), to assure for each source (1) utility, (2) transparency and traceability, (3) objectivity, and (4) integrity and security. All sources were assessed for IQA compliance. (NOTE: THIS IS IN PROCESS)
William	Rizer	The scientific evidence for anthropogenic climate change is incontrovertible. Climate change (global warming) is occurring and is caused mostly by the burning of fossil fuels. The consequences of this change are dire and demand immediate action if we are to avoid the worst of the predictions.	1. Executive Summary				This comment is consistent with the authors' conclusions.
Luben	Dimov	I'd love to see added to this chapter maps with the projected shift in forest types. This was done for the Southeast in Report#1 in 2000, but I have not seen a figure showing the shift for the West or a figure with any possible updates/refinements for the Southeast.	7. Forestry				Thank you for your comment, but your suggestion is outside the scope of this report. Given the challenges in projecting extreme climate events and in projecting forest responses such as tree death, there is much uncertainty in current projections and so we instead focus on the more general issue that many forests will shift rather than specifying which ones will.
Vincent	Gutschick	This section begins the discussion of hydraulic fracturing. I find it incomplete, because it fails to discuss methane leakage that makes the greenhouse-gas impact of fracked methane greater than even that of coal. Its widespread adoption in the US, primarily, has increased production of natural gas and reduced its price. This has generated great enthusiasm from major groups of consumers, producers, regulators, and government officials. States such as New Mexico, where I reside, have an economy heavily dependent on extracting natural gas, coal, and oil, and they seems to be in a position to benefit substantially if fracking for natural gas expands in scope. On the other hand, fracking has alarmed people in many other sectors of society – landowners whose property is impacted by well placement, seismic activity, and aquifer contamination, water managers who see large water diversions and contamination, and environmental groups on diverse counts. New Mexico, for one, is water-limited, so these concerns are obviously critical. There are several other telling facts about fracking that have had virtually no public exposure. One concerns the impact on climate. It is true that using natural gas in power plants and vehicles results in only about half as much generation of the potent greenhouse gas, carbon dioxide, as does generating	10. Water, Energy, and Land use		399		The text has been revised to incorporate this perspective. Information on emissions and water has been added to the natural gas discussion. However, due to space limitations, the author team is unable to include all the details of hydraulic fracturing. The author team has deliberated and chosen the topics and details to include.

		the same energy from coal. However, natural gas (methane) does leak during field production, and especially, it appears, when fracking is used. Recent measurements of methane concentrations and flows in air indicate that about 9% of the methane extracted escapes to the air (Nature 482: 139-140 [2012]). Methane is 25 times more potent a greenhouse gas than is carbon dioxide (and 72 times more, on the short-time scale of 20 years!). Twenty-five times 9% is 225%. To carry the math through in full (notes appended later), using fracking to provide energy from natural gas creates about 74% more greenhouse gas equivalents than using coal. So, fracking impacts water supplies, water quality, and climate, and more so than any other energy source. The second fact about fracking is that it's a shorter-term solution than claimed. The productivity of fracked wells declines faster than that of oil wells and other energy-extraction methods. To keep total production up, fracking has to be used on unprecedentedly large areas of the US. The "footprint" of fracking, as area affected, is larger than for any other energy technology in large-scale use. The attractions of making energy temporarily cheap and of providing jobs are seductive, at least currently. "Jobs" is a frequent mantra for promoters of many enterprises that have significant downsides. It should not be the major decision point; dealing drugs creates jobs, too, but we want to develop jobs that benefit both individuals and society. Fracking, certainly in its present form, fails to meet that criterion. Quick calculation: Comparison case: coal: 1 unit of carbon combusted (any unit) Warming potential is from carbon dioxide, CO2, as 1 unit of CO2 Natural gas from current gas fields: 0.5 units of carbon combusted gives the same amount of energy If 9% of the methane leaks: Original extraction in the field is 0.5/(1-0.09) = 0.549 units of carbon 0.5 units are burned, as stated Warming potential as CO2 is 0.5 units 9% of the 0.549 units of carbon leaks to the air, or 0.0494 units of carbon Warming potential as CO2 is 25 x 0.0494 = 1.24 units of CO2 equivalents Total warming potential = 0.5 + 1.24 = 1.74 units of CO2, or 74% higher than coal This analysis omits lesser accounts such as energy used for extraction and transport of either coal or natural gas. The conclusion of higher impact from fracked methane than from coal is unchanged.					

Ross	McCluney	The introductory letter to the American People is generally good, but it needs to be strengthened near the end to offer stronger warnings of what is likely to happen if we do not both take the threats more seriously and act more decisively to prevent the worst of them.	Introduction: Letter to the American People				This is a scientific assessment and is not intended to promote particular policy responses.
Ross	McCluney	Chapter 27 on Mitigation has a section on "Current Activities Affecting Emissions" with sections on • Federal Actions • City, State, and Regional Actions • Voluntary Actions While the actions listed are useful and supportive, they are not strong enough nor of a scale sufficient to stop the acceleration of greenhouse gas emissions before they reach and go over the tipping point that can further the accelerated loading of the atmosphere with methane and other greenhouse gases. I'm particularly concerned about the frozen tundra deposits which, once they melt sufficiently, can release sufficient quantities of methane to cause further warming and further melting of these deposits, accelerating the injection of this powerful greenhouse gas into the atmosphere, with serious results from which it will be very difficult for humanity to recover.	27. Mitigation				Details of non-linear feedbacks are beyond the scope with limited space, but the chapter does make clear the insufficiency of current efforts to meet frequently discussed targets.
Ross	McCluney	Chapter 26 on Decision Support is an excellent introduction to the scope of the difficulty in getting a sufficient portion of the populace to understand and accept the basic science and facts of global warming. It needs to go further in getting more people willing and able to put heavy pressure on political and other leaders to take the problem more seriously and to take bigger steps to stop greenhouse gas emissions. Along the way more needs to be done figuring out and training people how to live well, if more frugally, in the new era when energy may be more intermittent and variable. More needs to be done in planning for technical and economic changes needed to accommodate interuptible energy supplies as we shift to much greater reliance on intermittent solar and wind sources.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				Comment addresses policy issues that are beyond the scope of this chapter.
David	linouye	Although you mention changes in frost-free season length, I think there is growing evidence of the effects of frost on both natural and agricultural ecosystems at high altitudes, resulting from earlier snowmelt, hence earlier growing season, but an unchanged date of last hard frost. Thus plants are more likely to have developed leaves, flowers, or flower buds by the time the frost hits. There also seems to be an increasing frequency of "false spring" when a warm spell triggers earlier bud development or flowering, followed by cold weather sufficient to kill buds, flower, or developing fruits. Sample references for this phenomenon include: Inouye, D. W., M. A. Morales, and G. J. Dodge. 2002. Variation in timing and abundance of flowering by Delphinium barbeyi Huth (Ranunculaceae): the roles of snowpack, frost, and La Niña, in the context of climate change. Oecologia 130: 543-550. Inouye, D. W. 2008. Effects of climate change on phenology, frost damage, and floral abundance of montane wildflowers. Ecology 89(2): 353-362. Lambert, A., A. J. Miller-Rushing, and D. W. Inouye. 2010. Changes	20. Southwest				We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include in this chapter. However this topic is addressed in more detail in Chapter 8, Ecosystems.

		in snowmelt date and summer precipitation affect the flowering phenology of Erythronium grandiflorum Pursh (glacier lily, Liliaceae). American Journal of Botany 97(9): 1431–1437.This has also been shown to influence pollinator populations:Boggs, C. L., and D. W. Inouye. 2012. A single climate driver has direct and indirect effects on pollinator numbers. Ecology Letters 15(5):502-508. The phenomenon of warm spring followed by frost damate is also seen in other parts of the US:Gu, L., P. J. Hanson, W. M. Post, D. P. Kaiser, B. Yang, R. Nemani, S. G. Pallardy, and T. Meyers. 2008. The 2007 eastern US spring freeze: Increased cold damage in a warming world? BioScience 58:253-262.Marino, G. P., D. P. Kaiser, L. Gu, and D. M. Ricciuto. 2011. Reconstruction of false spring occurrences over the southeastern United States, 1901-2007: an increasing risk of spring freeze damage? Environmental Research Letters 6:024015.					
David	linouye	Although you mention the projected declines in snowpack, you do not address the known ecological consequences such as how high-altitude plants respond in terms of their phenology and abundance, and how this can affect interactions among species such as plants and pollinators. Earlier snowmelt typically results in earlier phenologies, such as for flowering, and via a variety of mechanisms, some known and some unknown, For example: McKinney, A. M., P. J. CaraDonna, D. W. Inouye, b. barr, D. Bertelson, and N. M. Waser. 2012. Asynchronous changes in phenology of migrating Broad-tailed Hummingbirds and their early-season nectar resources. Ecology 93(9):1987-1993.Anderson, J. T., D. W. Inouye, A. McKinney, and T. Mitchell-Olds. 2012. Phenotypic plasticity and adaptive evolution contribute to advancing flowering phenology in response to climate change. Philosophical Transactions of the Royal Society 279(1743): 3843-3852. Boggs, C. L., and D. W. Inouye. 2012. A single climate driver has direct and indirect effects on pollinator numbers. Ecology Letters 15(5):502-508. Aldridge, G., D. W. Inouye, J. R. K. Forrest, W. A. Barr, and A. J. Miller-Rushing. 2011. Emergence of a mid-season period of low floral resources in a montane meadow ecosystem associated with climate change. Journal of Ecology 99(4): 905-913.Miller-Rushing, A. J. and D. W. Inouye. 2009. Variation in the impact of climate change on flowering phenology and abundance: An examination of two pairs of closely related wildflower species. American Journal of Botany 96:1821-1829.Forrest, J., D. W. Inouye, and J. D. Thomson. 2010. Flowering phenology in subalpine communities: Does climate variation reshuffle species assemblages? Ecology 91(2):431-440.Lambert, A., A. J. Miller-Rushing, and D. W. Inouye. 2010. Changes in snowmelt date and summer precipitation affect the flowering phenology of Erythronium grandiflorum Pursh (glacier lily, Liliaceae). American Journal of Botany 97(9): 1431–1437.Inouye, D. W. 2008. Effects of climate change on phenology, frost damage, and floral abundance of montane wildflowers. Ecology 89(2): 353-362.	20. Southwest		690	27	We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include in this chapter. However this topic is addressed in more detail in Chapter 8, Ecosystems.
Jill	Hoehlein	Living in the Southwest corner of Colorado, I have observed that our spring flora is beginning to bloom earlier, geese are returning to our reservoir earlier, and right now at lower elevations the snow pack is decimated. We estimate that we received less than 70% of what we require to avoid drought conditions for this coming summer. Last summer we were on water restrictions - farmers are now concerned about their irrigation rights and who will get the water. We have yet to have any real moisture fall in over a month.Regarding the bark beetles - just come out and visit Pagosa Springs and head up Wolf Creek pass - the destruction of the forest is impossible to ignore. The trees are so stressed that there is no way they can deal with the beetles successfully. Plus the beetles are not having their populations reduced over the winter and due to the warmer weather are able to go through multiple reproductive cycles.I certainly strongly support the draft that you have written.	8. Ecosystems, Biodiversity, and Ecosystem Services		297	14	Thanks for the nice comment!
Richard	Wright	Say " Water management and planning would benefit from better coordination between the public sector, at national, state, and local levels, and the private sector, with participation of all relevant stakeholders in a well informed, fair, and equitable decision-making process."	3. Water Resources		127	8	The text has been clarified to incorporate this perspective.
Richard	Wright	Say "the marketplace" rather than "regulated markets" since the important point is the freedom of choice (but subject to regulations) in the private sector.	4. Energy Supply		183	16	After consideration of this point, we have chosen to keep the text as is. In

			and Use				common industry and consumer vernaculars, "market" is synonymous with "marketplace."
Richard	Wright	say “with mixed public and private ownership and management” since most railroads and pipelines and many roads and bridges are privately owned and managed.	5. Transportation		195	34	Thank you. We have edited the text to incorporate this suggestion.
Richard	Wright	The assessment of confidence is incomplete.	5. Transportation		214		Thank you for your comment. We revised the sentence.
Richard	Wright	“land use planners” is too narrow; say something like “Private and public sector decision makers must consider the impacts of strained water supplies on agricultural, ecological, industrial and urban needs.”	10. Water, Energy, and Land use		389	30	The text has been revised to incorporate this perspective.
Richard	Wright	Need to recognize explicitly the importance of private sector (industry, business and professions) in making societal choices.	1. Executive Summary		12	21	The authors agree, though this particular section may not be the ideal place to emphasize this.
Richard	Wright	The importance of infrastructure and its resilience is well expressed, but the key findings understate, seriously, the importance of urban systems to the nation. Yes, the health, safety and wellbeing of residents is important. So are the Nation’s economy, security and culture – all of which depend on the resilience of urban infrastructure systems.	11. Urban Systems, Infrastructure, and Vulnerability		419	13	Thank you for your suggestion. Based on your comment, edits have been made
Richard	Wright	It would be stronger to say “However, these efforts require for success broadly-based, cooperative private sector and governmental activities.”	11. Urban Systems, Infrastructure, and Vulnerability		419	24	Thank you for your suggestion. Based on your comment, edits have been made.
Richard	Wright	Say “businesses and non-profits” rather than “organizations” to better recognize the private sector role in land use and land cover.	13. Land Use and Land Cover Change		471	19	The text has been revised to incorporate this suggestion.
Richard	Wright	Decision processes affecting the built environment greatly influence mitigation of and adaptation to climate change, involve many stakeholders and substantial time and expense. The following text might be used as the basis for a box:Decision Processes Affecting the Built EnvironmentThe built environment (buildings, communications, energy, industrial facilities, transportation, waste, water and associated natural features) consists of constructed facilities that shelter and support most human activities. The built environment has an important role in reduction of greenhouse gas emissions and in measures to help society adapt economically, environmentally and socially to climate change. Decisions affecting	26. Decision Support: Supporting Policy, Planning, and				We have added in additional examples to the chapter, but have not included one specific to the built environment due to space constraints.

		the built environment take substantial time to make and to implement and their consequences endure for generations.The term “building community” describes the participants and stakeholders concerned with and responsible for (in fact, if not always legally) the economic, environmental and social effects, functionality, safety and resilience of constructed facilities through their whole life cycle (planning, design, construction, commissioning, operation, maintenance, renovation and removal).The building community includes: • Professionals (architects, engineers, geologists, landscape architects, planners, etc.) licensed to protect the public health, safety and welfare in design, construction, assessment and renovation of constructed facilities. • Owners, private and public • Investors and insurers • Facilities managers and maintainers • Contractors who build and renovate facilities • Manufacturers and suppliers of building materials and products. • Regulators responsible for health, safety, environmental quality, welfare, etc. • Stakeholders served or affected by constructed facilities (all of us.) All of the members of the building community have a voice and a role in decisions and actions to adapt (or not adapt) the built environment to mitigate and/or adapt to climate change.There are two paths from scientific knowledge to a built environment accomplishing mitigation of and/or adaptation to global change is: 1. For voluntary actions of the owners/proponents: Knowledge > Standards > Built Environment 2. For regulated actions: Knowledge > Standards > Model Codes > Regulations > Enforcement > Built Environment The decisions that determine the planning, design, construction, operation, maintenance, renovation and removal of infrastructure are guided (for voluntary decisions) and governed (for regulated decisions) by the standards and practices of the building community. The building community extends beyond the engineers and other professionals concerned with infrastructure to include owners, financial interests, product manufacturers, public officials, regulators, and other stakeholders. All of these stakeholders have a voice in the development and implementation of standards and practices. The process takes time (often years) but results in better decisions.Examples of the hundreds of important standards are: • The American Society of Civil Engineers (ASCE) Standard 7, Minimum Design Loads on Buildings and Other Structures.	Resource Management Decisions in a Climate Change Context				

		• The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard 169, Weather Data for Building Design Standards. • The International Code Council (ICC) International Building Code (a model building code which references the above standards and is adopted by state and local governments as the basis for their legal building codes). o The National Fire Protection Association NFPA 1144: Standard for Reducing Structure Ignition Hazards from Wildland Fire (NFPA 2013) a model code which is adopted by state and local governments as the basis for protection from wind driven conflagrations and wildfire.Climate/weather, ecological and social sciences need to be participants with the building community in this path. Many stakeholders will be concerned with safety, health, and economic and social consequences. • The process for development of standards and model codes requires openness to participation of all stakeholders, balloting of proposed provisions and explicit response to all negative votes. • The adoption of standards and/or model codes in regulations is a public policy process in which all stakeholders can present their concerns for safety, health, and economic and social costs and benefits. • Climate/weather scientists, engineers and other professionals need to demonstrate scientifically and technically sound, risk-based rationales for proposed standards, model codes and regulations. • Engineers and social sciences must define the economic and social costs and benefits for proposed standards, model codes and regulations. The development of recognized, consensus standards is a crucial step in gaining credibility for criteria for design extreme events. The private sector role in the development of standards is described at www.standards.gov. Federal policy recognizes this path. Circular A-119 of the United States Office of Management and Budget www.standards.gov/standards-gov/a119.cfm#1 directs agencies to use voluntary consensus standards in lieu of government-unique standards except where inconsistent with law or otherwise impractical.					
H	WITTE	Page 1165, Figure 28Might want to check the legend. The subtitle reads: "Average Annual Minimum Temperature by Climate-Related Planting Zone"Not sure the average low in Wash DC is 1-10F.Think you left out the word "EXTREME""Average Annual EXTREME Minimum Temperature"	Appendix: The Science of Climate Change	28	1165		Average Annual Minimum Temperature indeed refers to the minimum temperature of the year. We have revised the figure label to incorporate this suggestion.
H	WITTE	Page 1167, figure 29These are quite interesting graphs, but a bit hard to read. Seems a shame to squeeze them in such a compressed size. Perhaps use a tiny US map with the various sections marked since the US map would be what D. Kahneman calls a System 1 process (intuitive) and then use a full page to show the 10 graphs (2 columns, 5 rows) to show the System 2 graphs (Slow thinking).	Appendix: The Science of Climate Change	29	1167		The report will be published as an interactive pdf document. This will have a feature that one can click on a particular graph and it will provide a pop-up display of that graph for better visibility.
Richard	Wright	Add engineering to social and behavioral science research	27. Mitigation		967	16	We have edited the text to incorporate this concern.
Richard	Wright	Highly influential and deserving of specific attention are widely adopted and used voluntary standards such as ASHRAE 90.1, Energy Standard for Buildings (www.ashrae.org/resources--publications/bookstore/standard-90-1) and the International Green Construction Code	27. Mitigation		963	27	The text has been revised as suggested.

		(www.iccsafe.org/cs/igcc/pages/default.aspx)					
Richard	Wright	substitute “vulnerability” for “disaster risk”	28. Adaptation		983	31	The authors find the word vulnerability to be too general for the intent we were trying to convey and wanted to call specific attention to disaster risk reduction. In other parts of the chapter, the concept of vulnerability is explored. As such, no change was made.
Richard	Wright	The first sentence of Key Message #5 should be revised to say “Vulnerability to climate change is exacerbated by other stresses such as pollution, habitat fragmentation, socio-economic frailties and distressed or obsolete infrastructure.”	28. Adaptation		983	33	Thank you for your comment. We have revised this language to include poverty.
H	WITTE	Here's a good example of how a System Two (slow thinking) (D. Kahneman) graphic could easily be made into a System One (fast thinking) image. Or what Cognitive Multimedia Learning theory calls the "Contiguity Principle": align words to corresponding graphics. 1. Take the text of the left y-axis ("Number of fires, Thousands") and place it within the graph, aligned/paired with the black line. 2. Take the red text along the right y-axis (Area Burned, Millions of Acres) and align it within the graph with the red vertical bars. This makes reading and understanding the graphic a faster mental process. The reader doesn't have to slow down his/her mental processing to read the caption of what red and black mean, nor turn their heads sideways to read the vertical two y-axis text. Thus the caption could stick the the main message.	Appendix: The Science of Climate Change	31	1170		We thank the commenter for the suggestion. We have added labels inside the graphic to aid comprehension.
Richard	Wright	Revise Key Message #6 to read: “The effectiveness of climate change adaptation has seldom been evaluated, because actions have only recently been initiated, and comprehensive evaluation techniques, such as performance-based standards, are not yet broadly available.” See ASCE Policy Statement 418 (http://www.asce.org/Public-Policies-and-Priorities/Public-Policy-Statements/Policy-Statement-418---The-Role-of-the-Civil-Engineer-in-Sustainable-Development/)	28. Adaptation		983	37	The authors believe the existing statement covers the reviewer's comment, so no changes were made.
Richard	Wright	Table 28.4 should note role of standards developing organizations. Examples are: • The American Society of Civil Engineers (ASCE) Standard 7, Minimum Design Loads on Buildings and Other Structures.• The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard 169, Weather Data for Building Design Standards.• The International Code Council (ICC) International Building Code (a model building code which references the above standards and is used by state and local governments as the basis for their legal building codes).• The National Fire Protection Association NFPA 1144: Standard for Reducing Structure Ignition Hazards from Wildland Fire (NFPA 2013) a model code which is used by state and local governments as the basis for protection from wind driven conflagrations and wildfire.	28. Adaptation	28.4	994		We thank the commenter for this suggestion. Regrettably, we have not been able to assess the cited standards, and it is beyond the scope of our chapter to assess every kind of code specifications and the processes which set them in the context of adapting to climate risks. Indeed, the authors of the NCA Report have written this chapter based upon a variety of sources, all of which were assessed under Guidance on Information Quality Assurance to Chapter Authors of the National Climate Assessment: Question Tools (2/21/2012), to assure for each source

							(1) utility, (2) transparency and traceability, (3) objectivity, and (4) integrity and security. All sources were assessed for IQA compliance. As such, no change was made.
Richard	Wright	High priority research needs should include linking climate and weather models, and extending the latter to provide knowledge of the intensities and frequencies of extreme events.The building community must be involved with climate/weather, ecological and social scientists in research on assessing and responding to global change to assure that the research produces the information needed to produce standards, practices and regulations and otherwise inform actions for mitigation of and adaptation to global change. In particular, the design and resilience of the built environment are governed by extreme events (drought, flooding, storm surges, temperatures, wind velocities, etc.) that are affected by global change and are not now (and never have been) defined by climate/weather sciences. Our current design practices are based probabilistically on historical records. The only definitive guidance we currently have from climate/weather science is that the statistics of extreme events will not be stationary. No quantitative guidance is available.	29. Research Agenda for Climate Change Science		1036	1	The built environment is now addressed in several research goals. The issue of scale is critical in addressing this concern, and the new RG #1 and 2 mention regional scale and enhanced geographic coverage.
Richard	Wright	to Research Goal #2 add a bullet: • Research leading to performance based national and international standards and model codes for climate change adaptation and sustainable development.	29. Research Agenda for Climate Change Science		1037	20	We are unable to include this level of detail given page limits.
Richard	Wright	to Research Goal #3 add a bullet: • Understand the potential of national standards, model building codes and state and local building codes to provide climate change mitigation.	29. Research Agenda for Climate Change Science		1038	24	We are unable to include this level of detail given page limits.
H	WITTE	Page 1171, figure 32Multimedia Learning Theory and E. Tufte posit that this graph could be quickly understood without having to slow down and divert the eyes back and forth from the graphic to the caption to the graphic to the caption. Foveal vision is only about 2 degrees in width so one cannot take in the entire message at one glance. Place the descriptive items of "moderate", "severe" and "extreme" within the graphic, paired with the colored legend, or for even faster mental processing, place the descriptive terms on the appropriate areas of the map.	Appendix : The Science of Climate Change	32	1171		The discussion on drought has undergone substantial modification. The limitations of and statutory requirements of PDSI are discussed. Also, other measures of drought such as Consecutive Dry Days has been added.
Richard	Wright	to Research Goal #4 add a bullet: • Prioritize investments in observations and data systems that will define the intensities and frequencies of extreme events such as heavy precipitation, floods, storm surges, droughts, and extreme winds.	29. Research Agenda for Climate Change Science		1039	13	This is now part of the cross cutting theme on observations. Extreme events are now mentioned more in this chapter as well as under the observations crosscut (CCRC 2).
Richard	Wright	to Research Goal #5 add a bullet:	29.		1040	12	With the refocusing of mitigation

		• Many strategies for mitigation of global change, such as carbon capture and sequestration and renewable energy systems, require extensive planning, design and construction of infrastructure systems. Research to develop efficient, streamlined regulatory practices is needed for such construction. Without this research (involving ecological, political and social scientists and engineering researchers) and its implementation, a decade or more would be required to obtain regulatory approvals for a facility such as one for carbon capture and sequestration. If the regulatory system is not made substantially more efficient, we are likely to see deleterious waiving of requirements for environmental quality and social equity.	Research Agenda for Climate Change Science				recommendations we are unable to include this level of detail.
Richard	Wright	Is the title of this chapter Sustained Assessment or The NCA Long- Term Process?	30. The NCA Long-term Process: Vision and Future Development		1047	1	Agree an inconsistency exists. In addition, the lead in heading below the author list could also be confused as a title. The following change was made and should also be reflected in the report TOC. Deleted the heading on line 12 and replaced with "Introduction." Changed the chapter title to: "30. Sustained Assessment: A New Vision for Future U.S. Assessments." For the short header title on other than the title page, "Sustained Assessment" was used.
Richard	Wright	p1047, 37 -39: Revise the two sentences as follows: “The envisioned sustained assessment process includes continuing and expanding engagement with scientists, engineers and other learned professionals from government, academia, business and non-governmental organizations. These partnerships broaden the knowledge base from which conclusions can be drawn.” Scientists are necessary but not sufficient. Note the need to involve engineering and standards developing organizations is developed in the comment above for chapter 26.	30. The NCA Long-term Process: Vision and Future Development		1047	37	Agree. Text changes made to reflect suggested wording, except did not distinguish scientists form engineers. The phrase now reads "scientists and other experts." Chapter 26 comment needs to be separately addressed.
H	WITTE	For even more punch to the visual: zoom in to the area of interest, we don't need all the globe.Comparisons are often useful for people to get a sense of scale of the change: how does this area compare to the area of the lower 48? Overlay the US outline over one of the maps?Its a pretty picture, but what do the colors mean? Are they relevant to the message?	Appendix: The Science of Climate Change	33	1174		Figure caption has been augmented with information on the lost area (one third the area of the contiguous United States) and on the color scale for ice concentration (fraction of the ocean surface covered by sea ice). We believe this approach is preferable to adding an inset, which would clutter the figure.
H	WITTE	Would a short discussion of the decrease in the "volume" of the sea ice be helpful here?	Appendix: The Science of Climate Change		1173		A discussion of changes in ice volume (thickness) has been inserted into the revised supporting text for Chapter 2, Key Message 11.

H	WITTE	page 1176, figure 35 Melting of Arctic Land-based IceI see a plot of "increasing" values left to right, a little counter-intuitive.Perhaps flip the chart upside down and use a negative y-axis so that the concept of "loss" is intutive	Appendix: The Science of Climate Change	35	1176		The main message of this figure (as stated in the caption) is that there has been an increase in inputs of freshwater to the ocean from melting land ice. The present display captures this increase. Flipping the graph upside down could wrongly be interpreted as saying that the inputs of freshwater mass to the ocean are decreasing. So we believe the present orientation is preferable.
H	WITTE	Page 1176, line 3-6 "Glaciers are retreating" Would it be helpful to have a sentence about what "retreating" describes? Glaciers are melting, they are losing volume. Their termini are melting back and glaciers becoming thinner. It is vertical and a horizontal process.	Appendix: The Science of Climate Change		1176	3	Sentence has been changed to say that increased melt is decreasing both the mass and the extent of glaciers.
H	WITTE	page 1177, figure 36Oh my, this is definitely a System 2 (Kahneman) graphic! Surely there must be a pair of simpler linear graphics that can tell these messages: volume change of ice and SLR?	Appendix: The Science of Climate Change	36	1177		We thank the reviewer for the suggestion, which has been incorporated into the revised figure.
H	WITTE	Page 1179, figure 37Wouldn't it be helpful to place a inches/yr legend across the bottom with the mm/yr?	Appendix: The Science of Climate Change	37	1179		The caption has been modified to provide the conversion from mm/year to inches/year.
H	WITTE	page 1180, figure 38one figure is in mm/yr the other in cm/yrWould it be helpful in the caption to describe what these two losses mean with respect to sea level rise per year?	Appendix: The Science of Climate Change	38	1180		This figure has been updated and the color scales are now both shown in units of inches/year. In addition, the equivalent rates of sea level rise has been include in the caption as suggested.
Stace	Beaulieu	Comment for National Climate Assessment, Chapter 24: Oceans and Marine ResourcesSubmitted by WHOI/MIT Joint Program Biological Oceanography course (instructor: Stace Beaulieu, students: Maja Edenius, Benjamin Jones, Max Kaplan, Bennett Lambert)For Key Message 2: Although the authors state that there are regional differences in ocean pH, they may want to also point out that reductions in seawater pH are likely to occur sooner and with greater magnitude in coastal and high latitude regions. We note that this topic is addressed in the Griffis and Howard technical report with citations including Caldeira & Wickett (2003) and Steinacher et al. (2009). The authors' statement that "Increased ocean acidification, low-oxygen events, and rising temperatures are already affecting shellfish aquaculture operations" should refer explicitly to the box (which has citations).	24. Oceans and Marine Resources				The chapter focused on broad trends for the topic. We refer those interested in a deeper treatment of the topic to the provided citations. Regarding Key Message 2: this is a good point but is more relevant for Adaptation chapter; Key Message 4: there is good data showing increased prevalence with temperature for oysters, corals and abalones and this is not an artifact of more scientists; Key

		The authors should also recognize that most OA studies do not take into account the potential for phenotypically plastic responses to environmental change or genetic adaptation over multiple generations. Also, we note that the Griffis and Howard technical report cites Ries et al. (2009), who examined the effects of OA on 18 calcifying organisms and found a broad range of responses (no change to calcification rate, increased and decreased rate, of varying magnitudes). Box in Key Message 2: Although the early warning system for oyster hatcheries may be effective in the short term, as the ocean continues to acidify the effectiveness will be reduced. The authors may want to address longer-term solutions and sustainability.For Key Message 4: The authors begin by stating that there has been increased observation of disease in marine animals over the last several decades. However, increased observation ("reported incidences") is not necessarily increased incidence of disease. The authors should account for confounding variables such as increased numbers of scientists, improved technologies for monitoring ecosystem health, and better awareness of the environment before equating observation with incidence.For Key Message 5: The "Traceable Accounts" section for #5/6 appears to be specific to tourism and recreation industries and lacks information on uncertainties and confidence for "transportation, resource use, and extraction."One recommendation applicable to all key messages: Although we recognize that this is a national assessment, we recommend that the text be inclusive of a larger-scale/ international perspective. Initiatives implemented by the U.S. alone may have great regional impact but lesser impact than required to preserve the world ocean. The ocean is shared among all nations and initiatives must be coordinated to be effective on a large scale.Suggested figure edits: Fig. 24.1: The grey shading of the U.S. territory covers up some ocean temperature shading. Fig. 24.3: Title should indicate these photos are from lab experiments, and it is not mentioned if the dramatic picture on the right, 1500 ppm, is a reasonable concentration to be expected in the ocean. Fig. 24.4: The picture (a) on the left looks like the picture (d) on the right. Perhaps add some labels indicating the healthy (portion of the) coral colony.					Message 5: we have adopted your suggestion. Fig. 24:1 After consideration, we feel the figure is clear in it's present formFig 24:3 The text has been revised to incorporate this suggestion.Fig 24:4 We thank the reviewer for the helpful suggestion, which has been incorporated into the figure.
John	Hall	Dust and aerosols might also be referenced as affecting snowpack (e.g., see Painter, T. et al. 2010. Response of Colorado River runoff to dust and radiative forcing in snow. PNAS 107:17125-17130; Creaman, J. et al. 2013. Dust and biological aerosols from the Sahara and Asia influence precipitation in the western U.S. Sciencexpress. 28 February 2013).	3. Water Resources		109	7	Excellent suggestion. Included in revised discussion.
John	Hall	Declines in the Great Lakes' water levels are not necessary restricted to climate change. One group, Georgian Bay Forever, has stated that dredging of the St. Clair River has changed lake levels. Increased well use also is affecting aquifers that feed one or more lakes. Evaporation, because of increased temperatures, possibly brought on by climate change, also reduces lake levels. Please consider clarifying the range of factors that may affect lake levels.	3. Water Resources		124	16	Thank you for your comment. The text has been revised to clarify.
John	Hall	Water distribution infrastructure is also affected by variations in water pressure that can stress joints and pipe material that can then cause leaks and breaks. One adaptation strategy would be to consider EPA's recommendation for asset management of water infrastructure. See http://water.epa.gov/infrastructure/sustain/asset_management.cfm.	3. Water Resources		129	14	Thank you for your comment. We have noted that infrastructure planning can be improved by incorporating climate change as a factor in asset management
Reese	Cloud	The document does not contain a map of all the regions, nor is there a list in this introduction of which states, territories, and possessions fall into each region.	Introduction to Regions				The section has been revised to incorporate this suggestion.

John	Hall	Consider adding some discussion in an appropriate section of the report regarding climate change effects to the supply chain. Supply chains directly support the U.S./global economy and are vulnerable to climate change; however, limited discussion has occurred to date on what adaptation strategies need to be considered and implemented, particularly for those parts of the supply chain that serve critical infrastructure such as the Defense Industrial Base. The supply chain's energy and water needs will be affected by climate change.Effects on supply chains also could be considered the subject of a future special topical report by the NCA.					Thank you for the comment. Additional description of the International context and national security context have been added to the introduction. As the commenter notes, specifics of supply chain impacts could be an interesting future report.
Reese	Cloud	The executive summary does not contain a map showing the regions of the country. There should be a map illustrating regions so that readers may easily locate themselves or areas of interest.	1. Executive Summary				A map of the regions, with examples of regional impacts, has been included in the Executive Summary.
John	Hall	For each one of the states or regions, clarify whether the water use is in millions of gallons per day withdrawn or consumed or both. It appears to be both. In addition, clarify whether the water needed to generate the energy is accounted for in the water column under thermo-electric. This would seem to be a similar concern for hydro, but hydro is not included in the water column. Please clarify.	10. Water, Energy, and Land use	10.3	391		The figure caption has been revised. The revised caption indicates that water is in million gallons per day or billion gallons per day, depending on the region. Water is reported for withdrawals (which is stated in the caption). Thermoelectric water use is defined in the paragraph above the figure. Hydro is not assigned water use as evaporation off reservoirs is associated with many uses, not just hydroelectric.
John	Hall	The use of carbon capture and storage (CCS) requires significant amounts of water (see <http://spectrum.ieee.org/energy/environment/the-water-cost-of-carbon-capture>) and should be mentioned.	10. Water, Energy, and Land use		399	14	Some specifics on CCS water use and references were added.
John	Hall	Switchgrass, grown on marginal lands unsuitable for food crops such as corn, may still require large quantities of fertilizer to produce the volume of crops required for viable biofuel. The fertilizer will degrade water quality when it runs off the land and will accumulate in large water courses, potentially contributing to the dead zone in the Gulf of Mexico if the field is located in the Mississippi River watershed. Please address these considerations.	10. Water, Energy, and Land use		404	33	The biofuels discussion text has been revised to incorporate this suggestion.
John	Hall	Change"dryer" to "drier."	10. Water, Energy, and Land use		405	11	We thank the commenter for the suggested edit.
John	Hall	Recommend you define water security. It does not appear any where else in this chapter.	10. Water, Energy, and Land use		408	3	The text has been revised and the term has been deleted.
John	Hall	Carbon capture and storage (CCS) may reduce CO2 emissions; however, significant amounts of water are required for CCS. Reference should be made to the water chapter as to why at present this may pose limitations on the use of this technology as a viable mitigation option.	27. Mitigation		962	32	This topic is more appropriate for the energy-water-land chapter.

Reese	Cloud	It is unclear which states, administrative districts, territories, etc. are included in each of the regions. The table should list the states, etc. that comprise each region.Further, the table does not provide the full names for each region. Specifically, "Southeast" should be "Southeast and Caribbean", "Alaska" should be "Alaska and Arctic", and "Hawaii" should be "Hawai'i and U.S. Affiliated Pacific Islands" (also note misspelling of Hawai'i in the document text).	1. Executive Summary	1.1	11		A map of the regions, with examples of regional impacts, has been included in the Executive Summary.
John	Hall	Given that Energy STAR is mentioned, than EPA's WaterSense also should be mentioned to emphasize the interconnection between saving water and energy.	27. Mitigation		964	5	Thank you for your comment. The table is a sample, and not a complete list.
John	Hall	Energy security is unachievable without water security. Both should be mentioned.	27. Mitigation		964	11	This seems like a topic for energy-water-land interactions.
John	Hall	Although some technologies may be available to reduce the monetary cost of carbon capture and storage (CCS), the water required for CCS may make CCS impractical. Please address.	27. Mitigation		965	43	The topic of CCS and water is addressed in the Energy-Water-Land chapter.
Robert	Bullard	Akin to SETI, I offer the following for consideration -1. Establish a searchable by appropriate query standards a digital archive of all local weather data collected by television stations and presented to or available for presentation as the basis for weather cell movements, etc.2. Solicit qualified members of the public for their interest in collecting quality meteorological, marine, etc. data and presentation to and inclusion in the data base in 1., above.3. A sizable portion of the world's population live in locale with heat island conditions, with that effect likely being more prominent the more advanced the development of locale, etc. Understanding the physical nuances (building characteristics, urban usage, etc.) may help devise retroactive mitigation methods or, more likely, moderation with further development of heat island areas. Therefore, applying the focus of 1. and 2., above to heat islands may be particularly beneficial.	29. Research Agenda for Climate Change Science				Comment has been added in observations and data (CCRC #2) regarding citizen science. Built environment is mentioned as an adaptation/mitigation win-win. We have mentioned these issues in the section on capacity building as well.
Jonathan	Allen	Over all the Report is excellent. I have just one minor point. In writing about greenhouse gas emissions we should distinguish between "carbon" and "carbon dioxide." This is not just a matter of sloppy writing; elemental carbon (soot) also exits smoke stacks and is an important pollutant. Once upon a time there was an electrician who did not discriminate between aluminum and aluminum oxide. Of course he got electrocuted. Keep up the otherwise good work.					Thank you for the comment. We have attempted to be clear in the distinction. Additional discussion of black carbon and other aerosols has also been added to the Climate Science chapter.
Charles	Carlson	P5 / line 41. "Biodiversity loss" understates the probability of extinctions for plant, animal, and microbial species. Throughout the NCA there is much discussion about vulnerabilities and pressures on species. How many "pressures" does it take to lead to an extinction?	1. Executive Summary		5		The request from the commenter is not clear, no change is recommended. However, there is more information on this topic in the Ecosystems chapter.
Charles	Carlson	P299 / lines 1ff. "Adaptation" discussion here presents a very passive approach. Aren't there more approaches to enhancing adaptation, e.g., preservation of habitat, breeding and seed stock?	8. Ecosystems, Biodiversity, and Ecosystem Services		299		No change. The third paragraph of this section lists a series of more aggressive approaches to enhancing adaptation.
Michael	Charles	ASCE believes that the Global Change Research Program needs to ensure that the NCA gives high priority to the following policy approaches in order to help mitigate the potential effects of climate	28. Adaptati				The NCA cannot be a policy perscriptive process. As such, the

		change, which cannot be predicted with absolute certainty but which ASCE considers possible and potentially dangerous to public safety based on the current state of the scientific knowledge in climatology. Civil engineers are responsible for design and maintenance of infrastructure projects that facilitate economic development and protect human health, welfare and the environment. Climate change may result in significant impacts to this infrastructure. Civil engineers and government policy makers must work together to anticipate and plan for these impacts. ASCE, its members, leaders, and resources are ready to develop and implement prudent policies as part of their mission to serve the public good.Impact of Climate Change (Chapter 28)The American Society of Civil Engineers (ASCE) supports government policies that encourage anticipation of and preparation for possible impacts of climate change on the built environment. Climate change could pose a potentially serious impact on world wide water resources, energy production and use, agriculture, forestry, coastal development and resources, flood control and infrastructure. Examples include: • Alterations to the surface and aquifer hydrologic patterns for multi-purpose water resource projects, of particular concern to civil engineers working in the power-generation industry, flood control, and water supply utilities where reservoir storage capacity may need to be increased. • Climate extremes such as floods and droughts and other significant variations in hydrologic patterns that may necessitate changes or additions to flood control and public infrastructure to provide adequate public safety and performance. • Changes in frequency and strength of tropical storms that will require changes in coastal protection systems. • Changes in ocean levels that will require adaptation of coastal infrastructure, including ports. • Changes in permafrost conditions that require retrofitting existing foundations and alterations to foundation design. Such impacts could require modified agricultural practices and measures to deal with rising sea levels, water supply and quality, threats to critical infrastructure facilities and the potential for the outbreak of disease.	on				authors did not feel it was appropriate to recommend specific adaptation actions. No change to the text was made.
Michael	Charles	ASCE believes that the Global Change Research Program needs to ensure that the NCA gives high priority to the following policy approaches in order to help mitigate the potential effects of climate change, which cannot be predicted with absolute certainty but which ASCE considers possible and potentially dangerous to public safety based on the current state of the scientific knowledge in climatology.Greenhouse Gases (Chapter 27)ASCE supports the following public and private sector strategies and efforts to achieve significant reductions in greenhouse gas emissions from existing and future infrastructure systems: • Establishing sustainable, long-term infrastructure development and maintenance plans at federal, state and local levels that promotes reduction of greenhouse gas emissions and timely adaptation to the effects of climate change, while maintaining or enhancing natural, economic, and social resources.• Establishing clear and reasonable targets and time frames for the reduction of greenhouse gas emissions.• Improving energy efficiency and reducing greenhouse gas emissions produced by infrastructure systems over their entire life cycles by making cost-effective use of existing technologies. These improvements should cover all sectors, and include both stationary and mobile systems and emission sources.• Researching and implementing new technologies and materials	27. Mitigation				Discussion of mitigation measures has been added to the chapter, but the space for the detail suggested is limited. It's outside the scope of the NCA to prioritize policy recommendations.

		to further improve energy efficiency and reduce greenhouse gas emissions.• Encouraging the use of lower greenhouse gas emitting energy-generating sources such as nuclear, hydropower, wind and solar.• Incorporating additional incentives for the short term development and implementation of high efficiency and low or zero greenhouse gas emitting technologies and cost-effective carbon capture and storage of emissions from large stationary sources that can't easily be displaced.• Stimulating private investment in greenhouse gas reducing technologies by establishing a market value for greenhouse gas emissions over the long term.• Encouraging the use of all tools, including financial mechanisms, to reduce greenhouse gas emissions.• Encouraging actions by other countries to reduce their greenhouse gas emissions.Exploring the utilization of natural systems (e.g., forests, oceans, and subsurface void spaces) as greenhouse gas (carbon) sinks via sequestration as well as developing other greenhouse gas mitigation technologies (e.g., carbon dioxide capture and conversion through phase shift).If current trends continue, by the end of this century atmospheric greenhouse gas concentrations could be twice what they were at the beginning of the industrial revolution. These increased concentrations could contribute to climate change, including severe precipitation events, increases in global average temperatures, droughts (and associated wildfires), floods, and rising sea levels. With time, these changes could become more pronounced with attendant weather, disease, and national/global economic disruptions. Efforts to reduce the rate of greenhouse gas emissions are desired where possible.					
Michael	Charles	ASCE believes that the Global Change Research Program needs to ensure that the NCA gives high priority to the following policy approaches in order to help mitigate the potential effects of climate change, which cannot be predicted with absolute certainty but which ASCE considers possible and potentially dangerous to public safety based on the current state of the scientific knowledge in climatology.Hydrologic Data Collection (Chapter 29)ASCE urges the federal government to continue and expand a long-term hydrologic data collection program for major watersheds and their associated coastal areas, with funding on a continuing basis sufficient to allow prediction of storm surges, major flood events, and sediment transport as well as to allow effective management of changes to established hydrogeomorphological processes, that is, the interaction of water and soil through river systems.Hydrologic data, including associated hydraulic data, are vitally important to water resource planning, regional sediment management, and flood-risk management, as well as the design and operation of water projects. Such data are critical for performing risk assessment and economic analysis properly, and for evaluating the impact of water projects on public health, welfare, safety and the environment. Good, consistent historical data are absolutely essential for the modeling necessary to make accurate predictions. Most importantly, because these data must be collected on a regional basis, this is inherently a federal responsibility. Many U.S. agencies, in particular the National Weather Service and the U.S. Geological Survey, provide the foundation of the basic data collection program for water in the United States. Inadequate and uncoordinated hydrologic data collection, resulting from budget shortages and neglect, has long term adverse effects on the efficiency and certainty of planning, design, construction, and operation of water and other projects and results in an unnecessary and significant risk to the public safety.The lack of adequate data impacts the ability to model, predict and plan for catastrophic events. These events, such as floods and droughts, have obvious impacts on public health, safety and our nation's economy.Civil engineers rely on hydrological, meteorological and water quality data for integrated watershed management, floodplain management, and regional sediment management, as well as the design of water supply, flood control, navigation, and development projects. Collection, analysis and dissemination of continuous hydrologic data are critical for effective modeling, forecasting and all types of water resource management.	29. Research Agenda for Climate Change Science				We now mention hydrological observations explicitly and more frequently but were unable to include this level of detail.
Michael	Charles	ASCE believes that the Global Change Research Program needs to ensure that the NCA gives high priority to the following policy approaches in order to help mitigate the potential effects of climate	3. Water Resource				We appreciate your suggestion and have revised the text to note the

		change, which cannot be predicted with absolute certainty but which ASCE considers possible and potentially dangerous to public safety based on the current state of the scientific knowledge in climatology.Watershed Management (Chapter 3)ASCE supports:• Sustainable and basin-wide water resources management. • The development of plans and regulations by the federal, state, and local governments to protect water on a watershed basis. • Federal legislation defining the goals and standards for watershed managers to permit them to accommodate regional needs.Legislation authorizing and funding water resource management and planning has typically been written for a specific level of government. It has also focused on individual water resources, rather than the interrelated, hydrologic and environmental system that defines the watershed. As a result, efforts to manage water resources are often limited and single-purpose. Watershed plans should consider the multiple water resources and aquatic habitats comprising the watershed, and should include consideration of water supply, water quality, water conservation, flood protection, land use and protection of fish and wildlife resources. A key component of watershed management is cooperative partnerships between the stakeholders in the watershed. ASCE believes that effective watershed management is facilitated when the government, the public and the private sector work collaboratively on this issue. Many water problems are not amenable to traditional regulatory approaches. Examples include non-point sources, competition for water supplies, dam safety, flood damage reduction, habitat degradation, aquatic sediments and minor sources. With the watershed approach, full use of modern technologies like remote sensing, geographic information systems (GIS), global positioning satellites, the personal computer and the world-wide web can be brought to bear on our remaining water quality and quantity problems.Furthermore, the diverse nature of these problems suggests that top-down management and standard setting is an inappropriate way to deal with them. Using the watershed approach, all levels of government, the public and private industry are encouraged to participate in the decision-making and implementation process. In this way, management actions which reflect local and regional viewpoints are inherently incorporated in watershed policy.	s				importance of addressing water resource management at a watershed scale
Michael	Charles	Infrastructure Survivability Research (Chapter 29)ASCE supports additional basic and applied research efforts and the development of national standards in support of design and construction initiatives that will increase the reliability, safety, security, and survivability of the nation's vast infrastructure (e.g., water, energy, utilities, buildings and transportation) against natural and man-made disasters. This includes research, development, and standards that identify and address vulnerabilities in the infrastructure, and promote implementation of innovation leading to safety, security, sustainability, resilience and survivability. Events such as the 2001 terrorist attacks, Hurricane Katrina, and the 1989 Loma Prieta and 1994 Northridge earthquakes have demonstrated the vulnerability of the nation's infrastructure to natural and man-made disasters. The United States government needs to address infrastructure vulnerability in order to render infrastructure critical to the U.S. economy safer, secure, and more resilient. Risks to the nation's infrastructure also demands an enlightened and responsive work force to implement both established, as well as, newly developed improvements to increase safety, security, and robustness of critical systems in the nation. The federal funding of research and standards is insufficient to provide the resources necessary for mitigating natural and man-made hazards. Such funding is critical to the health and safety of the nation, its citizens, and resilience of the nation's economy and critical infrastructure. The disasters of September 11, 2001, and Hurricane Katrina revealed the nation's infrastructure's vulnerability to man-made and natural hazards. The civil engineering profession is responsible for designing, building, and maintaining the nation's infrastructure. Thus, ASCE is obligated to assist with the national research, development, production of	29. Research Agenda for Climate Change Science				Infrastructure now mentioned under research goal on impacts (RG2)

		standards, and other needs that are necessary to develop and implement new strategies and technologies for mitigating the impact of future disasters on the nation's infrastructure.					
Michael	Charles	ASCE believes that the Global Change Research Program needs to ensure that the NCA gives high priority to the following policy approaches in order to help mitigate the potential effects of climate change, which cannot be predicted with absolute certainty but which ASCE considers possible and potentially dangerous to public safety based on the current state of the scientific knowledge in climatology.Decision Processes Affecting the Built Environment (Chapter 26)The built environment (buildings, communications, energy, industrial facilities, transportation, waste, water and associated natural features) consists of constructed facilities that shelter and support most human activities. The built environment has an important role in reduction of greenhouse gas emissions and in measures to help society adapt economically, environmentally and socially to climate change. Decisions affecting the built environment take substantial time to make and to implement and their consequences endure for generations.The term "building community" describes the participants and stakeholders concerned with and responsible for (in fact, if not always legally) the economic, environmental and social effects, functionality, safety and resilience of constructed facilities through their whole life cycle (planning, design, construction, commissioning, operation, maintenance, renovation and removal).The building community includes:• Professionals (architects, engineers, geologists, landscape architects, planners, etc.) licensed to protect the public health, safety and welfare in design, construction, assessment and renovation of constructed facilities. • Owners, private and public • Investors and insurers • Facilities managers and maintainers • Contractors who build and renovate facilities • Manufacturers and suppliers of building materials and products. • Regulators responsible for health, safety, environmental quality, welfare, and the like. • Stakeholders served or affected by constructed facilities (all of us.)All of the members of the building community have a voice and a role in decisions and actions to adapt (or not adapt) the built environment to mitigate and/or adapt to climate change.There are two paths from scientific knowledge to a built environment accomplishing mitigation of and/or adaptation to global change: 1. For voluntary actions of the owners/proponents: Knowledge > Standards > Built Environment2. For regulated actions: Knowledge > Standards > Model Codes > Regulations > Enforcement > Built Environment The decisions that determine the planning, design, construction, operation, maintenance, renovation and removal of infrastructure are guided (for voluntary decisions) and governed (for regulated decisions) by the standards and practices of the building community. The building community extends beyond the engineers and other professionals concerned with infrastructure to include owners, financial interests, product manufacturers, public officials, regulators, and other stakeholders. All of these stakeholders have a voice in the development and implementation of standards and practices. The process takes	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				We have added in additional examples to the chapter, but have not included one specific to the built environment.

		time (often years) but results in better decisions.Examples of the hundreds of important standards are:• The American Society of Civil Engineers (ASCE) Standard 7, Minimum Design Loads on Buildings and Other Structures. • The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard 169, Weather Data for Building Design Standards. • The International Code Council (ICC) International Building Code (a model building code which references the above standards and is adopted by state and local governments as the basis for their legal building codes). o The National Fire Protection Association NFPA 1144: Standard for Reducing Structure Ignition Hazards from Wildland Fire (NFPA 2013) a model code which is adopted by state and local governments as the basis for protection from wind driven conflagrations and wildfire.Climate/weather, ecological and social sciences need to be participants with the building community in this path. Many stakeholders will be concerned with safety, health, and economic and social consequences.• The process for development of standards and model codes requires openness to participation of all stakeholders, balloting of proposed provisions and explicit response to all negative votes. • The adoption of standards and/or model codes in regulations is a public policy process in which all stakeholders can present their concerns for safety, health, and economic and social costs and benefits. • Climate/weather scientists, engineers and other professionals need to demonstrate scientifically and technically sound, risk-based rationales for proposed standards, model codes and regulations. • Engineers and social sciences must define the economic and social costs and benefits for proposed standards, model codes and regulations. The development of recognized, consensus standards is a crucial step in gaining credibility for criteria for design extreme events. The private sector role in the development of standards is described at www.standards.gov. Federal policy recognizes this path. Circular A-119 of the United States Office of Management and Budget www.standards.gov/standards-gov/a119.cfm#1 directs agencies to use voluntary consensus standards in lieu of government-unique standards except where inconsistent with law or otherwise impractical.					
Michael	Charles	ASCE believes that the Global Change Research Program needs to ensure that the NCA gives high priority to the following policy approaches in order to help mitigate the potential effects of climate change, which cannot be predicted with absolute certainty but which ASCE considers possible and potentially dangerous to public safety based on the current state of the scientific knowledge in climatology.Floodplain Management (Chapter 10)ASCE urges governments at all levels to adopt proactive floodplain management policies that:• Hold paramount the public's safety, health, and welfare. • Protect and restore, where practical, natural floodplains. • Enact land use policies, ordinances and building codes that consider life safety and prevent the development or major redevelopment of communities in unprotected areas below sea level or in high-risk, flood-prone areas. • Inform residents in floodplains of the hazards associated with the development or major redevelopment of communities below sea level or in high-risk, flood-prone areas.	10. Water, Energy, and Land use				Thank you for your comment, however policy issues are beyond the defined scope of the National Climate Assessment, a scientific document that provides the basis for decision making, but does not address policy.

		• Develop flood disaster mitigation and relief plans commensurate with remaining risk. • Develop and exercise flood disaster preparedness and evacuation plans commensurate with remaining risk. • Support creative partnering between federal, state and local governments to adopt floodplain management policies. • Fund the design and implementation of floodplain management policies and flood mitigation projects in a timely manner. • Incorporate the concept of building disaster resistant communities consistent with sustainable development. • Encourage risk appropriate, multiple-uses of flood prone areas. • Pursue flood mitigation facilities, including river restoration, wetland restoration, aquifer recharge, improvements in habitat, ecosystems, and water quality, recreation and open space use. • Incorporate floodplains into comprehensive watershed management programs.Development and associated infrastructure in flood prone areas has increased rapidly as people are attracted to historically fertile floodplains and coastal areas. Even though the benefits of preserving the natural floodplains as flood storage areas and wildlife habitat have been recognized, the floodplains continue to be developed and new inhabitants are subjected to periodic flooding and related devastation, as shown by Hurricanes Katrina and Rita. People living and working in flood prone areas often have developed a false sense of security. Once a flood occurs, residents and businesses often expect government to reduce or eliminate the risk of flooding through large capital projects. These populations need the protection of an efficient floodplain management program implemented before the flood occurs. By recognizing the likelihood of future flooding and the beneficial aspects of the natural floodplain, areas can be protected and communities can become disaster resistant. Floodplain management includes the operation of an overall program of corrective and preventive measures for reducing flood damage, including, but not limited to, emergency preparedness plans, flood control works, and floodplain management regulations. Methods for evaluating the benefits and costs of mixed systems allow for the consideration of both tangible and intangible benefits and costs and should permit formulating programs, including both structural and nonstructural elements, which provide the greatest return on society's investment.Civil engineers are largely responsible for the implementation of floodplain management programs and the design and maintenance of flood mitigation systems. Civil engineers recognize the benefits of both floodplain management and flood mitigation and develop projects to educate the public about the importance of first, preserving the natural floodplain, and second, integrating floodplain regulations and flood mitigation projects into comprehensive floodplain management programs.					
Michael	Charles	ASCE believes that the Global Change Research Program needs to ensure that the NCA gives high priority to the following policy approaches in order to help mitigate the potential effects of climate change, which cannot be predicted with absolute certainty but which ASCE considers possible and potentially dangerous to public safety based on the current state of the scientific knowledge in climatology.Coastal Wetlands (Chapter 25)	25. Coastal Zone Development and				Thank you for your comment, however policy issues are beyond the defined scope of the National Climate Assessment, a scientific document that provides the basis for decision making, but does not assess policy options. In

		ASCE supports:• Efforts to reduce land loss along America's coastal wetlands through protection and restoration of the physical processes necessary to sustain these unique ecosystems. ASCE supports the ongoing effort to fund and implement the beneficial use of dredged material, regional sediment management, and a programmatic authorization of federal civil works projects that allow restoration and preservation work to continue on a long-term basis. • The principle that coastal and wetland restoration and hurricane protection must be part of an integrated regional watershed and coastal zone management effort, which considers the interrelationships of natural, social and economic systems and includes federal, state, local and private initiatives in a collaborative way. • Continued funding for wetland preservation and restoration projects under the Coastal Wetlands, Planning, Protection and Restoration Act of 1990 (CWPPRA).America's coastal states—those states bordering on the Atlantic, Pacific, or Arctic Ocean, the Gulf of Mexico, Long Island Sound, and one or more of the Great Lakes—contain vital ecological and economic resources. These resources are threatened. For example, the Louisiana coastal wetlands have been disappearing through land subsidence and erosion at an alarming rate of 25 to 35 square miles annually. Since 1930, more than 1,800 square miles have been lost. It is estimated that an additional net loss of more than 500 square miles may occur by the year 2050. The rate of this land loss is some of the highest in the world and exposes communities and critical infrastructure to damage from storm surge as Hurricanes Katrina and Rita vividly demonstrated.The levee system that was constructed for flood control on the Mississippi River, while acknowledged for its beneficial aspects, is one of several reasons for the coastal land loss. Other reasons include land subsidence from oil and gas extraction activity in the coastal area, naturally occurring land subsidence, erosion, and the rise in sea level. Regional sediment management offers a strategy that may be able to balance the different causes of land loss and their potential remedies.One of the largest deltaic systems in the world, Louisiana's coastal wetlands are a highly productive area and an important base of the United States' economy and energy security. It is the home of the critical U.S. Strategic Petroleum Reserve. The loss of coastal area means that this population, which includes the City of New Orleans, will experience increasing vulnerability to hurricanes, including storm surges that top levees and cause severe flooding. Hurricanes Katrina and Rita highlighted this increased vulnerability.Since the CWPPRA was enacted in 1990 it has authorized 151 restoration or protection projects, benefiting more than 110,000 acres in Louisiana.The economic investments described above indicate there is a significant cost savings in acting now to protect and restore America's coastal wetlands. Restoring wetlands can provide a level of flood attenuation to storm surge and protection from erosive forces, as well as valuable ecological benefits.Project managers, scientists, and engineers use a variety of techniques to protect, enhance, or restore wetlands. Each restoration project may use one or more techniques to repair delicate wetlands. These techniques include marsh creation and restoration; shoreline protection; hydrologic restoration; beneficial use of dredged material; terracing; sediment trapping; vegetative planting; barrier island restoration; and bank stabilization.	Ecosystems				various places throughout the chapter however, we already describe what is known about the negative impacts of certain coastal protection measures.
Michael	Charles	Mitigating the Impact of Natural and Man-Made Hazards (Chapter 28)ASCE supports sustained efforts to improve professional practices in planning, design, construction, operation, maintenance and reuse/decommissioning that mitigate the effects of natural and man-made hazards. ASCE is committed to developing standards and participating in other national and international activities that encourage mitigation of the effects of hazards and improvement of warning systems against of impending hazards. ASCE will collaborate and cooperate with government, citizen, and private agency initiatives and activities for hazard mitigation, preparedness, and disaster recovery. ASCE supports efforts to ensure that sufficient federal, state, and local funding is available for research, development of standards, enforcement, preparedness planning for response and recovery, and for disaster mitigation funds that are non-taxable.Natural hazards include floods, hurricanes, tornadoes, earthquakes, landslides, tsunamis, wildfires, droughts, heavy winter storms, and dust storms. Man-made hazards include explosive, chemical, biological, and radiological attacks and other accidents or terrorist acts.	28. Adaptation				Thank you for your comment. We appreciate hearing about the good work happening at ASCE, but we are unclear how to integrate this information into the text. As such no change was made.

		Natural and man-made hazards may result in the loss of lives, property damage, and destruction, and interruption of business causing immediate and long-term economic, social, and environmental losses. Appropriate mitigation measures can significantly reduce these losses. ASCE is expected to be strongly involved in national and international efforts because the primary responsibility of many civil engineers is to mitigate natural and man-made hazards. ASCE develops and maintains standards, supports the funding of professional guideline writing organizations such as the Building Seismic Safety Council and the American Lifelines Alliance, and works with governments at all levels to assist in mitigating the impacts of natural and man-made hazards.As the stewards of infrastructure civil engineers plan, design, construct, operate, maintain, reuse, and decommission buildings, bridges, roads, pipelines, towers, dams, and other projects which are exposed to natural and man-made hazards. It is in the interest of ASCE to become fully involved in local, state, national, and international efforts for mitigating disasters improving safety, making communities more resilient and reducing economic disruptions. National performance-based standards are needed to assure that appropriate and consistent design and construction methods are available worldwide for mitigating natural and man-made hazards. These standards rely on the collaborative work of various agency and professional societies. Adequate funding is needed for professional guideline-writing organizations, such as the Building Seismic Safety Council and the American Lifelines Alliance.As the leading professional society representing civil engineers involved in mitigating the effects of disasters on the built environment, ASCE needs to maintain its leadership role in improving practices that reduce vulnerability and improve resilience.					
Terry	Grant	I see the most value from this report lies in it being credible and showing that we, the USA, although not the most effected nation by the expected impacts of climate change, represent the projected largest contributor (~30%) to the increased CO2 levels which are driving the effects. People would like to have quantitative measures of cost to mitigate verses the cost of the impact, but that is not likely nor needed to realize that the lack of action is beyond any reasoning or justification.					Thank you for the comment. We hope that the transparent and credible process behind the development of this report will be useful. For this report, economic information is limited to what could be developed from case studies and reports in particular sectors and regions; for the next report due in 2017, though, we can expect solid and expanded coverage.
Donald	Albertson	Somehow mention or reference "Storms of My Grandchildren" by climatologist James E. Hansen, PhD. This book talks about climate change political history plus climate change science, problems and worthy solutions.	Introduction: Letter to the American People				We appreciate the suggestion, but space is limited.
Donald	Albertson	Air freight is bad news for climate. We need to use more local sources of food -- starting with backyard gardens like the "victory gardens" during World War II. It is sad for multiple reasons that some grapes sold in Arizona come from Chile rather than California. Most farmed salmon comes from Norway and Chile.	6. Agriculture				This comment indirectly calls for reduction in greenhouse gas emissions by changing food consumption choices that influence emissions from transportation. This is not directly an agricultural issue and implies a need for a policy change, which is beyond the scope of the report.
John	Christy	Report FindingsSpecial Important Note:Some of the analyses below were done specifically for this comment and thus have not had time for submission to the literature or would simply not be of interest due to the simple nature of the analysis. However, the key point regarding evidence that is	1. Executive Summary				The NCA used thousands of sources and had over 1000 people directly contributing as authors of technical

		used throughout the real world is simply “reproducibility” and so if the readers of this comment desire, I will be happy to submit the underlying time series so they can verify the comments I am making. In other words, I will be happy to informally follow the legal rules of “discovery” so that nothing mysterious is being offered (see next). The temptation for some NCA authors is to dismiss evidence that directly contradicts the views presented here on human-causation by falling back on claims made by assessments such as the IPCC and/or restricting information to “peer-reviewed” literature of their own selection. I realize there is a range of views among the lead authors, but that range is narrow compared with the actual community and compared with what is offered by a critical look at the evidence. It is important to know that material in the NCA will be cross-examined by the informed public, by congressional investigations, by credentialed climate scientists, and very likely by professional legal experts. In legal venues, the notion of “peer-review” (which the IPCC is not since Lead Authors were their own reviewers) is only a feature of a piece of information and does not accord it special rights or even the category of “admissible evidence.” In such venues, information presented that has known provenance and is reproducible and verifiable, counts as “admissible evidence” (which basically eliminates climate model output since there have been no engineering-level verifications of their veracity – i.e. vague statements of “fairly good agreement” don’t qualify.) The notion that because a finding appears in the IPCC should give it some gravitas, as some scientists believe, is not true if its conclusions can be contradicted by simple evidence. The information presented in my comments fits the description of admissible evidence (and actually has been presented in legal venues) and thus it behooves the NCA to address them directly in the text (and similar comments from others) or risk being found unresponsive to “admissible evidence” that contradicts the fundamental opinions presented in the NCA. Demonstrating that the NCA suppresses clear and reproducible evidence that contradicts its draft “Findings” is a quick way to destroy any default credibility one might have believed should be ascribed to the document. It will be interesting to see if the NCA has the fortitude to embrace and promote evidence that contradicts the assertions conceived in the IPCC.					reports and the final report. Every effort has been made to avoid bias, and the draft has been reviewed multiple times by the National Academy of Sciences, the public, the NCA federal advisory committee, and 13 federal agencies.
John	Christy	Report Finding Point 1 from NCA Report Findings: Global climate is changing, and this is apparent across the U.S. in a wide range of observations. The climate change of the past 50 years is due primarily to human activities, predominantly the burning of fossil fuels.That the global climate is “changing” is a simple statement of fact since as a non-linear dynamical system the “climate” (defined by any number of response variables) never reaches static equilibrium. Thus, each of its variables (i.e. temperature, precipitation, etc.) is constantly fluctuating over all time scales. This first claim is trivial being neither remarkable nor falsifiable (i.e. one can’t prove the climate is not changing in some way).The next assertion, i.e. that in the past 50 years the change is due “primarily” to human activities, has not been proven. In other words the simple question, “Has natural variability been ruled out as the primary source of the change?” has nowhere been demonstrated by rigorous methods. The supporting statement regarding U.S. temperatures does not qualify as “proof” for two basic reasons among many others, (a) the statistical population size is woefully too small and (b) the reliance on climate model simulations is improper as these are shown to be significantly different from observations over the recent few decades – the very same decades being claimed as responding to human activities. [Note: Chapter 2 claims that “much” of the change of the last 50 years is due to humans, not “primarily” as in “Report Findings”. These two statements are not consistent with each other, nor has either been proven.]For (a), a temporal population size of U.S. temperatures that begins in 1895 constitutes only a tiny portion of the history of climate of our nation. To make claims based on these specific 118 years of data (which suffer from issues discussed later) as representing a population large enough to make the further claim that a 50-year sample is somewhat outside of natural variability is not supported by standard statistical analyses nor by the evidence from larger populations.Simply put, to make claims of unusual behavior, standard statistical techniques indicate one should have a population size of 30 independent values (or in this case: 30 50-year periods). For this claim therefore, the NCA requires	1. Executive Summary		8	2	This multi-part comment contains a large number of assertions. The majority of these comments relate to the climate science chapter, and the evidence related to the report's conclusions about anthropogenic forcing can be found in that chapter, the Commonly Asked Questions appendix, and the Climate Science appendix. A graphic that provides evidence related to human causation has been added to this chapter. The human causation issue is addressed within the climate science chapter (Chapter 2), the Commonly Asked Questions Appendix, and the Climate Science Appendix. There is no argument that climate varies over time, and there has been significant additional work done on the connections between variability and trends in chapter 2, as well as a new section on this in the Context and

		30x50, or 1500 years, not 118. The statistical statement in Point 1 (regarding U.S. temperatures) is analogous to flipping a coin, observing “heads”, then flipping it again and observing “tails” and claiming that the latter result is outside of the system’s natural capability. One can only make that claim if approximately 30 consecutive flips were “heads” with the final one being “tails” – in this case “tails” is statistically outside of the system’s natural simulations.Fortunately, there are some fairly robust samples of useful variables that extend over 1000 years in the U.S. that bring to bear the appropriate statistical evidence that demonstrates current variations are within natural variability and therefore provide evidence that the “primarily” descriptor in Point 1 is ill-conceived, and indeed falsified.Drought events through the centuries leave measureable impacts in various ways, especially in the Western U.S. The megadroughts of the early second millennium C.E. with their associated high temperatures, are well established, and these easily exceed any such conditions of the past 118 years (e.g. Piechota et al. 2004, Cook et al., 2010, Griffin et al. 2013). Dramatically illustrating the megadroughts are photographs of submerged trees in alpine lakes of the Sierra Nevada of California (Kleppe 2005). In these photos, divers are pictured examining and coring trees that at one time grew on dry ground over many consecutive decades. Dating of these samples indicates the megadroughts of the early second millennium were so severe that several current lakes were completely dry back then. Further, that the current situation there is relatively stable (i.e. not changing as models project for the recent 50 years) is supported by 133 years of Sierra snowfall records, assembled for homogeneity, which reveal no trend (Christy 2012.) Thus the current century and recent decades are well within the variations of the past 1000 years in terms of the most critical to human sustenance of climate components (water). Then too, reconstructions of the Mississippi Valley show similar, naturally-forced, megadroughts (Cook et al. 2010). Also in the early second millennium C.E. drought was so severe and protracted that the western plains were classified as a migrating-sand-dune ecosystem (i.e. a desert: Muhs 1985, Muhs and Holiday 1995, Schmeisser 2009). Summer heat accompanies such droughts, as demonstrated by the 1930s in the U.S., which would enhance desertification as documented in soil horizons containing aeolian sand in this region deposited during the most recent millennium. What is demonstrated by this brief discussion is that the U.S. climate has been drier and hotter in the past (as shown by an appropriate statistical population) due to unforced natural variability during which time enhanced greenhouse gas forcing was non-existent. Such a span of time is the appropriate temporal population from which to test the variability of a sample element that is 50 years in length. Thus, without putting the recent 50 years in the context of the last 1000 or so years, the assertion of human causation cannot be statistically sustained, and indeed the evidence shows our current climate fits within the population’s parameters and is therefore not significant at all.As to part (b) much of the “evidence” related to assertions presented in Point 1 is derived from the belief that climate model simulations are accurate enough to reproduce the current (and future) climate. This belief depends especially on the past 35 years during which the impact of increasing greenhouse gas emissions should be clearly evident in response variables such as atmospheric temperature. Since Point 1 begins with the generic “global climate” there is much that could be examined here, but I shall be brief.The latest CMIP-5 climate model runs are now open to examination. Early studies, such as Santer et al. 2012 using 20 models, show that since 1979 the bulk atmosphere has warmed much less than models indicate. They found that for the global lower troposphere, the models on average warmed the Earth 1.9 times that of observations and for the mid-troposphere by a factor of 2.5. Through 2012, a larger set of CMIP-5 rcp8.5 models show an average global lower-tropospheric (mid-tropospheric) trend of +0.27 (+0.22) °C/decade warming due, primarily, to greenhouse gases. Observations indicate trends of +0.14 (+0.06) °C/decade (see my Figure 1 and upcoming BAMS State of the Climate), being considerably below the model simulations. [Note: because the comparison with observations ends in 2011 or 2012 the choice of rcp scenario (i.e. rcp4.5, rcp6.0, rcp8.5) is of no consequence as the differences in model simulations of these rcp scenarios occurs later in the 21st century.] These model vs. observation differences are					Background section.

		significant and indicate models are likely too sensitive to greenhouse forcing and therefore are not particularly useful at ascribing the reason for recent changes – mainly because the models can't reproduce the recent changes.A more discriminatory test is found in the tropical (20°S-20°N) tropospheric temperature because it is in the tropical troposphere (especially the upper troposphere) where models indicate greenhouse gas forcing will amplify a large surface warming as one ascends to 250 hPa where the amplification factor is about 2.5. Thus, there are two issues here, (1) the actual magnitude of warming and (2) the amplification of the surface warming with altitude. What appear below are simply updates of Christy et al. 2010 and Klotzbach et al. 2010 which continue to verify the findings of those papers. An update is shown in Figure 2 in which a comparison between US (NCAR, GFDL, GISS) and UK (HadGEM) models and four sets of observations is given. To conclude models are capable of attributing recent variations to anything is invalidated by this evidence since, by a statistically significant amount, the models clearly do not replicate the real world.With regard to the actual magnitude of warming, the average tropical lower troposphere (mid-troposphere) warming rate for 1979-2012 in 44 CMIP-5 rcp8.5 is +0.27 (+0.26) °C/decade (as mentioned in the Special Note above, output will be made available if requested). The observational average trends are +0.09 and +0.06 °C/decade respectively. My Figure 3 displays the time series of the models vs. observations for the tropical layer centered on the mid-troposphere but which includes the upper troposphere. Again these differences are even more significant than found for the global values, and they are of a metric (tropical tropospheric temperature) that is clearly a consequence in models of the enhanced greenhouse forcing – a signature metric if you will (see Douglass and Christy 2013 for update of Christy et al. 2010 statistical tests).So, the conclusion here is that reliance on climate model simulations (which are shown here and elsewhere to be significantly different than observations) over the past third of a century in the most fundamental response variable (temperature) is improper. The model results have been falsified in terms of the large-scale, main response variable. Therefore, by a simple examination of the evidence from (a) an appropriately large population of the U.S. climate and (b) by the falsification of climate model simulations, one can show that the first assertion (that climate is changing) is trivial and the second assertion (that humans are the primary cause of climate change) is incorrectly deduced. Under open and transparent cross-examination, the fundamental claim (human causation is "primarily" responsible for the change) on which the alarm and subsequent material of the entire NCA rests is statistically unsupportable.					
John	Christy	Report Finding Point 2: Some extreme weather and climate events have increased in recent decades, and there is new and stronger evidence that many of these increases are related to human activities.A parenthetical comment is needed here. I realize the authors of this assessment are to varying degrees wedded to the notion that the second statement of Point 1 is correct even though it has not been proven to be so. Since it is relatively easy to demonstrate that Point 1 is unsupportable by objective tests, it is no surprise that some authors then seek to selectively discover "evidence" that can be fashioned to support the assertions without a rigorous and critical eye on the methodologies applied (i.e. conformational bias). This is an unfortunate consequence of the manner by which authors are selected for such assessments (by the government with its own vested political interest) and by the process in which the lead authors are anointed with overwhelming "review authority", giving them the conflicted-position of judging comments contradictory to their own views. What could possibly go wrong? This is where the policymakers desperately need a sanctioned "red-team" of credentialed scientists who have a different view, one grounded in hard-core data analysis, regarding the potential dangers and the clearly-evident benefits resulting from greenhouse gas emissions. To continue, Point 2 is an assertion that rests on essentially little concrete evidence. "Some" events have increased. What does this mean – "most" have not increased? The time frame is further cherry-picked "in recent decades." What does that mean? (evidently, it means only 50 years as I read the sub-point finding – for Pete's sake, my own body is way older than that.) The evidence indicates that had the full length of the	1. Executive Summary		8	9	The authors of this report were selected by a federal advisory committee, not by the government. Although there are non-voting members of this advisory committee who are government employees, they are 15 of the 60 members. The evidence related to the content of these comments is contained in Ch 2, the Commonly Asked Questions Appendix, and the Climate Science Appendix. Significant detail has been added to the climate science chapter related to the connections between variability and trends, and there is a new section in the Context and Background section on this topic. The evidence that the authors depended

		time series of the extreme events been examined, there would be no significant changes (i.e. floods, droughts, tornadoes, hurricanes – for example, Fig. 2.23 is completely dishonest by starting ~1970 and ending ~2005, etc.), and that for others, even in the "recent decades" there has been no change.I shall repeat the statement that a sample size of 50 years is wholly inadequate to define changes in extremes. By their nature, extremes are rare, thus a short time series will obviously have a trend of one sign or the other. Think of it this way. With only 50 years of record and dealing with rare "extreme" events, simply by chance, half will have an upward trend and half a downward trend (though significance will likely be low for all.) So, one should have expected about half (i.e. "some") of the extreme metrics to have risen for natural reasons only. Or, look at it this way. The 20th century produced a set of record values for any specific metric of interest. Simply by statistical properties we should expect about half of those records to be broken in the 21st century (a good number should already have been broken by now - 2013). In other words, the climate realizations of the 20th century in no way encompass all possible solutions to the potential outcomes of a non-linear climate system. We should expect, therefore, extreme events, unseen in our currently-small population of events, simply out of the natural chaos of the climate system. Extreme events have happened, are happening and will continue to happen. A rigorous testing of the frequency and intensity of extremes will yield no alarm (see next).The inappropriate idea of cherry-picking short periods (i.e. order 50 years) for high and low temperature extremes was put to the test in my recent congressional testimony (un-rebutted) regarding the number of record high temperatures experienced in the central U.S. (AR, IL, IN, IA, KS, MO, NE, and OK) during the terrible drought of 2012. This testimony also exposed the disingenuousness of Meehl et al. 2009 (cited in the NCA many times) who conveniently began their time series after the heat waves of the 1930s. If the uninformed person were discussing the heat and dryness, but started the record only 50 years ago (i.e. 1962 or as Meehl et al. 2009 in 1951), then indeed 2012 was the worst (i.e. driest and hottest) in this region. However, by selecting stations with the longest period-of-record (at least 80 years) I demonstrated the folly of Meehl et al. showing that the number of record high temperatures in 2012 in these most-affected states was exceeded a number of times just since 1895. Thus 2012 was hot and dry in the central U.S., but not the worst and definitely not part of a trend. A similar study of west coast states (CA, OR and WA) indicated a noticeable lull in record high temperatures in recent decades. The basic idea of my comment here is that a careful and methodical look at extremes indicates the extremes that people really care about are not increasing, but still happening. Figure 2.18 which seeks to support Point 2 misinforms the reader because all it says is the number of low temperature records has gone down faster than the number of high temperature records which has also declined. This is a good example of creating a plot to confirm a bias. In my Figure 4 one can see why the data, when presented properly, do not support Point 2. The number of TMax records in the decade 2001-10 ranks only 7th out of the 11 decades examined, i.e. hottest days are not becoming more frequent. However, when convoluting the message by choosing the metric of "ratio" as in Fig. 2.18, the very low number of record cold TMins is clearly what is driving the last decade with its small denominator. The divergence between record hi TMax and record lo TMin is not a signature of the enhanced greenhouse effect. Indeed, TMin is measured largely in a decoupled, shallow nocturnal boundary layer and thus does not represent the deep layer of the atmosphere, where greenhouse forcing is detected, as well as TMax. This is an issue that has been largely unappreciated in the NCA. Minimum temperatures have clearly risen in the past 100 years (no argument there), and thus the number of low temperature records has decreased. Observational, theoretical and modeling studies however have demonstrated that changes in the surface and nocturnal boundary layer characteristics by human development will lead to warmer nighttime temperatures (e.g. Christy et al. 2009, McNider et al. 2012, and many others). Though not perfect, the daily maximum temperature is at least a better metric for capturing deep-layer atmospheric changes that may be related to enhanced greenhouse gas forcing. The use of minimum temperatures is therefore improper in attributing changes					on in reaching their conclusions can be found in Ch 2, the Commonly Asked Questions Appendix, and the Climate Science Appendix.

		to greenhouse forcing and should not be used in assessments of this type without clearly stating the science about why these minima are rising. Thus Fig. 2.18 says more about the character of the human-altered surface than of the deep atmospheric response to greenhouse gases and hides a more interesting and honest picture about what is changing and why. As such, a phrase extending the current Point 2 would be "… human activities such as surface development."It is also very irritating to the State Climatologist of Alabama when "evidence" turns out to be merely climate model projections regarding extreme events in his area of expertise and residence. I shall overlook here the fact that none of these climate models has been tested for veracity in an engineering sense (and thus very likely will be considered inadmissible in legal proceedings), but a simple comparison demonstrates the problem. The alarming plot of Fig 17.4 depends on climate model temperature output that at present (2013) is already well above the observed values – and thus (as with the global and tropical temperatures discussed in Point 1 above) should not be used as forecasted-evidence because the output fails simple statistical tests related to the ability to characterize low frequency behavior. The observed trend of maximum temperatures in Alabama is actually downward, and no climate model has simulated this basic character of our time series. For temperature projections, the models have been falsified in statistical tests. This fact should be stated and that any projections shown should be heavily cautioned and caveated. In summary, a complete check of the evidence of changes in extremes does not support the squishy claims of Point 2.					
John	Christy	Report Finding Point 3 Human-induced climate change is projected to continue and accelerate significantly if emissions of heat-trapping gases continue to increase.Point 3 relies entirely on the faith one has in climate model output. These models have been shown here and elsewhere to be inadequate for characterizing the real climate trajectory because they overwarm the atmosphere. Thus, this "Finding" is "true" in the "model world", but cannot be assumed for the real world. The statement would be truer and much more informative for the nation if it was stated as "Human-induced climate change is projected by models shown to be critically deficient in characterizing the current climate to continue and accelerate significantly if emissions of heat-trapping gases continue to increase." This is one way to be honest and transparent.	1. Executive Summary		8	16	The climate science chapter authors have based their conclusions on the weight of the evidence, which does not support the commenters' claims.
John	Christy	Report Finding Point 4 Impacts related to climate change are already evident in many sectors and are expected to become increasingly challenging across the nation throughout the century and beyond.This is a bait-and-switch type of statement. That climate change occurs and has impact on society is a trivial truth. Climate will always be changing and therefore will always be impacting society. We know that the negative impacts of weather have been significantly reduced in the past century (in the face of alleged human-induced climate change) in essentially every pertinent metric, i.e. food availability and harvests, longevity, economic output, loss of life to weather disasters, etc. The vague statement "to become increasingly challenging" is meaningless.Since the NCA purports to have a social dimension, there is a fundamental and fatal flaw in the impression given here and in other assertions made in the remaining points. Where is the information about the benefits to all of society that carbon-based energy has and will continue to provide? Without an exhaustive analysis of the benefits, this report (already one-sided and alarmist) ignores the basic reason for the emissions of CO2 and therefore cannot be considered a credible assessment of the total impact of greenhouse emissions. A fundamental question here is, "Why do we emit CO2?" Humans generate energy and emit CO2 because of the unquestioned and overwhelming benefits provided. Humans are not evil for doing so, they are actively reducing the effects of poverty, hunger, exposure, diseases, etc. by utilizing the almost miraculous characteristics of energy to fight these age-old enemies. Reduction of these human-killing effects is why carbon-based energy is sought and prized. This report is therefore appallingly incomplete without a direct assessment of the basic analysis of the profound benefits to human life, health and welfare that carbon-based energy provides the citizens of the U.S., i.e. answering the question, "What	1. Executive Summary		8	22	After considering all of the evidence, the authors have concluded that overall, the net effects of climate change on the US are negative.

		have we as a society gained through our CO2 emissions?" The answer includes a doubling of longevity, massive reduction in childhood mortality, enough food for everyone to afford, advances in medical care, etc. (not to mention an invigorated biosphere.) Quite remarkable when you think about it. Associated with this question is the other side, "What are the human consequences from increased energy prices?" If energy costs rise, so does the price of everything. Answers include restricted energy availability, degraded human health and welfare, higher food, shelter and transportation costs, and other profoundly negative results. It is almost obvious that the "increasing challenges" of human existence will arise from making energy less affordable and less available, not from climate change. This is a first-order issue to address if this report seeks to understand the human dimension.Since the remainder of the "Report Findings" assumes Point 1 is fact, there is no need to address the other points. My comments above regarding Points 1-4 are sufficient to treat the others as sub-points based on an ill-conceived assumption at the start. However, I will briefly address Table 1.1 for the Southeast.					
John	Christy	Table 1.1 Southeast Decreased water availability, exacerbated by population growth and land-use change, is causing increased competition for water; risks associated with extreme events like hurricanes are increasing.This statement is a classic case of trying to create the impression of alarm when there is nothing to say about climate change in the Southeast. The water provided by the climate of the SE is not decreasing and the number and intensity of hurricanes is not increasing. Thus, regarding the climate response to enhanced greenhouse gases, as the Table's title claims "Observations of Climate Change", there are no claims to be made. This statement merely says the population is growing and the normal impacts of that growth are being seen, (a) that water needs are increasing (though the SE consumes only about 2.5 percent of its available surface water while cities consume less water than forests) and (b) that more infrastructure is being built to get in the way of hurricanes. The Table's claim in the box says nothing about the Table's heading "Regional Observations of Climate Change." Had the box addressed the actual truth of the matter the "Observations of Climate Change" would simply say, "nothing seems to be changing outside of the variations seen in the past century." This is how to be honest and transparent.	1. Executive Summary	1.1	11		After consideration of this point, we still feel the existing text in the infographic is clear and accurate. Further evidence is available in the Climate Science and Southeast chapters.
John	Christy	This figure is extremely dishonest - beginning in ~1970 and ending ~2005. The entire time series shows no change in intensity or frequency of Atlantic hurricanes.	2. Our Changing Climate	2.23	61		The report is not making any claims that there is a detectable human influence on TCs. The graphs focus on the Atlantic and NE Pacific basin as those are basins most germane to the US National Climate Assessment. The data from about 1980 on are regarded as best quality for intensity, with data from about 1970 on also probably more reliable than that back to 1950. The reviewer is suggesting use of data for which the reliability is known to be less than for the years shown. Thus deciding on a start date here is a subjective decision depending on whether one wants to include longer (but less reliable) records. While this would be crucially important if a claim were being made as to a detection of an anthropogenic signal, we see no reason to change the figure along the

							lines suggested by the reviewer, since no claims of climate change detection are being made.
Donald	Albertson	Bees are very important for honey and pollination. According to recent issues of the Kiplinger Agriculture letter, last summer's widespread drought (1) reduced honey production raising honey prices and (2) reduced bee populations -- for example, bees needed to pollinate almonds during March 2013.	6. Agriculture				Thanks for the comments; however, there are no reports on the effect on the current bee population. Text is unchanged.
John	Christy	The following comments were also submitted in Chapter 1 under the "Finding" regarding increased extremes. I re-enter it here to make the point more strongly and to alert the readers to the way the figure should be presented (my Figure 4 submitted through the alternate, and cumbersome, process provided.)The inappropriate idea of cherry-picking short periods (i.e. order 50 years) for high and low temperature extremes was put to the test in my recent congressional testimony (un-rebutted) regarding the number of record high temperatures experienced in the central U.S. (AR, IL, IN, IA, KS, MO, NE, and OK) during the terrible drought of 2012. This testimony also exposed the disingenuousness of Meehl et al. 2009 (cited in the NCA many times) who conveniently began their time series after the heat waves of the 1930s. If the uninformed person were discussing the heat and dryness, but started the record only 50 years ago (i.e. 1962 or as Meehl et al. 2009 in 1951), then indeed 2012 was the worst (i.e. driest and hottest) in this region. However, by selecting stations with the longest period-of-record (at least 80 years) I demonstrated the folly of Meehl et al. showing that the number of record high temperatures in 2012 in these most-affected states was exceeded a number of times just since 1895. Thus 2012 was hot and dry in the central U.S., but not the worst and definitely not part of a trend. A similar study of west coast states (CA, OR and WA) indicated a noticeable lull in record high temperatures in recent decades. The basic idea of my comment here is that a careful and methodical look at extremes indicates the extremes that people really care about are not increasing, but still happening. Figure 2.18 which seeks to support Point 2 misinforms the reader because all it says is the number of low temperature records has gone down faster than the number of high temperature records which has also declined. This is a good example of creating a plot to confirm a bias. In my Figure 4 one can see why the data, when presented properly, do not support Point 2. The number of TMax records in the decade 2001-10 ranks only 7th out of the 11 decades examined, i.e. hottest days are not becoming more frequent. However, when convoluting the message by choosing the metric of "ratio" as in Fig. 2.18, the very low number of record cold TMins is clearly what is driving the last decade with its small denominator. The divergence between record hi TMax and record lo TMin is not a signature of the enhanced greenhouse effect. Indeed, TMin is measured largely in a decoupled, shallow nocturnal boundary layer and thus does not represent the deep layer of the atmosphere, where greenhouse forcing is detected, as well as TMax. This is an issue that has been largely unappreciated in the NCA. Minimum temperatures have clearly risen in the past 100 years (no argument there), and thus the number of low temperature records has decreased. Observational, theoretical and modeling studies however have demonstrated that changes in the surface and nocturnal boundary layer characteristics by human development will lead to warmer nighttime temperatures (e.g. Christy et al. 2009, McNider et al. 2012, and many others). Though not perfect, the daily maximum temperature is at least a better metric for capturing deep-layer atmospheric changes that may be related to enhanced greenhouse gas forcing. The use of minimum temperatures is therefore improper in attributing changes to greenhouse forcing and should not be used in assessments of this type without clearly stating the science about why these minima are rising. Thus Fig. 2.18 says more about the character of the human-altered surface than of the deep atmospheric response to greenhouse gases and hides a more interesting and honest picture about what is changing and why. As such, a phrase extending the current Point 2 would be "… human activities such as surface development."	2. Our Changing Climate	2.18	53		The figure has been removed due to space limitations. We do disagree with the reviewer. First of all, 50 years is not a short time period when we are examining the climate changes over the last century. Secondly, the temperature record only started around 1900 so early decades will of course be breaking many records. Nothing in the reviewer's comment takes away from the increase in heat records relative to cold records over the last 5 decades or that the decade of the 2000s had the highest ratio in U.S. recorded history. We have added discussion of the differences between daily and monthly record highs. While the daily record highs have not been increasing very much, the monthly record highs have been increasing and have reached levels comparable to the 1930s. We now cite the McNider et al paper and include the possible cause of boundary layer forcing due to changes in the near-surface atmosphere. However this does not explain why there is the difference between daily and monthly record highs. A probable contribution is from certain changes in the network, specifically the shift from pm to am observation times and the change to electronic instrumentation starting in the 1980s. For further discussion, please see the Appendix on Science of Climate Change, Supplemental Message 7.

District	Energy	Thank you for the opportunity to submit the comments on the draft 3rd National Climate Assessment report. These comments are submitted on behalf of the Board of Directors of the International District Energy Association (IDEA), a non-profit industry organization formed in the United States in 1909. Today, IDEA has over 1,700 members from 23 countries involved in the design, construction, operation and optimization of district energy and CHP (cogeneration) systems and microgrids. IDEA commends the report authors for assembling this latest comprehensive study that confirms the urgent need to address climate change. IDEA has compiled a few brief comments for your consideration, specifically focused on Chapters 4, 10 and 11.Essentially, our comments reflect our experience with an often-overlooked aspect of global energy usage - thermal energy. The International Energy Agency (IEA) has found that heat represents 37% of total final energy consumption in OECD countries and stated that heat is deserving of more attention in the energy debate. When deployed properly, district energy, combined heat and power (CHP) and microgrids can be effective mechanisms for achieving clean energy targets and deliver multiple benefits to a range of stakeholders, including improved fuel flexibility, grid reliability, energy security, environmental performance, cost savings, economic development and integration of innovative clean energy technologies. The National Climate Assessment report would benefit from additional consideration of the end-use energy spent on heating and cooling and the potential for local district thermal and electric energy production to provide considerable environmental and pollution reduction benefits. The studies that were reviewed for each chapter appear to represent a variety of publications and authorship. We appreciate the challenge in undertaking a comprehensive review of literature in such a widely discussed subject affecting so many critical issues; however, we believe that the authors would be well-served to consider additional data sets and reports on the topics of district energy, combined heat & power (CHP), industrial energy efficiency and integration of district energy into urban renewal opportunities. We submit these reports as representative references in support of the potential for industrial energy efficiency mechanisms to deliver significant emissions reductions as efforts – perhaps none more striking than the 2012 White House Executive Order 13624 calling for 40 GW of additional CHP capacity by 2020. We appreciate your consideration of our comments and once again offer our full support for your important work. Additional Resources:U.S. Department of Energy and Environmental Protection Agency. August 30, 2012. Combined Heat and Power: A Clean Energy Solution. http://www1.eere.energy.gov/manufacturing/distributedenergy/pdfs/chp_clean_energy_solution.pdf The White House. August 30, 2012. Executive Order 13624 - Accelerating Investment in Industrial Energy Efficiency. http://www.whitehouse.gov/the-press-office/2012/08/30/executive-order-accelerating-investment-industrial-energy-efficiencyThe Northeast-Midwest Institute. September 12, 2013. New Energy for Older Cities: District Energy, Combined Heat and Power, and the Northeast-Midwest Region's Older Industrial Cities. http://www.nemw.org/images/issues/ROC/NEMWI_DECHPCities%20Report%209.12.12.pdfAmerican Council for an Energy-Efficient Economy. 2012. Local Power: Lessons from Recent District Energy System Development. Prepared by A. Chittum for the American Council for an Energy-Efficient Economy Summer Study on Energy Efficiency in Buildings. http://www.aceee.org/files/proceedings/2012/data/papers/0193-000353.pdfState and Local Energy Efficiency Action Network. 2013. Guide to the Successful Implementation of State Combined Heat and Power Policies. Prepared by B. Hedman, A. Hampson, J. Rackley, E. Wong, ICF International; L. Schwartz and D. Lamont, Regulatory Assistance Project; T. Woolf, Synapse Energy Economics; J. Selecky, Brubaker & Associates. http://www1.eere.energy.gov/seeaction/pdfs/see_action_chp_policies_guide.pdf					We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include. Policy issues are beyond the defined scope of the National Climate Assessment, a scientific document that provides the basis for decision making, but does not address policy.
District	Energy	Chapter 4 does not contain a key message referencing the inefficiency of current US electricity	4. Energy				Thank you for your comment. The

		generation system or opportunities to improve the efficiency of it in order to extend the supply and reliability of energy. Additionally, there is not a key message related to the fact that diversifying the energy supply system is an option to mitigate supply disruptions. One could assume the report intends to include these points in the key message, but we believe that these items are deserving of explicit recognition. There is enough research to support a discrete message around the inefficiency of the current energy system and related opportunities to mitigate risk.There is very little mention of the potential for distributed generation in the chapter as a means to strengthen grid reliability and resiliency. There is an opportunity to increase awareness of the inherent efficiencies to be gained by greater consideration of thermal energy recovery and use in the report.	Supply and Use				charter and focus of the National Climate Assessment (NCA) Report is to identify the key challenges associated with the projected impacts of climate change and so the Key Messages in this chapter relate to the impacts. Improvements in energy efficiency, distribution and distributed generation are potential adaptation actions to build resiliency (as noted in Table 4.2).
District	Energy	Key message #2 resonates; for example, the Chair of the Metropolitan Council in Minneapolis-St. Paul recently discussed the increased demands on the metro region's aquifers and noted the potential impacts on that region: if droughts continue and demands on the river and aquifers increase, the impacts of declining water supply could lead to constraints in power production.Key message #3 lends itself to the additional discussion of community district energy systems. The report authors would do well to evaluate how local energy systems integrating district energy and/or combined heat and power (CHP) would reduce the impact on land use and water demands while still producing energy – and in fact, produce energy significantly more efficiently and with associated pollutant reductions. The focus of this section of the report leans to electricity production without a sound discussion regarding CHP and thermal energy opportunities to mitigate some of the demands of electric heating and cooling. The International Energy Agency has found that heat represents 37% of total final energy consumption in OECD countries and deserves "more attention…in the energy debate." (Reference – International Energy Agency. 2011. Cogeneration and Renewables: Solutions for a low-carbon energy future. http://www.iea.org/publications/freepublications/publication/CoGeneration_RenewablesSolutionsforaLowCarbonEnergyFuture.pdf)	10. Water, Energy, and Land use				We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include. Key Message #3 has been revised to incorporate more general discussion of adaptation.
District	Energy	This chapter focuses on related and resulting unintended consequences of infrastructure failures. With more diversified and distributed energy delivery systems, there does exist the opportunity to modify infrastructure and reduce supply interruptions and their resulting impacts on humans. The chapter focuses on worst-case scenarios but does not explore or report on opportunities for more distributed generation assets that can enhance energy resiliency. In light of recent extreme weather events and the frequent supply interruptions from severe storms, we recommend the following resources for consideration:American Council for an Energy-Efficient Economy. December 6, 2012. How CHP Stepped Up When the Power Went Out During Hurricane Sandy. A. Chittum. http://www.aceee.org/blog/2012/12/how-chp-stepped-when-power-went-out-dForbes. October 31, 2012. Lessons From Where The Lights Stayed On During Sandy. W. Pentland. http://www.forbes.com/sites/williampentland/2012/10/31/where-the-lights-stayed-on-during-hurricane-sandy/	11. Urban Systems, Infrastructure, and Vulnerability				We agree that distributed networks are a good source of enhancing resilience; the chapter is more focused on the adaptation process in urban areas, many of which rely on power grids from multiple sources.
D. Radford	Shanklin, MD, FRSM	Pages 348, 351, and 360 have descriptions of various effects of major climate change on human health through the medium of adverse effects on agriculture and other food sources, especially referent children, poor families, and elderly persons. Unaccountably omitted, I think, from this list of vulnerable subsets of humanity, are pregnant women. In my book, "Maternal nutrition and child health, [Charles C Thomas, Springfield, Ill., 2000" I make note of a coastal African country, The Gambia, which has to now experienced wide swings of wet and dry seasons, with substantial effects on pregnancy nutrition (pp. 151-158). This is the "canary-in-the-coal-mine" prototype of distress, very likely to be magnified substantially globally, as time goes on.Thank you. D. Radford Shanklin, M.D., FRSM, Emeritus professor of pathology and obstetrics-gynecology, University of Tennessee, Memphis.	9. Human Health		348	1	We appreciate the suggestion, and while the focus of the chapter and report are mainly on US impacts, pregnant women have also been identified among US' vulnerable populations. Balbus and Malina 2009 which is cited in the p.352 section on "Most Vulnerable at Most Risk" contains a discussion of these vulnerabilities, however because of

							space limitations, we cannot include a deeper treatment of several of the important topics provided in the citations.
Anne	Schrag	Please include the time period for North Dakota's increase in annual average temperature being the fastest in the contiguous U.S.	19. Great Plains		658	28	The text has been revised to incorporate this suggestion.
Anne	Schrag	For the statement regarding overwintering insect populations, can you include some information on how this might impact agriculture in the region?	19. Great Plains		660	7	Due to the size of the topic, and the page limit for the chapter, we focused on broad trends rather than delving too deeply or providing such a level of specificity.
Anne	Schrag	Delete "for" in "certain that for those"	19. Great Plains		660	13	The text in this paragraph has been revised and is now grammatically correct. Thanks for pointing out this error.
Anne	Schrag	For figures depicting predictions throughout the document, we have found that mid-century predictions are easier for the audience to 'digest' than end-of-century. Also, for a lay audience, it is sometimes easier to comprehend if all predictive maps are depicting the same time period. Thus, we would suggest swapping this figure for one that shows projected changes in the number of dry days by mid-century.	19. Great Plains		662	1	We thank the reviewer for the helpful suggestion, which has been incorporated into the maps for this chapter, which have been redrawn to reflect other comments.
Anne	Schrag	North Dakota is said to be the second largest producer of oil in the U.S., not just the Great Plains.	19. Great Plains		662	17	While the comment suggests a good specific example, the authors feel the existing examples are appropriate and adequate. We chose to keep the discussion limited to the Great Plains in order to highlight within-region variations.
Anne	Schrag	It would be appropriate here to also mention tile drainage of wetlands in the Northern Plains, due to agriculture.	19. Great Plains		666	17	We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include.
Anne	Schrag	We suggest you reference also:Schrag, A., Konrad, S., Miller, S., Walker, B. & Forrest, S. (2011). Climate-change impacts on sagebrush habitat and West Nile virus transmission risk and conservation implications for greater sage-grouse. GeoJournal 76(5): 561-575.This paper deals more directly with climate change impacts to greater sage-grouse in the region referenced in Figure 19.5, and provides information about West Nile virus, which is also tied to energy development and should be mentioned in this section.	19. Great Plains		666	32	We have added the suggested citations in our chapter assessment.
Anne	Schrag	The Hopi and Navajo lands of northern NM are referenced in the caption, but NM is not included in the maps in Figure 19.7.	19. Great Plains		670	4	We thank the reviewer for the helpful suggestion, which has been incorporated into the figure.
P	Getty	Wisdom comes suddenly. The billions of galaxies in the Universe do not care if we destroy ourselves - it is not significant.	Introduction: Letter to				Thanks for your comments.

		Awareness, consciousness, and motivation to evolve from ignorance takes time - normally generations. So I say, Welcome the Crisis of global climate change, it is the only way that the unconscious will wake up. Still, out of the audacity of hope, send this report to every politician and voice your concern.Repower America developed a scientific based study that concluded the US can transform to nearly all renewable electricity generation in as few as 10 years! http://climaterealityproject.org/Paul M Getty, PE Getty Engineering Services, Inc.	the American People				
Christopher	Miller	The Working Group I report for AR5 is scheduled for completion in September, 2013, although the full Synthesis Report will not be completed until later, in 2014. Is there an opportunity for the Assessment Report to benefit from the updated information from, at least, the WGI report, particularly if there is an expectation of new information that adds to our knowledge base and/or information that differs significantly from previous results and understanding? If this opportunity does not exist, will there be a timely update of the Assessment Report after it is published, in line with the sustained assessment paradigm?					Many of the participants in the NCA process are also involved with the IPCC process and are aware of the WG1 schedule. While the Third NCA Report will not be updated per se, the sustained assessment process and the availability of the report information online will enable timely updates as needed prior to the next quadrennial assessment report.
H	WITTE	Executive Summary Page 12, Figure 1.2This figure is rather difficult to decipher on first glance. If an "executive summary" is designed to give an overview of the science, as opposed to detailed science, perhaps this figure would be better placed later in the report. Graphs and figures are in general meant to be what Daniel Kahneman and Edward Tufte would call System1 or Fast Thinking devices. This particular figure is a System II, or Slow Thinking translation of the text. The figure within a figure is not intuitive. I doubt there are very many policy folks who would take the time to try to decipher this message about sea level rise. They'll just skip over it saying it is too complicated. Perhaps remove the smaller graphic (1990-2015) and make it a separate graphic. Gray-colored area is not intuitive: is the gray the past from 2000 thus the "observed"? or the "future"; but it is already 2013? Cognitive multimedia theorist R. Mayer would posit that one could make this simpler, and therefore easier to understand by removing the legend and actually labeling each of the lines (red, blue, green) with text along the line itself. Perhaps place this figure in the appendix: Climate Science?	1. Executive Summary	1.2	21		Good points - Changes to the sea level rise graphic have been made to simplify it.
H	WITTE	Page 36, Figure 2.6This is a very interesting set of figures: but hard to read since the 10 small figures	2. Our	2.6	36		The report will be published as an

		are so tiny. Since many readers will zero in on their particular local region perhaps it is worth a second full page for the 10 individual area plots?	Changing Climate				interactive pdf document. This will have a feature that one can click on a particular graph and it will provide a link to a version with better visibility.
H	WITTE	Page 40, figure 2.9 Observed Changes in Frost-Free Season.Foveal vision theory and cognitive multimedia learning posit that a legend is a confounding tool and many times can be avoided.Make this a faster reading graphic by placing the word "days" with the individual numbers on the map: +10 days, +9 days, +18 days, and removing the legend and placing a subtitle of "Increases in Annual Number of Days" as a subtitle.Help speedy comprehension by taking information on the 3rd line of the caption: "1991-2011 relative to 1901-1960" and placing as a subtitle to "Observed Changes in Frost-Free Season"	2. Our Changing Climate	2.9	40		In our opinion, the suggested changes would clutter the presentation by adding more text to the titles and sub-titles. All of the necessary information is in the caption and we think that the form of the graphic is effective and also consistent in style with the rest of the graphics in the report. The authors have deliberated and decided to make no changes.
H	WITTE	Very interesting graphics, but the individual graphic plots are SO tiny. Maybe insert separate full page with just these graphs so that people can see their particular local zone?	2. Our Changing Climate	2.11	42		The report will be published as an interactive pdf document. This will have a feature that one can click on a particular graph and it will provide a link to a version with better visibility.
H	WITTE	Tiny tiny graphical plots on a large map. Perhaps switch the perspective ... a smaller, separate US map (which is very intuitive for readers) and larger individual plots of the 10 graphs which show the important local regional details?	2. Our Changing Climate	2.15	49		The report will be published as an interactive pdf document. This will have a feature that one can click on a particular graph and it will provide a link to a version with better visibility.
H	WITTE	"Ratio" of Record Daily High to Record Daily Low Temperatures. How intuitive is "ratio" to the layman (or congressional staffer)? Ratio is what Daniel Kahneman would call a System II word for the majority of Americans; they have to slow down and think. How fast is the answer of 2x4=? (system I), vs. 17x24 (system II)?Surely there is more intuitive way to say that in the past ten years there were twice as many record highs as record lows. Such a trend indicates a warming trend. This graph takes a lot more mental effort to figure out than is really necessary for the message. It is getting warmer and therefore we would expect more record highs than lows. Scale: What is 1? What does < 1 mean? What about >1? Challenging to the lay reader?The colors red and blue for warmer and colder could be used to show relative number of records with a sightly different design.	2. Our Changing Climate	2.18	53		The figure has been removed due to space limitations. The supporting text for the Key Message now discusses the numbers of record high and low temperatures, rather than the ratio.
H	WITTE	Global Sea Level Rise: (same graphic as on page 12, figure 2.1) This figure is rather difficult to decipher. Perhaps this figure would be better placed later in the report.	2. Our Changing Climate	2.26	65		This figure has been simplified by removing the inset, changing the grey region and labeling the curves as suggested

		Graphs and figures are in general meant to be what Daniel Kahneman and Edward Tufte would call System1 or Fast Thinking devices. This particular figure is a System II, or Slow Thinking translation of the text. The figure within a figure is not intuitive. I doubt there are very many policy folks who would take the time to try to decipher this message about sea level rise. They'll just skip over it saying it is too complicated ("science is too complicated"). Perhaps remove the smaller graphic (1990-2015) and make it a separate graphic. Gray-colored areas are not intuitive: is the gray the past from 2000 thus the "observed"? or the "future"; but it is already 2013? Then there is gray on top of gray. Cognitive multimedia theorist R. Mayer would posit that one could make this simpler, and therefore easier to understand by 1. making this two graphs 2. removing the legend and actually labeling each of the lines (red, blue, green) with text along the line itself. Perhaps place this figure in the appendix: Climate Science?					
H	WITTE	Arctic Sea Ice DeclineZoom in on the area of interest.	2. Our Changing Climate	2.28	67		This figure and accompanying discussion address the pan-Arctic ice extent, so there is no particular area to zoom in on. (The discussion of the Bering Sea in the following paragraph is for winter; Figure 2.28 is for the summer ice minimum in September.
H	WITTE	The plot for CO2 is unnecessarily "messy-looking: Why not just plot the ANNUAL average CO2 level?	2. Our Changing Climate	2.30	70		The figure has been redrawn and updated.
H	WITTE	Indicators of WarmingVery interesting plots. Why not make it easier to read by utilizing the whole page?	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z	3	1061		The figure has been redrawn and fills as much of the page as possible.
H	WITTE	Ten Indicators of A Warming World If this section is a FAQ section perhaps add under the descriptive	Appendix	2	1059		The magnitude of the change is not

		label for each indicator a descriptive phrase?Water Vapor (increased by 4%)Sea Level (increase of 8" since 1880)	: NCA Climate Science - Addressing Commonly Asked Questions from A to Z				important in the CAQ section. A reference to Figure 3 for some of this info is provided. If the reader wants more detail, they can find it in the science chapter and appendix as well as in other documents.
Charles	Carlson	As a small woodland landowner (10 acres) I strongly endorse Key Message #4 and its call for improved information for forest managers on the implications of climate change. In my home region (Southern Oregon) our local Extension Service has already started outreach to help us make wiser choices about replanting and forest management. Replanting with existing species may no longer be a wise choice for forests that have an economic life of 40 to 100 years.	7. Forestry		282		We greatly appreciate your positive comment.
H	WITTE	"blue whales"?.... not sure how appropriate this comparison is as I have not seen any blue whales in the sky lately and not sure what billions of whales would look like. Would a volumetric comparison be helpful here? Would it help to describe that the global warming gases in the atmosphere are the reason why that at the surface of the earth the heat energy from atmosphere is twice that of the sun. So small changes in the CO2 composition can bring significant heat energy changes.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1072	12	The text has been revised and the mention of blue whales eliminated.
H	WITTE	Human influence on the Greenhouse EffectVisual and graphical learning theories posit that the simpler the better. Global warming is about the radiative heat energy from the changing atmosphere. This particular graphic confuses more than clarifies. The caption is wrong: "LEFT: ...heat-trapping gases normally trap some of the Sun's heat, keeping the planet inhabitable..." WRONG: The atmosphere is generally transparent to the sun's energy. The heat-trapping gases trap the heat energy FROM THE EARTH. The scale of the atmosphere is WAY out of proportion in this diagram. The implication is that the atmosphere is a HUGE, DEEP dumping ground for man's pollution. In reality it is effectively < 10 miles thin. Where is the indication of man-made GWG wafting up into the atmosphere? If the message is about HUMANS then the sun doesn't really need to be emphasized as it is here. Why does the earth re-radiate heat? This cartoon is misleading and does not add to effective learning of the global warming principles.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z	11	1073		The graphics have been redrawn and the caption revised.
Charles	Carlson	Is there a way for this chapter to more clearly recognize the spectrum of "decision makers" that are already making commitments whose time scale is long enough to make climate change a relevant consideration? The lead example in Chapter 26 deals with planning for a public water system, unarguably a relevant decision maker. However, there are many smaller enterprises and individuals that would benefit from an awareness of climate change. Here are a few:- A farmer or orchardist making land improvement or planting choices	26. Decision Support: Supporting Policy, Planning, and				The chapter now includes a summary table and several examples of decisions and decision makers working at various scales. The discussion of boundary processes and science translators has been expanded.

		- A home builder deciding where to build, and what to build in coastal areas - A lender or insurer deciding whether to lend, and on what terms - Any business acquiring assets (land, other businesses, technology) that has an outlook of more than a few yearsThe recommendation for "science translators" is appropriate and could use some sharpening to specify professional specialties that would be appropriate to reach out to, e.g., civil engineers, insurance organizations.	Resource Management Decisions in a Climate Change Context				
H	WITTE	Perhaps the implied "strength" of the solar signal on this graphic is a bit over done.Just the scale of the solar flux in this diagram implies a much more powerful effect than reality.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z	12	1075		We have redone this figure and provided additional explanation in the caption. We thank the reviewer for the ideas.
Cassarah	Brown	This is an interesting graph and is clear. However, the term "cooling degree day" feels jargon-y and may be hard to keep track of.	4. Energy Supply and Use	4.2	170		"Cooling degree day" is the technically accurate description of the indicator metric. The term is defined in the caption.
Cassarah	Brown	It seems odd to define "cooling degree days" in the previous figure when it is first used here. At the very least, it should be redefined here.I would like to see a definition of "high" and "low" emissions. Who sets these definitions?	4. Energy Supply and Use	4.3	171		"Cooling degree day" is defined in the Figure 4.2 Caption when it is first used in the chapter. The term is used subsequently in several places in the chapter. Emission scenarios are described in detail in Chapter 2: Our Changing Climate.
Cassarah	Brown	Is there another way to show this data? It is a dense graph. It is hard to take in and interpret. There also isn't a number to use to make sense of the percentage increases and decreases of cooling and heating degree days.	4. Energy Supply and Use	4.1	173		The National Climate Assessment's page length limitations and the charter to present regional-level information led the authors to produce a relatively dense chart.
Cassarah	Brown	This is a very clear graph.	4. Energy Supply and Use	4.3	175		Thank you for the accolade.
Cassarah	Brown	What is a "100-year flood"? A note in the caption explaining how much energy is produced by a certain size facility (in terms of energy consumed by the average American, perhaps) will give this graph deeper meaning and effectiveness.	4. Energy Supply and Use	4.5	177		A "100-yr flood" is standardly defined as a flood event that has a 1% probability of occurring in any given year. It can be easily found on internet information sites. Given the variety of power plant technologies and sizes, the authors have not attempted to state how many homes are powered

							by a "typical" power plant.
Cassarah	Brown	This is a remarkably dense table. It would be great to find a way to present it that was easier to interpret.	4. Energy Supply and Use	4.3	181		We have removed two columns from the table. This change addresses this comment.
Cassarah	Brown	If the audience is the general public, then the authors may want to define energy systems and energy infrastructure.	4. Energy Supply and Use		167	25	The targeted audience for this chapter is broad and encompasses Energy Sector Experts and the general public. The National Climate Assessment's page length limitations required the authors to strike a balance in deciding which industry terms to define. It is assumed that the reader will access the internet or references for definitions and in-depth studies.
Cassarah	Brown	This language feels roundabout and may confuse the lay person.	4. Energy Supply and Use		167	30	The sentence has been revised to focus on energy use in the summer season.
Cassarah	Brown	This feels lacking in substance - perhaps adding a more concrete example will set up a more convincing argument.	4. Energy Supply and Use		167	34	This concept is expanded and supported in the body of the chapter. The introductory section and this sentence provide an overview of topics discussed in the chapter itself.
Cassarah	Brown	Once again, this has a vague feel to it and is unlikely to "grab" the reader's attention. "Other factors" could be just about anything and may hurt any arguments about the impacts of industrialization and population growth	4. Energy Supply and Use		167	37	After consideration of this point, we have decided to leave the text as is. "Other factors" are expanded and discussed in the body of the chapter. The introductory section and this sentence provide an overview of topics discussed in the chapter itself.
Cassarah	Brown	Adaptation should either be defined or this could be hot-linked to the "adaptation" chapter.	4. Energy Supply and Use		168	1	Thank you for your suggestion. We have added a link to Chapter 28: Adaptation.
Cassarah	Brown	"Extreme weather" should be defined in the first paragraph.	4. Energy Supply and Use		168	11	"Extreme weather" is defined in the following paragraph via a link to Chapter 2: Our Changing Climate.
Cassarah	Brown	This invalidates/weakens comments about extreme weather. If a term cannot be defined, then it should not be used.	4. Energy Supply and Use		168	21	We have changed "some" to "various".
Cassarah	Brown	It is unclear to me what "billion dollar weather events" are.	4. Energy Supply and Use		168	31	We have deleted this term and reworded the text to clarify the meaning of billion dollar weather events.
Cassarah	Brown	This is a very confusing sentence. I know what the authors are trying to say, but I don't feel like they have really highlighted interdependencies.	4. Energy Supply and Use		168	38	We agree with your suggestion and have reworded the text.

Cassarah	Brown	Again, who projects it? What models/experts are saying this?	4. Energy Supply and Use		169	7	Due to the National Climate Assessment's page length limitations, it is not possible to include the details of the models or model ownership. It assumed that interested readers will refer to the studies referenced for the details on the models (with the study cited directly in the same sentence).
Cassarah	Brown	What are extreme surge events?	4. Energy Supply and Use		169	8	We refer you to Chapter 24 – Ocean and Marine Resources and Chapter 25 – Coastal Zone Development for a discussion of extreme surge events.
Cassarah	Brown	The rate of temperature change meaning the average yearly temperature compared to other years? The minimum and maximum yearly temperatures across years?	4. Energy Supply and Use		170	21	The sentence refers to average temperatures. We have changed the text to make this clarification.
Cassarah	Brown	I think the caption should note why certain regions are assumed neutral. Why assume warmer winters in Alaska and warmer summers in the Pacific Islands and not model them? This should be explained.	4. Energy Supply and Use		173	4	The original modeling work did not include Alaska and the Pacific Islands due to small population counts. We have changed the Table to show regions that were not studied.
Cassarah	Brown	This sentence structure is hard to follow.	4. Energy Supply and Use		174	23	We have expanded the sentence. Documentation of references cannot be avoided.
Cassarah	Brown	It would be nice to connect these precipitation changes directly to energy supply. How will the decrease affect the south's energy infrastructure? And the areas with increased precipitation? Maybe they could hotlink to regional chapters.	4. Energy Supply and Use		174	26	The link between water availability and energy production has been made on the local level, but it is not possible to credibly draw a general conclusion on precipitation beyond what has been stated in this chapter.
Cassarah	Brown	This sentence feels out of place. It might flow better to move it down a paragraph, or to move it into the next paragraph and move that entire paragraph up.	4. Energy Supply and Use		175	17	Thank you for your suggestion. We revised the text.
Donald	Watson	I recommend and urge your consideration to adjust wording of a sentence in Chapter 1-Executive Summary, line 34, Page 8 "Draft for Public Comment." The sentence currently reads:"5. Climate change threatens human health and well-being in many ways,...etc." I recommend that the sentence be amended and augmented to insert the term "pubic safety," so that the sentence may read:"5. Climate change threatens human health, public safety, and well-being in many ways,...etc." This change will make it make very explicit that climate change impacts, including natural disasters, directly threaten public safety, and further, the term "public safety" relates directly to the legal, ethical and professional responsibilities that define the standard of care in decision making, projects and actions required to preserve, protect, and provide for health, safety and welfare.These specific terms are widely used in the U.S. State and local statutes in defining professional qualifications and certifications of professional engineers, architects, planners, in their responsibilities that qualify for licensure. Explicitly stating all three terms in the NCA is needed to make these lines of responsibility clearly defined in all public documentation and notices.Thank you	1. Executive Summary		8	34	The authors chose not to make the suggested change, but they do agree that there is a strong relationship with public safety..

		for considering this recommendation.Donald Watson, FAIA, NCARB Trumbull CT 06611 (203) 459-0332					
Cassarah	Brown	The authors may be able to link to other chapters here if readers want more information.	4. Energy Supply and Use		176	26	Two links are provided to Chapter 2: Our Changing Climate. This is the chapter that provides the details of the projections of sea level rise.
Cassarah	Brown	This is a very roundabout sentence.	4. Energy Supply and Use		180	12	After consideration of this point, we have decided to leave the text as is. Certainty in future energy systems is not linear and it is difficult to describe it in linear terms.
Cassarah	Brown	This phrasing is difficult to follow.	4. Energy Supply and Use		180	18	After consideration of this point, we have decided to leave the text as is. Certainty in future energy systems is not linear and it is difficult to describe it in linear terms.
Cassarah	Brown	Perhaps the authors can hotlink to the decision making chapter?	4. Energy Supply and Use		183	9	Thank you for your suggestion. We added a link to Chapter 26: Decision Support.
Max	Neale	This chapter covers the topic of ecosystems, biodiversity, and ecosystem services well. It provides a solid summary of key important areas of concern, potential impacts, and is generally effective at relating the ecological effects back to human interests. I believe the chapter's greatest weakness lies not in its content, but in the completeness and cogency of its writing. The authors are clearly experts in their fields, which creates meaningful content. However, the clarity of the examples and of the writing in general could be enhanced significantly to make it easier for those less familiar with the topic to understand the subject matter. I have two main critiques:(1) Being more explicit with examples and facts would benefit the chapter. There are numerous instances where information is presented incompletely. For example, the chapter may mention the impact of an X foot sea level rise on coastal ecosystems but it may not detail when that rise is projected to occur. My detailed comments highlight when the text could be more explicit. (2) The chapter is largely devoid of transitions and conclusions. I found that it jumped around from one topic to another without warning the reader. For example, it may discuss the impact of climate change on birds and then, in the next sentence, same paragraph, skip to impacts on fish without a transition. Adding text such as, "Another example of how increased temperatures affects biotic communities is…" would make the chapter easier to read and smoother overall.Similarly, adding conclusions to paragraphs would also increase the cogency of the chapter. I found that many sections or paragraphs that discuss examples end abruptly, leaving the reader pondering the possible implications for what was discussed. Wrapping things up before moving on would lead to greater understanding and make the chapter easier and more pleasurable to read. An example of this is after the introductory section on ecosystem services and before the Water section (page 292, line 14). The introduction ends abruptly without summation and the reader is thrust forward into the "Water" section. Also, on a general note, the titles for sections, such as Water, are rather vague. More detailed titles or subtitles would help to inform the reader where the chapter is headed. The 30 examples of biological responses convey the fact that climate change has numerous	8. Ecosystems, Biodiversity, and Ecosystem Services				We feel that chapter edits made in response to the many review comments that we received address the issues raised by this reviewer.

		and varied impacts, but this extensive list is overwhelming. I don't believe the target audience will read them all. Fewer examples might be more understandable and more effective- using only 10 could highlight the key changes.Figure 8.1 is very effective at illustrating how climate change impacts water availability. Figure 8.2 and its caption clearly describe the effects of extreme weather events. It is placed above the Extreme Events section, however. Moving it into or immediately after that section would be more effective, such as to page 296, between lines 14 and 15.Overall, I left the chapter with the message that climate change is and will continue to have dramatic impacts on natural systems, and that adaptive, forward-thinking management may help to lessen the severity of changing ecology.					
Max	Neale	Climate change impacts on ecosystems reduce their ability to improve water quality and regulate water flows. "The sentence refers to terrestrial "ecosystems" but does not explicitly state this. I suggest adding "terrestrial" or a similar word to guide readers to the fact that this key message refers to land based ecosystems.	8. Ecosystems, Biodiversity, and Ecosystem Services		291	14	No change. The finding also refers to aquatic ecosystems and functions such as in stream removal of nitrogen.
Max	Neale	"Ecosystem services translate into jobs, economic growth, health, and human well-being.""translate in" could be more effective if it were more direct. I suggest "create" or "contribute to." This is particularly important because this sentence's message is a critical component of the NCA –climate impacts can negatively affect humans--. I'm also unclear why this sentence stands alone. It might work to move it up to the bottom of the preceding paragraph.	8. Ecosystems, Biodiversity, and Ecosystem Services		291	39	Changed to "contribute" as suggested.
Max	Neale	"Ecosystem perturbations driven by climate change have direct human impacts, including reduced water supply and quality, the loss of iconic species and landscapes, distorted rhythms of nature, and the potential for extreme events to overcome the regulating services of ecosystems."What are the "rhythms of nature"? It is unclear what this refers to. And, importantly, are distorted rhythms bad or uncommon? Have they been distorted in the past? I don't believe these three words positively contribute to the chapter.	8. Ecosystems, Biodiversity, and Ecosystem Services		292	4	No change. "Rhythms of nature" is discussed fully in subsequent sections of this chapter.
Max	Neale	"weather" should be added before "events" to be more specific	8. Ecosystems, Biodiversity, and Ecosystem Services		292	5	No change. Extreme events are not just weather, e.g., big fires.
Max	Neale	The Water jumps from the general introduction to the Water section without a transition.	8. Ecosystems, Biodiversity, and Ecosyste		292		Thank you for the suggestion. The text has been revised to incorporate this perspective.

			m Services				
Max	Neale	“and even more difficult to say how people will be affected by the loss of a favorite fishing spot or a wildflower that no longer blooms in the spring.”I like the fishing spot reference but found the flower reference to be less effective. This could be a more vivid if it explicitly said what happened to the flower. When I first read it I thought: does it now bloom in the summer? Or maybe it blooms in late winter? I suggest something like, “the loss of… a wildflower that no longer blooms in the region.” Describing the cause of the loss(es) might also add poignancy.	8. Ecosystems, Biodiversity, and Ecosystem Services		292	10	Thank you for your suggestion. Edits have been made to improve clarity.
Max	Neale	“the equivalent of more than 40% of renewable supplies of freshwater in more than 25% of all watersheds”It is somewhat unclear where these watersheds are. I suggest being explicit: “…25% of all U.S. watersheds.”	8. Ecosystems, Biodiversity, and Ecosystem Services		292	23	Changed as suggested.
Max	Neale	“the A2 scenario used in this report”It would be useful to list the page number where one could find an overview of the A2 scenario.	8. Ecosystems, Biodiversity, and Ecosystem Services		292	32	Reference to Executive Summary and Chapter 2 has been added.
Max	Neale	“Currently, many U.S. lakes and rivers are polluted”How many? What share of total lakes? This is vague.	8. Ecosystems, Biodiversity, and Ecosystem Services		292	38	No change. We give specific examples of places where these problems were reported and state that "the majority" of U.S. estuaries are affected.
Max	Neale	“The Mississippi basin is yielding an additional 32 million acre-feet of water each year – equivalent to four Hudson Rivers – laden with materials washed from its farmlands.”The additional amount is an increase over what? The average over a certain time period? Or something different? This was unclear to me.	8. Ecosystems, Biodiversity, and Ecosystem Services		293	1	This has been corrected to state "over the past 50 years" and a citation (Raymond et al. 2008) has been added.
Max	Neale	“Links between discharge and sediment transport”What type of discharge? Does this refer to the additional discharge of water, or nutrients, or something else?	8. Ecosystems, Biodivers		293	6	No change. The links between precipitation and river discharge are discussed in the previous paragraph.

			ity, and Ecosyste m Services				
Max	Neale	This is the first time “dissolved organic carbon” is mentioned in the chapter. Later DOC is used. It would be useful to list the abbreviation here.	8. Ecosyste ms, Biodivers ity, and Ecosyste m Services		293	17	Changed as suggested.
Max	Neale	The word “future” is unnecessary in this line because it is implied by the use of “projected” earlier in the sentence.	8. Ecosyste ms, Biodivers ity, and Ecosyste m Services		293	30	Changed as suggested.
Max	Neale	“One of the few future projections available suggests”I want to know the projection is. Could it be referenced? Also on this line, it is unclear what “CO2” is. Explicitly saying “atmospheric concentration add clarity and prevent one from confusing it with emissions from a particular sector, or something else.	8. Ecosyste ms, Biodivers ity, and Ecosyste m Services		293	34	A reference is provided for this projection in the next sentence. In addition, “atmospheric” added.
Max	Neale	“Some large lakes, including the Great Lakes, are warming at rates faster than the world’s oceans (Verburg and Hecky 2009) and the regions surrounding them”Is it surprising that lakes warm faster than oceans? This info is presented as if it is novel. I am unclear whether second part of the sentence “and the regions surrounding them” refer to the lakes or to the oceans.	8. Ecosyste ms, Biodivers ity, and Ecosyste m Services		294	4	We have deleted the comparison between lakes and the ocean.
Max	Neale	Figure 8.2 “The Aftermath of Hurricanes” precedes the section on extreme events. I suggest moving it later to fit with that section, such as to page 296, between lines 14 and 15.	8. Ecosyste ms, Biodivers ity, and Ecosyste m Services		294	7	No change. The figure emphasizes the links between precipitation, discharge and nutrient loading to coastal waters, which is a central theme of this section.
Max	Neale	Does the $2.2 billion cost estimate include economics impacts to the Gulf from hypoxia? This section jumps around from oceans to freshwater ecosystem in a fashion that makes it unclear what this	8. Ecosyste		294	9	No change. The sentence clearly refers to freshwater degradation. The Gulf is

		specific estimate refers to.	ms, Biodiversity, and Ecosystem Services				not freshwater.
Max	Neale	Where they are lost to inundation, the consequences would be profound."Note the typo- "are" should be deleted. Also, what exactly would the impact of reduced wetland buffers? Does the literature offer any insights or cost estimates? The subsequent example of sea level rise in NYC is not sufficiently related, in my opinion.	8. Ecosystems, Biodiversity, and Ecosystem Services		296	7	This sentence has been deleted.
Max	Neale	There are dramatic wildfire examples from 2012. The total acres burned and total economic impact might be larger than in 2011? If so, it would be nice to update this section with more recent information.	8. Ecosystems, Biodiversity, and Ecosystem Services		294	19	The report does not cover the 2012 fire season.
Max	Neale	"For example, the average time between fires in the Yellowstone National Park ecosystem is projected to decrease from 100 to 300 years to less than 30 years."This sentence could be clearer: the range could shift or the average could shift?? And, also important, when is this shift projected to occur?	8. Ecosystems, Biodiversity, and Ecosystem Services		294	30	The sentence has been edited to clarify its meaning.
Max	Neale	This whole paragraph seems rather disjointed. It jumps around from one example to another without smooth transitions between examples. The concluding sentence is very powerful and effectively communicates a key message, that extreme weather events have significant negative impacts.	8. Ecosystems, Biodiversity, and Ecosystem Services		294	24	The importance of large fires is discussed above. Here we discuss "novel" fires that have the potential to greatly alter species composition.
Max	Neale	This paragraph ends without a conclusion. How about adding something poignant about the implications to climactic forcing/ biome switching. I found that I wanted a summary sentence that described why these examples were relevant or important.	8. Ecosystems, Biodiversity, and Ecosystem Services		297	8	No change. The focus of this section is on changes in plants and animals. We don't want to add in other topics.

Max	Neale	What are the ecological and economic implications of changes in fish habitat – moving to deeper, colder waters? This paragraph ends without a conclusion of the impacts of the examples discussed.	8. Ecosystems, Biodiversity, and Ecosystem Services		297	26	No change. We do not have space to discuss the ecological and economic implications of fish moving to deeper, colder waters. Our focus here is on just what is shifting.
Max	Neale	“Warming is likely to increase the ranges of several invasive plant species in the U.S.” Here, the word “several” seems like a drastic understatement. Will warming not increase the range of the majority of invasive plant species?	8. Ecosystems, Biodiversity, and Ecosystem Services		297	27	No change. We have no evidence to support a statement saying that "the majority of invasive plant species" will increase their range.
Max	Neale	Add a citation after “American West.”	8. Ecosystems, Biodiversity, and Ecosystem Services		297	40	Changed as suggested.
Max	Neale	What are the impacts of bark beetles? The text mentions that their populations will increase but doesn’t mention the possible effects of this. A conclusion for this section would also add value.	8. Ecosystems, Biodiversity, and Ecosystem Services		298	3	No change. The sentence states that these bettles are "killing stands of temperature and boreal confier forest . . . "
Max	Neale	This paragraph jumps around between topics without clear transitions. At the end of it, lines 32 and 33, it could be useful to see a transition between nutrient leaching caused by a longer spring season and the next sentence on exacerbating human allergies.	8. Ecosystems, Biodiversity, and Ecosystem Services		298	25	We have added "also" to the second to last sentence to ease the transition.
Max	Neale	Add a transition between the examples of birds and fish. Currently it jumps from one to the other without telling the reader.	8. Ecosystems, Biodiversity, and Ecosyste		298	41	A paragraph break has been inserted.

			m Services				
Max	Neale	I found this section's title "Adaptation" to be uncear. Who or what is adapting? Perhaps a more detailed title would prepare the reader for the topic ahead.	8. Ecosystems, Biodiversity, and Ecosystem Services		299	5	No change. The terms are defined in the Introductory paragraph that immediately follows the title.
Max	Neale	Wildlife corridors that solve what problem or address what issue? The reader is left hanging, waiting for an example of what this adaptation measure addresses.	8. Ecosystems, Biodiversity, and Ecosystem Services		299	25	The text has been edited to clarify that wildlife corridors are used to connect fragments of wildlife habitat.
Max	Neale	"alternative approaches" to adaptation? Or to ecosystem based management?	8. Ecosystems, Biodiversity, and Ecosystem Services		300	13	"alternative" has been changed to "additional"
Max	Neale	"Higher temperatures, reduced snowpack, and earlier onset of springtime are leading to increases in wildfire in the western U.S. (Westerling et al. 2006), while extreme droughts are becoming more frequent…"The latter part of this sentence feels disconnected, like a fragment. Can the extreme drought portion be incorporated into one sentence that addresses all of the topics?	8. Ecosystems, Biodiversity, and Ecosystem Services		301	11	No change. The extreme droughts are listed as a separate important component of climate change.
Max	Neale	Why have mussels and barnacles declined? All of the other biological response examples discussed what motivated the response. Mention this here, too.	8. Ecosystems, Biodiversity, and Ecosystem Services		302	8	Added additional information to Box text on climate driver causing this change.
Max	Neale	Mention the timeline for the sea level rise in Hawaii. By what year are these changes expected to occur?	8. Ecosystems, Biodivers		305	7	Projection year has been added to box text.

			ity, and Ecosystem Services				
Gene	Fry	The Report is an excellent compilation. It substantially advances the standard set by the 2009 interagency report “Global Climate Change Impacts in the United States”, as well as many other reports. It includes a refined estimate of temperature rise, graphs of projected sea level rise and extreme drought, and many other features. Temperature rise projected over the next few decades and to 2100 seems reasonable, as do most projected consequences of those temperatures. However, the draft National Climate Assessment is not perfect. It suffers from 3 very major gaps, 2 more modest gaps, and a few places where editing can help. The gaps appear when most of the relevant research is in the past 4 years. The Executive Summary should (1) discuss current and especially future carbon emissions from thawing permafrost; (2) include paleo-climate analog data as reality checks on model results; (3) discuss the $ value of the damages from climate change; (4) detail methods of active carbon dioxide removal; (5) make very clear that sea level will keep rising for many centuries; (6) include examples of several statements, especially tipping points; and (7) expand its description of impacts on agriculture, using key points from the agriculture chapter.(1) Thawing Permafrost Annual carbon emissions from permafrost (plus seabed methane hydrates) may exceed annual ones from fossil fuels, sometime after mid-century. The amount of carbon in permafrost around the Arctic is about twice as much as the atmosphere holds and 5-6 times the amount humans have emitted from burning fossil fuels. The rate of release, both now and in years to come, is uncertain by a factor of 4 or more, but is the focus of much research. Estimates of annual carbon release from permafrost in the past few years are 2-11% (central 3-6%) of annual carbon releases from burning fossil fuels. Estimates of future permafrost carbon release rates ramp up from there, and are as high as 80% of current rates from fossil fuels by 2100. Planning to deal with climate change by reducing emissions must include permafrost emissions. This makes it vital to take carbon out of the air and sequester it for centuries or more it in other reservoirs. (2) Paleo-Climate Analogs Three paleo-climate analogs are important. The first suggests to us that current, not just future, CO2 levels will yield much more warming (3-6°C) and far higher sea levels (25-40 meters) than we observe so far. That is, we are experiencing a serious lag in effects; long-term climate sensitivity greatly exceeds short-term. The second tells us that thawing permafrost in the past has driven geologically sudden warming. It suggests that this can happen again, triggered by human CO2 emissions from fossil fuels, especially since warming now is faster than 55 million years ago. The third gives a reasonable estimate for the mean rate of sea level rise over the next few centuries. (3) $ Value of Damages I did not find the subject discussed in the Assessment, but perhaps it was buried in some chapter I did not read. As we think about the costs of mitigation, especially reducing carbon emissions via (1) a carbon tax or (2) a carbon cap and trade system, we need to balance the costs of inaction against the costs of action. The costs of action are reasonably well defined, uncertain by less than one order of	1. Executive Summary				There are limits to how much detail can be included in an Executive Summary. There is significant information on methane and permafrost in the climate science chapter; Paleoclimate analogs are critical to climate science chapter and water chapter findings in particular; there is limited information available on the costs of climate change, though the coastal chapter and several others do contain cost information; your point is well taken that substantial additional work is needed on this topic and this is noted in a new section on economics in the Context and Background. CO2 sequestration is covered to some degree in the mitigation chapter, but there was a deliberate attempt to avoid a discussion of technological solutions due to limitations on length; the sea level discussion does indicate that levels are expected to rise over time; an example of a tipping point has been added to the Executive Summary. Regarding (4), additional information on methane and short-lived forcing has been added to Ch 2; Regarding (5) language has been modified in response to this comment; Regarding (6) this point is made in the Executive Summary; Regarding Examples, additional examples of diseases and tipping points have been added; regarding the number of agriculture conclusions brought forward, the authors believe the current emphasis is sufficient.

magnitude. Many, especially in carbon-intensive industries, say they are too high and neglect the cost of inaction. They promote small (some tens of billions of $) private goods and a much larger public good (many trillions of $).

The $ value of damages from climate change (i.e., inaction) feature much larger error bounds than the cost of action. However, there is a rich literature on the subject. Apparently (4/10/13 e-mail from Moms Clean Air Task Force), the 2009 National Climate Assessment said such an analysis would be included in the 2013 edition.

This topic really should be a separate chapter. I am filing more detailed guidance to the literature, for such a chapter, in my comments on the Assessment as a whole.

(4) Carbon Dioxide Removal

By 2100, rising annual carbon emissions from permafrost and subsea methane hydrates are likely to exceed current human emissions from fossil fuels. This will speed up climate change and bring catastrophic impacts (e.g., cut world food supply in half, collapse of civilization) sooner, perhaps by 2100.

In this context, active carbon dioxide removal, on a vast scale, becomes vital. Nature has removed carbon from the air for eons, but slowly. Humans need to speed up those processes hugely that move carbon from air to rocks, soil, and the deep ocean. There is a small role also for moving carbon from the air to vegetation.

There is a substantial literature on the subject and some experiments are under way. My comments on Chapter 27 (Mitigation) address this subject in a bit more detail.

(5) Rising Sea Levels

On line 1 of page 21 of the Executive Summary, the statement should be added (from Chapter 2, p. 64) "Sea level rise will continue for many centuries after 2100."

Using paleo-climate analogs, seas were 25-40 meters higher with today's CO_2 levels (Tripati 2009). Thermal expansion at 5°C can account for only ~ 8 meters. Almost all the rest must come from large ice caps: Greenland and Antarctica. Research finds that Greenland's ice cap will melt away at today's CO_2 levels or with temperatures only 1.6°C above pre-industrial ones. Many have noted the vulnerability of the West Antarctic ice sheet to ice loss, since it is grounded below sea level. The difference between 25 meters of 8 meters exceeds the combined ice mass of Greenland and West Antarctica; this indicates that at least some substantial net ice loss will also occur in East Antarctica.

(6) Examples to Include

The Summary should note (p. 3, line 31) that recent human carbon emissions have exceeded the IPCC's (2001) highest emission scenario – despite a 13% decline in US emissions since 2005. An example of what temperature changes mean should be added: "Assuming negligible permafrost carbon emissions, in the high global emissions case, summer 2012 US temperatures would become the norm around 2070-2080. But in the low emissions case, that would not happen till after 2100, if at all." (See Figures 2.3, 2.7, and 2.8.)

		On page 6, line 37, disease examples should be given (e.g., Lyme disease, West Nile virus, dengue fever). On page 10, line 6, pest outbreak examples should be given (e.g., pine bark beetles or mountain pine beetles). On page 13, section 4, examples of tipping points should be given. At the end of line 11, based on, for example, the January 2006 Tipping Point Report, by the International Climate Change Taskforce for Sen. Olympia Snowe (summarized in Fry 2006), the following should be inserted: "Tipping points identified in 2006 include (1) loss of Arctic Ocean summer ice; (2) changing carbon sinks into sources; and (3) carbon release from permafrost as Earth warms. All 3 (and other) tipping points create positive feedback loops. We may be passing the first and third now, and certainly in the first half of this century." The 2004 Arctic Climate Impact Assessment (Berner 2004) used changed ocean circulation instead of changing carbon sinks (especially forests) into sources. The tipping points situation should be discussed in more detail in Chapter 2. (7) Climate Change and Agriculture More of key messages 1-4 from the Agriculture chapter should be included in section 8 on page 9. I suggest wording the opening paragraph to say: "Adverse impacts to crops and livestock have increased in the recent past and are expected to increase over the next 100 years. Over the next 25 years or so, the agriculture sector is projected to be relatively resilient, even though there will be increasing disruptions from extreme heat, drought, and heavy downpours. However, by mid-century and beyond, these impacts will be increasingly negative on most crops and livestock, as critical thresholds are passed, and as weeds, diseases, and insect pests exert increasing stress. Current soil and water losses from increasing precipitation extremes will be problems, unless we adopt innovative conservation methods. U.S. food security and farm incomes will also depend on how agricultural systems adapt to climate changes in other regions of the world. Berner, Jim; Terry Callaghan, Shari Fox et. al, 2004. Impacts of a Warming Arctic: Arctic Climate Impact Assessment. Cambridge Univerity Press, New York. ISBN: 978-0-521-61778-9Fry, Gene, 2006 . The Tipping Point. www.docstoc.com/docs/129332982/Global-Climate-Approaches-Its-Tipping-PointTripati, Aradhna K.; Christopher D. Roberts, Robert A. Eagle, 2009 . Coupling of CO2 and Ice Sheet Stability Over Major Climate Transitions of the Last 20 Million Year. Science, Vol. 326:1394-1397. doi: 10.1126/science.1178296					
Gene	Fry	The Report is an excellent compilation. It substantially advances the standard set by the 2009 interagency report "Global Climate Change Impacts in the United States", as well as many other reports. It includes a refined estimate of temperature rise, graphs of projected sea level rise and extreme drought, and many other features. Temperature rise projected over the next few decades and to 2100 seems reasonable, as do most projected consequences of those temperatures. However, the draft National Climate Assessment is not perfect. It suffers from 3 very major gaps, 2 more modest gaps, and a few places where editing can help. The gaps appear when most of the relevant research is in the past 4 years.Chapter 2 - "Our Changing Climate" - needs 4 substantial improvements and a modest one: (1) a projection of Arctic Ocean icepack, based on ice thinning (volume), plus details for (2) thawing permafrost, (3) paleo-climate analogs, (4) sea level rise, and (5) treatment of fading carbon sinks. (1) Thinning Arctic sea ice is key to understanding ice loss. Arctic sea ice volume has declined more rapidly than area. It is headed to zero in mid-September, in 2016 or so, and for 6 months of the year by	2. Our Changing Climate				(1) Key Message 11 has been expanded to include a discussion on recent reductions in sea ice thickness, including two new references. (2) Regarding methane, note the urging to temper the hype about methane releases from Arctic permafrost (Comment 32496). As it now stands, we cite the paper by Shakhova et al. (2010), which argues that Arctic subsea permafrost releases are equal to those from the rest of the global ocean, despite the somewhat controversial nature of that conclusion. Even ongoing changes in

		about 2022. Figure 2.29 should be replaced with a figure showing Arctic sea ice volume. Arctic sea ice loss has a substantial warming effect on Earth. (2) Future carbon emissions from permafrost should be addressed in detail. Annual carbon emissions from permafrost (plus seabed methane hydrates) may well exceed annual ones from fossil fuels, starting after mid-century. Failure to treat human and natural (permafrost +) emissions in tandem understates emissions and the resulting heating, variation in precipitation, and sea level rise, plus their effects on agriculture, infrastructure, forests, etc. Such a failure makes us relatively complacent and content with measures to solve our problems that will not do so. (3) Data from 15-20 million and 3-5 million years ago, with current CO2 levels, should inform temperature and sea level projections, as well as estimates of climate sensitivity to doubled CO2. Data from 55 million years ago should inform estimates of carbon release from permafrost and seabed methane hydrates. Data from 7-20 thousand years ago should inform estimates of future sea level rise. (4) The chapter should say that sea level rise will continue after 2100. It is not likely to slow and may speed up. Adaptation to sea level must be a staged retreat. (5) Carbon sinks turning into carbon sources should be addressed. Also (6), the chart projecting future severe US droughts is a useful addition.Chapter 2 – Our Changing Climate The January 2006 Tipping Point Report by the International Climate Change Taskforce (co-chaired by US Sen. Olympia Snowe, R-ME) identified three tipping points: (a) loss of summer Arctic Ocean ice, changing Earth's albedo to absorb substantially more radiation, warming the Arctic Ocean and indeed the globe, further; (b) changing carbon sinks into carbon sources in forests and the ocean; and (c) thawing permafrost, releasing trapped methane (CH4), which would warm the air further, in a positive feedback loop. These, especially the first and third, deserve much more attention in this chapter. Substantial ocean circulation changes, as a result of melting ice and temperature feedbacks may also deserve mention here. Eleven more tipping points, some overlapping (3 about ocean circulation, 2 about monsoons, etc.) are mentioned in answer to Frequently Asked Question T in an appendix to this Assessment. It should be noted that loss of Arctic Ocean ice cover, especially during the daylight season, will increase the speed of permafrost thaw and loss of Greenland ice. Moreover, loss of Greenland ice and permafrost thaw will reinforce each other. Albedo changes from ice loss will warm the polar air, increasing carbon release from permafrost, while carbon release from permafrost will warm especially polar air, accelerating surface melt on Greenland ice and movement of its glaciers to the sea. In fact, what we are seeing is geologically extremely fast (fast even by human time scales) occurrence of "slow" feedbacks identified by James Hansen (2012) and others: change in atmospheric carbon levels in response to warming and albedo changes from melting ice sheets and vegetation changes. (1) Loss of Arctic Ocean Ice Loss of Arctic Ocean ice (albedo ~ 0.6), which is replaced with dark water (albedo 0.06) on the surface, would increase heat absorption there several-fold, with an effect so far like 20 years of extra CO2					releases of methane from permafrost, both marine and terrestrial, are highly uncertain at the present time, and there is no sound basis for estimating future methane releases from permafrost. Prudence dictates that we avoid speculative statements such as those in this comment. (3) A discussion on paleo analyses has been added to the text for Key Message 1. (4) The text has been revised following this suggestion. (5) We do not think the science at this point is clear enough to put in a discussion on carbon sinks changing to sources in the chapter. Tipping Points: A sentence has been added on tipping points (with reference to the discussion on this in the appendices). (1) Loss of Arctic Sea Ice: The changes of albedo, and the associated feedback to temperature and ice loss, are contained in the model simulations that produced the projections in the figure on Arctic sea ice decline. The recent thinning of sea ice has been added to the discussion of sea ice loss in Key Message 11. We have added a sentence citing Laxon et al.'s (2013) results concerning autumn ice volume loss. We have also added a statement to the caption of the figure on projected Arctic sea ice decline that the models' rate of ice loss (under all scenarios) lags the observed rate of loss. The text includes a new statement that extrapolation of the observed rate of loss implies an ice-free Arctic even earlier than the 2030s (projected by the more aggressive models). (2) Thawing Permafrost: We have augmented the discussion in Key Message 11 to include the projected contributions of permafrost thaw to carbon release and climate warming

		emissions (Wadhams, Sept. 2012). Ice extent, averaged over the sunshine season, has so far declined only a quarter of the way to ice-free, so the ultimate effect could be 4 times that much. Many sources document the accelerating loss of Arctic Ocean sea ice cover. (See pages 66-69 in Chapter 2 of the NCA.) See www.ijis.iarc.uaf.edu/seaice/extent/plot.csv for daily data. Thinning of sea ice is especially important, but is merely mentioned on page 67. Thinning – and volume - is key to understanding the timing of Arctic sea ice loss. For several years, the PIOMAS model, calibrated to several sources, has estimated Arctic ice thickness and volume. Used with the satellite data about ice area (or extent), it also estimates the volume of Arctic Ocean ice. In early 2013, data from Europe's Cryostat satellite missions confirmed the PIOMAS picture in a general way (Laxon 2013). Cryosat uses radar altimetry to measure the difference between the top of marine ice and the water in adjacent cracks. Changes Cryostat observed since NASA's Icesat gathered similar data over 2003-08 show a 64% decline in autumn ice volume thru 2012, over only 7.5 years. Cryosat data look similar to the PIOMAS simulations. Wipneus has graphs extrapolating monthly mean ice volume from recent trends in the PIOMAS results: https://sites.google.com/site/arctischepinguin/home/piomas. They indicate the Arctic Ocean will become ice-free by late September in 2015, ice-free for 3 months by 2017, and for 4 more months (at least half the year) by 2022. The draft Assessment mentions (page 67, lines 26-27) that models have underestimated the amount of decrease since 2007. Figure 2.29's projections greatly underestimate into the future. But the caption to Figure 2.29 is missing this vital caveat. Thus, the Figure is highly misleading. It should be deleted and replaced with a PIOMAS graph of ice volume by month, after summarizing Icesat, Cryosat, and PIOMAS results. (2) Thawing Permafrost Emissions from thawing Arctic permafrost require a section of its own in Chapter 2, and in the Executive Summary. It can draw from the exposition in the Alaska chapter, especially pages 767-771. (The proposed section might also address seabed methane hydrates.) Thawing is not just a problem for Alaskan roads, buildings, shore erosions, and drunken trees. The maps of future permafrost thaw in Alaska (Figure 22.5) are excellent and worth repeating in Chapter 2. But the next edition of Figure 22.5 should account for positive feedback temperature loops more than these may have. Many scientists have investigated permafrost thaw recently, publishing mostly from 2009 onward. The amount of carbon in northern permafrost, not including Greenland, was estimated at 1,600 GT by Schuur (2009), 1,672 GT by Tarnocai (2009) and 1,894 GT by Hugelius (2013). This amounts to twice the carbon in Earth's atmosphere, or 5-6 times the carbon emitted from burning fossil fuels. On average, permafrost stores almost 3 times as much carbon per hectare as tropical rainforests. More have estimated the current carbon release rate from permafrost, including Schuur (2009), Dorrepaal (2009), Joosten (2010), and Bloom (2010). Those estimates range from 0.15 to 1.0 GT of carbon per year, mostly .23-.55. This is 2-11% (central estimate 3-6%) of the 9 GT per year now emitted from fossil fuels. Also, Shakhova (2010) and AMEG (2012) have estimated current carbon release rates from seabed CH4 hydrates (about 2% of permafrost emissions rates), while Sanchez-Garcia (2011) has estimated the stock, which remains poorly known.					by 2100, citing the recent work of MacDougall et al. (2012). However, there are two arguments against a more extensive discussion. First, the large areas of permafrost thaw shown in the figure on projected thawing in the Alaska chapter are based on changes in soil temperature at a depth of 1 meter. Most of the carbon in permafrost (the 1600 GT noted by the reviewer) is locked in frozen material at greater depths (tens to hundreds of meters) that will take many centuries to thaw. So permafrost will not disappear (nor will all its carbon be made available) by 2100 from the newly red areas in the figure on projected thawing in the Alaska chapter. Second, there are large uncertainties in the future rate of permafrost thaw. The 2012 UNEP report (http://www.sciencedaily.com/releases/2012/11/121127094250.htm) points out the potential importance of permafrost carbon releases but acknowledges the large uncertainties by including as its first recommendation: "Commission a Special Report on Permafrost Emissions: The IPCC may consider preparing a special assessment report on how carbon dioxide and methane emissions from warming permafrost would influence global climate". Given the need for such an assessment, we do not consider it prudent to go beyond our present highlighting of Shakhova et al. (2010) and MacDougall et al. (2012). We have added a reference to MacDougall et al. (2012), and now state that the potential release of carbon from permafrost soils could add as much as 0.4ºF to 0.6ºF of warming by 2100 (Key Message 11). We hesitate to add more on this topic because the projected changes in permafrost carbon release

		Most telling, several scientists have estimated future permafrost carbon releases. These include Canadell (2009), Schaefer (2011), a survey of 41 experts by Schuur (2011), MacDougall (2012), Harden (2012), and Schaefer (2012). Their projected release rates are sensitive to projected temperatures, which respond to carbon emissions from fossil fuels and permafrost. Projected permafrost release rates are quite large. MacDougall's projected releases include 68-508 GT by 2100, while Schuur's earlier survey responses (adjusting C in CH4 released to C in CO2 equivalent) included 232-380 GT C by 2100 and 549-865 GT C by 2300. These compare to 320 GT released from fossil fuels since 1900 and about 800 GT now in the atmosphere. Restated, projected carbon release from northern permafrost (not counting Greenland) is projected to exceed by 2300, and perhaps by 2100, all the carbon released to date by burning fossil fuels, and perhaps by 2300 all the carbon now in the atmosphere. From Schuur's survey, the projected mean annual permafrost carbon rate from now to 2040 is 12-26% of current emission rates from fossil fuels, up from 3-6% now. From 2040 to 2100, it is 40-60% as large, but from 2100 to 2300 it is only 20-30% as large. MacDougall's later study, using a coupled-vegetation model, projects permafrost emissions averaging 65% (508 Pg C by 2100) as large as current fossil fuel rates. Schuur and MacDougall characterize these as small compared to future emissions rates from fossil fuels, but that depends on how much fossil fuel we burn. In MacDougall's high human emissions scenario, permafrost emissions accelerate modestly over 2100-2300, while they decelerate by half in the low case. In the high case, MacDougall projects permafrost to add 380 ppm of CO2 to the atmosphere by 2300. That is virtually double today's level, and much more than the roughly 120 ppm added from burning fossil fuels to date. Depending on climate sensitivity (perhaps best addressed by Pagani (2011) and Fasullo (2012)), the doubling can warm Earth's surface by several more °C, not just the 1.69°C at the upper end of MacDougall's range. In any case, a large fraction of the permafrost carbon reservoir would be transferred to the atmospheric one, mediated by a decades-long residence of up to 40% in other soil reservoirs (and above-ground vegetation), with little added to the ocean and almost none to standing biomass. With thermokarst failures exposing more deep carbon to sunlight (Cory 2013), large emissions may occur sooner than projected. The discussion above does not account for permafrost under Antarctic ice (Wadham 2012, DeConto 2012), which may be far more than around the Arctic, nor for any under Greenland ice. A massive carbon release from permafrost appears to have happened before. DeConto (2012) deduced that release of about 3,400 GT of carbon from Antarctic permafrost drove the PETM 55 million years ago. Global surface temperatures then rose 5-6°C over a few thousand years. The shove came from orbital variations, while now it comes from burning fossil fuels. The threshold for release then was 900 ppm CO2. However, our sun has continued brightening since then, warming Earth ~ 1.7°C more now than it did then, so today's ppm threshold would be lower. If humans reduce carbon emissions as many hope, carbon emissions from permafrost are likely to exceed human emissions, by or after mid-century. Thus, future temperatures - and their effects - will exceed, perhaps by a great deal, those shown in the 2013 draft National Climate Assessment. To keep carbon levels in the atmosphere at levels below the catastrophic (especially cutting the world					presented by Schuur et al. (2008) and even by MacDougall et al.) emphasize projections for 2300, which is beyond the time horizon of this assessment. Moreover, there are large uncertainties concerning the rate at which permafrost carbon will become accessible via thaw, as the thawing of soil more than several to several 10's of meters below the surface will likely take centuries (SWIPA, 2011). See also the cautionary review comment 32496. Release of permafrost carbon from under the Antarctic and Greenland ice sheets requires the removal of the ice, which is unlikely to occur by 2100 (SWIPA, 2011). The most recent and best estimates of the contribution of thawing permafrost to future warming are those of MacDougall et al. (2012), which is now cited, together with its quantitative estimates of the consequences of permafrost thaw, in the supporting text for Key Message 11. Moreover, the extreme example cited by the reviewer in connection with Antarctic permafrost thaw, a warming of 5-6C over a few thousand years, is much slower than the projected warming of 2-4C by 2100 due to anthropogenic greenhouse gas emissions. Finally, the carbon sequestration and geoengineering mentioned by the reviewer are not within the purview of this chapter. (3) Key Paleo-Climate Analogs: Regarding (A), the revised chapter includes a special box on the subject of climate sensitivity (noting that some recent studies have argued that climate sensitivity is lower than previous estimates, others that it is higher). Regarding (B), we have added a statement and reference in Key Message 11 concerning projected carbon release and associated warming from thawing permafrost.

		food supply in half; see e.g., Rind 1990, Schlenker 2009), large-scale carbon dioxide (CO_2) removal (CDR) from the atmosphere will be required. However, CDR is barely mentioned in the Mitigation chapter, mostly on pages 958-961. It mentions only one active means: ocean fertilization. Other means should be discussed, including active sequestration by livestock in (prairie) soils, active sequestration in rocks / minerals, pumping carbon to deep oceans, burying biochar, and active sequestration in forests and cropped fields. In light of the permafrost (and seabed methane hydrate) situation, developed such means of CDR must be given top priority. (3) Key Paleo-Climate Analogs Three paleo-climate analogs are important. The first (A) tells us that the current CO_2 level will give us much more warming and far higher sea levels than we observe so far. That is, we are experiencing a serious lag and climate sensitivity is significantly higher than many current models assume. The second (B) tells us that thawing permafrost in the past has driven geologically sudden warming. This strongly suggests a repeat, triggered by human CO_2 emissions from fossil fuels, especially since warming now is faster than then. The third (C) gives a reasonable estimate, for now, of a mean rate of sea level rise over the next few centuries. First (A), Tripati (2009) found that 15-20 million years ago, atmospheric CO_2 levels at several sites around the globe approximated today's, give or take a little. She also found that sea levels then were 25-40 meters higher than today's, and temperatures were 3-6°C warmer. Pagani (2009) similarly found 3-4°C warming with CO_2 levels of 365-415 ppm, but only 4.5 million years ago. Pagani 's work supports Tripati's. See also Csank (2011). Pagani found that climate sensitivity to doubled CO_2 was quite high then: 7.1 to 9.6°C for doubled CO_2. This is consistent with Tripati. Fasullo's (2012) use of current data supports Pagani. He shows that model results assuming climate sensitivities around 4.4°C are more consistent with observations of atmospheric H_2O and clouds, than are lower climate sensitivities of 1.7 to 4.4°C. The second important paleo-climate analog (B) is that, 55 million years ago, the PETM, when global temperatures rose 5-6°C in a single millennium, was due to carbon release from thawing permafrost in Antarctica (DeConto 2012). Orbital variations triggered the release. The third paleo-analog (C) dates to ~ 14,000 years ago. In Meltwater Pulse 1A, seas rose 20 meters in 5 centuries (Webster 2004). Similarly, seas rose ~60 meters over ~ 30 centuries starting ~ 11,000 years ago (Fleming 1998, Milne 2005). These are rates of 4 and 2 meters per century. These suggest sea level rise rates over the coming centuries. Earth's surface is warming faster than it was then, but the volume of ice was larger then. Thus, 2-4 meters of sea level rise per century is a good ballpark estimate, until experience, and further modeling informed by paleo-climate data, improve on it. (4) Sea Level Rise After 2100 Shepherd (2012) brought together many estimates of sea level rise from melting ice. His team found that Greenland and Antarctica were contributing similar amounts to sea level rise till 2001, but Greenland has contributed twice as much since then, due to a 3.2-fold increase in its ice mass loss rate. Koenig's (2012) modeling results indicate that Greenland's ice sheet is unstable over the long term, at today's CO_2 levels. Robinson's (2012) modeling suggests that it will melt away with 1.6°C global					With regard to the statement about Antarctic permafrost, a warming of 5.5C over a millennium is much less than the rate of warming projected for the next century (2 to 4C over 90 years) as a result of fossil fuel burning. (4) Sea level rise by 2100: The estimates of sea level rise (KM 10) have been painstakingly compiled into a range based on a consensus of recently published literature, a NOAA-led panel of experts, and the authors of this report and the IPCC AR5. The sea level projections in Key Message 10 are consistent with those in the upcoming AR5 report of the IPCC. Sea Level Rise After 2100: Reference to the long-term loss of the Greenland ice sheet at present day CO_2 levels has been added and it was noted that rates of sea level rise in future centuries are likely to meet or exceed those of the 2100s. (5) Carbon Sinks Turn into Carbon Sources: It is not clear how this would affect the chapter as written. We did expand the discussion on the carbon cycle in the Climate Science Appendix. (6) Extreme Drought: Note that this figure using PDSI has been moved to the Appendix and a detailed discussion of the limitations of this drought index added. The new discussion about drought in chapter 2 focuses on soil moisture projections in the western U.S. (a similar calculation for the entire country being yet unavailable) and Consecutive Dry Days. Both of these measures suggest increased drought risk for much of the US.

warming (vs today's global 0.8°C, but 3.0°C in the Arctic – NASA GISS), which Tripati's and Pagani's work suggest current CO2 levels already commit us to. This makes Koenig and Robinson consistent. Robinson observes that the warmer Greenland gets, the faster its ice sheet melts. With 8°C warming, it would melt within 5 centuries, or 1.2 to 1.4 meters per century.

Thermal expansion will increase as global warming accelerates, perhaps from the current rate of 0.17 mm/year to twice that: 0.34 meters per century by 2100.

The remainder would come from net ice loss in Antarctica. Many have observed that much of the West Antarctic ice sheet is grounded below sea level. Thus, it may be subject to relatively sudden major ice loss. Pollard (2009) found that the West Antarctic Ice Sheet has collapsed and re-grown several times over the past 5 million years. Transition between glacial and collapsed states took one to several thousand years. The faster rate corresponds to 0.5 meters per century (Pollard 2009).

1.3 meters + 0.34 meters + 0.5 meters corresponds to 2.14 meters per century, in line with data from 11 to 8 thousand years ago.

For the much larger East Antarctica ice sheet, Pollard's (2005) modeling estimated that CO2 concentrations 2 to 4 times pre-industrial levels are enough to induce a transition from a large continental ice sheet to very little ice. With permafrost carbon added to high human emissions, we may hit that by 2300. But full melting of the East Antarctic ice sheet may take over a million years (in 2 stages), given the continent's isolation by continuous ocean, following opening of the Drake Passage to South American several million years ago.

Still, while 2/3 of West Antarctica's ice is grounded below sea level, so is 1/3 of East Antarctica's. See http://en.wikipedia.org/wiki/File:AntarcticBedrock.jpg. It is not clear if any net melting from East Antarctica will occur over the next few centuries (Shepherd 2012). But the difference between 25 meters of sea level rise, 15-20 million years ago, and 8 meters from thermal expansion, exceeds the combined ice mass of Greenland and West Antarctica (plus mountain glaciers). This indicates that substantial net ice loss will also occur in East Antarctica over many millennia, on the order of 5-20 meters of sea level rise, associated with TODAY's CO2 levels. I note that the sun has brightened slightly (perhaps 0.6°C at Earth orbit) in the meantime, as it moves along its main sequence lifetime (think "faint sun paradox"). Thus, the long-run effect may be a little more.

Overall, seas are very likely to continue rising for centuries, at rates equal to or higher than this century's. 2 to 2.5 meters per century (an inch per year) is a good rule of thumb. Adaptation measures should take long-term future sea level rise into account. The attitude should be: "This will last us for about X years, then we will need to let the sea reclaim some land and do Y for the next line of defense, for another Z years." This can be called a staged retreat.

(5) Carbon Sinks Turn into Carbon Sources

Principal current sinks at annual to decadal time scales include the ocean, forests, and soils. We have observed short-term declines for several sinks in some areas. For example, the 2005 and 2010 Amazon droughts made the rainforest into a net carbon emitter larger than China (Phillips 2009, Zhao 2010, Lewis 2011). (However, in other years, the Amazon rainforest was a net carbon sink.) The 2002 North American drought cut its forests' net CO2 absorption 50% (Peters 2007). If and when 2/3 or more of the Amazon rainforest turns to dryland and desert scrub (Cox 2000, Cook 2008, Harris 2008, Jones

2009), one carbon sink turns into a source, to the tune of 20 ppm of CO2 in the air. Similarly, US forests may become net carbon sources (e.g., Potter 2013, Vose 2013), especially as extreme droughts become more common (Figure 2.21). Wildfires, pine bark beetles, and conversion of forests to biofuel plantations can mediate a transition to a shrinking carbon sink.

CO2 absorption by the world oceans fell 8% over 50 years (Canadel 2007). Behrenfeld (2006) and Schuster (2007), identified decreases of 7% to 50% in particular sections of oceans. Boyce (2010) found that ocean phytoplankton (which can absorb CO2) fell 40% since the 1950s and 1%/year since 1979, though the former figure especially is disputed.

It is not clear that carbon sinks in general are turning into carbon sources (Hansen 2013), due to growth in temperate and boreal forests, but it may be that pockets where this is so are increasing.

(6) Extreme Drought

Figure 2.21 shows a projection of extreme drought frequency. It is similar to one for the globe by Rind (1990), but the increase happens a bit more slowly. It is also consistent with Dai's (2004) findings for increase in severe droughts over 1950-2002.Arctic Methane Emergency Group (AMEG), 2012. Message from the Arctic Methane Emergency Group. http://a-m-e-g.blogspot.com/2012/05/message-from-arctic-methane-emergency.htmlBehrenfeld, Michael J.; Robert T. O'Malley, David A. Siegel et al., 2006. "Climate-driven trends in contemporary ocean productivity", Nature 444:752-755. doi:10.1038/nature05317Berner, Jim; Terry Callaghan, Shari Fox et al., 2004. Impacts of a Warming Arctic: Arctic Climate Impact Assessment Cambridge Univerity Press, New York. ISBN: 978-0-521-61778-9Bloom, A. A.; Palmer, P. I.; Fraser, A. et al., 2010. "Large-Scale Controls of Methanogenesis Inferred from Methane and Gravity Spaceborne Data", Science 327(5963): 322–325. doi:10.1126/science.1175176Boyce, Daniel G.; Marlon R. Lewis & Boris Worm, 2010. "Global phytoplankton decline over the past century", Nature, doi:10.1038/nature09268Canadella, Josep G.; Corinne Le Que, Michael R. Raupach et al., 2007. "Contributions to accelerating atmospheric CO2 growth from economic activity, carbon intensity, and efficiency of natural sinks", Proceedings of the National Academy of Sciences doi 10.1073 pnas.0702737104Cook, Brian, Ning Zeng, Jin-Ho Yoon, 2012. "Will Amazonia Dry Out? Magnitude and Causes of Change from IPCC Climate Model Projections", Earth Interactions 16:3, 1-27. doi: http://dx.doi.org/10.1175/2011EI398.1Cory, Rose M.; Byron C. Crump, Jason A. Dobkowski et al., 2013. "Surface exposure to sunlight stimulates CO2 release from permafrost soil carbon in the Arctic", Proceedings of the National Academy of Sciences, 110:9, 3429-3434. doi: 10.1073/pnas.1214104110Cox P, Betts R, Jones C et al., 2000. "Acceleration of global warming due to carbon-cycle feedbacks in a coupled climate model", Nature 408, 184–187. doi:10.1038/35041539Csank, Adam; Aradhna K. Tripati, William P. Patterson et al., 2009 . "Estimates of Arctic land surface temperatures during the early Pliocene from two novel proxies", Earth and Planetary Sciences Letters 304: 291-299. doi: 10.1016/j.epsl.2011.02.030Dai, Aiguo; Kevin E. Trenberth, Taotao Qian, 2004. "A Global Dataset of Palmer Drought Severity Index for 1870–2002: Relationship with Soil Moisture and Effects of Surface Warming", Journal of Hydrometeorology 5:1117-1130DeConto, Robert M.; Simone Galeotti, Mark Pagani et al., 2012 . "Past extreme warming events linked to massive carbon release from thawing permafrost", Nature 484:87-92. doi: 10.1038/nature10929Dorrepaal, Ellen; Sylvia Toet, Richard S. P. van Logtestijn et al., 2009. "Carbon respiration from subsurface peat accelerated by climate warming in the subarctic", Nature 460:616-619. Doi:10.1038/nature08216Fasullo, John T.; Kevin E. Trenberth, 2012 . "A Less Cloudy Future: The Role of Subtropical Subsidence in Climate Sensitivity", Science 338:6108,792-794. Doi: 10.1126/science.1227465Fleming, Kevin; Paul Johnston, Don Zwartz et al., 1998. "Refining the eustatic

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Stephen	Hamilton	The order of the key messages seems odd; it would be more natural to cover the environmental aspects first, then human health and then energy. Also it is not clear how the tables at the end will be published. I did not see something comparable in the last report that was associated with each chapter.	18. Midwest				The chapter has not been restructured in this way because each key message contained multiple components, rendering a clear grouping moot.
Stephen	Hamilton	Need to explain the dashed line better. It would be best to put the end date on the x axis because some people will not realize it goes beyond 1995. Maybe labels could extend from 1890-2010 or 1900-2010.	18. Midwest	18.1	619		The figure has been clarified.
Stephen	Hamilton	The title of the figure could be "Projected Temperature Changes". Above each scale it would be better to say "increase" instead of "difference". Much of the upper left map is above the upper limit of the scale; can the scale be rescaled to show this better?	18. Midwest	18.2	620		The figure has been clarified.

		The subtitle "Frost-free Season" should be called "Growing Season" as it is in the caption. Cooling degree days are not well defined and will confuse some readers. The subtitle "Cooling Degree Days" could instead be "Need for Air Conditioning".					
Stephen	Hamilton	Need to explain that this is the mean of the daily maximum temperatures for the June-Aug period, not the single highest temperature reached as some might think. Mention of pollination and grain filling period in caption is confusing because it is not clear how that relates to the June-Aug period shown here. In fact Mishna called that 3-month period the "grain filling period". The corn panel needs a vertical dashed line through zero like the soybean one.	18. Midwest	18.3	622		The text has been revised to incorporate this suggestion.
Stephen	Hamilton	Maps could be larger and key could be smaller (but not its font). Do you need those nearly insignificant forest categories like Loblolly/Shortleaf and the Oak/Gum/Cypress? Why are there so many areas with no data -- are they simply not forested? The term "North Woods" would better be "northern forests".	18. Midwest	18.4	623		We thank the reviewer for the helpful suggestion about the map size, which has been incorporated into the figure. All species were retained for completeness, and the grey area denotes non-forested areas.
Stephen	Hamilton	This figure is problematic in several ways. It needs an extreme makeover! Readers are going to have trouble interpreting it as it is now. My class of 20 graduate students (natural and social scientists) puzzled over it for a long time and was left confused. Title should be "Heat-related Deaths in Chicago". An alternative approach is to graph out the annual historical record of total deaths and as deaths per heat event, showing both the frequency and severity of past events, and how measures to mitigate them have been successful. Then add the mean and variance of the projections at the far right for comparison. Are the bars in the current chart showing the mean annual death rate? In other words, is every year going to be worse than 1995 was?! Do the projections account for the current (improved) state of readiness in Chicago? Need to clarify.	18. Midwest	18.5	624		We thank the reviewer for the helpful suggestion and have removed the figure in favor of text explanation.
Stephen	Hamilton	This figure is confusing. The left map scale would better be titled "Reduction in number of deaths". The nonlinear scales will be hard for non-scientists to interpret. Right map is especially unclear. How would cases in urban areas increase ("Negative reductions" as portrayed here) with a reduction in auto emissions?! Perhaps these data would better be depicted in a bar chart showing the net change in deaths/cases in the urban areas, or maybe the overall Midwest.	18. Midwest	18.6	625		The figure has been clarified.

		Some state borders are gray rather than black in the right map.					
Stephen	Hamilton	Title is cute but does not fit style of rest of chapter. Would be better as "Projected Changes in Precipitation". In scale titles, better to say "increase" (where only positive) or "change" instead of "difference". Wording in caption should be consistent with the similar wording in the earlier figure. "Heavy Precipitation" subtitle could be "Heavy Rainfall". Use rainfall rather then precipitation wherever it is correct to do so. Why not use the same color scheme in all four maps? Softer colors in lower two has a psychological effect. These changes in absolute inches seem very modest. I wonder how they would look as a percentage of the current values. At any rate they understate the changes in heavy precipitation events and resultant flooding and high stream flows that we already seem to be experiencing in the Midwest.	18. Midwest	18.7	628		After consideration of this point, we still feel the existing text is clear and accurate. Precipitation is the correct usage since it includes more than rain. The color scheme was adjusted after discussion with our graphic artists.
Stephen	Hamilton	My graduate class did not like the satellite images, even though I am partial to such imagery. They thought the selection was exaggerating the changes, and that the algal blooms on the ice-free one were distracting. Alternative ideas for maps include one of the typical ice cover across the Great Lakes system (Google "Great Lakes ice cover" then select images to see a lot of variants of this). One could also show time series for an inland lake like Lake Mendota to show how the same conclusion applies to them as well.	18. Midwest	18.8	631		We thank the reviewer for the helpful suggestion and have removed the images.
Stephen	Hamilton	The leveling off or even reduction in warming in the middle of the last century is very apparent in these data. We now have a strong scientific basis to say that atmospheric pollution and the resultant aerosols from industrial sources, combined with aerosols of volcanic origin, likely caused this counteraction of the warming trend, especially from about 1940-75. Perhaps that is worth noting here. (There are other explanations as well that involve the oceans.)	18. Midwest		618	29	The text has been revised to incorporate this suggestion.
Stephen	Hamilton	Need to reword: "Extreme weather events will influence future crop yields more than changes in average temperature or annual precipitation" to "Future crop yields will be more strongly influenced by extreme weather events than by changes in average temperature or annual precipitation."	18. Midwest		621	9	The text has been revised to incorporate this suggestion.
Stephen	Hamilton	Does the Midwest have a particularly high potential for CCS relative to other regions? If so, why? Should the increased availability and utilization of natural gas be mentioned in this paragraph?	18. Midwest		626	32	This section of text has been completely revised to better reflect a range of comments, and no longer addresses CCS.
Stephen	Hamilton	This discussion of changes in crop yields, as well as the figure, would be more useful to non-experts if there were some indication of the percentage changes.	18. Midwest		620	7	The text has been revised to incorporate this suggestion.

Stephen	Hamilton	This major uncertainty in the direction and magnitude of lake level changes would seem to warrant highlighting as a research need, perhaps in the table at the end if not here.	18. Midwest		632	19	We appreciate this suggestion and forwarded that suggestion to the 'Research Needs' chapter where such recommendations are captured for the entire report.
Stephen	Hamilton	The discussion of forests as carbon sinks or sources could be clearer to a novice reader. Could always specify "atmospheric carbon dioxide" sink or source. Could note that as forests mature their function as a sink diminishes and ultimately ceases.	18. Midwest		623	3	The text has been revised to incorporate this suggestion.
Stephen	Hamilton	Could note that the Midwest is heavily dependent on Canadian oil sands imports, and that the carbon footprint of the oil sands is larger than conventional crude oil. Use of oil sands is likely to increase over rest of nation in future.	18. Midwest		626	1	While the comment suggests a good specific example, the authors feel the existing examples are appropriate and adequate.
U.S.	Environmental Protection Agency	CRITICAL COMMENT: Ensure consistency regarding description of A2 and other emission scenarios throughout the document.					We have worked for consistency across the report in the way the A2 and B1 emissions scenarios are described. Where other emissions scenarios are used, they are described in reference to A2 or B1 for context.
Stephen	Hamilton	How would coldwater fish habitat expand in Lake Superior in a warmer climate?	18. Midwest		643	20	We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include.
Stephen	Hamilton	Should acidification of the lakes by increased atmospheric carbon dioxide be included as an uncertainty?	18. Midwest		644	45	While the comment suggests a good specific example, the authors feel the existing examples are appropriate and adequate.
Stephen	Hamilton	The emphasis on the Great Lakes leaves the rest of our abundant freshwater resources out. Could at least note how much the discussion on the Great Lakes applies to inland lakes. Also could have included groundwater, streams and rivers, wetlands...	18. Midwest		630	34	Although the comment suggests a good specific example, the authors feel the existing examples are appropriate and adequate.
Sarah	Quick	The strengths of the chapter are the environmental impact sections that Native peoples have and will continue to face due to climate change (the forest, fires, and food section onwards), although I think more could be highlighted in the water section (will comment directly on that section later). However, I think that the traditional knowledge section seems disconnected from the larger chapter, negating its relevancy. I think it definitely should be included, but perhaps it could integrated with the other sections more so or could be included at the end of the chapter for greater impact. In addition, your narrative doesn't really include the differing understanding of what tk may mean and/or is applied depending on the Native group, nor any of the potential limitations of the concept as it has been applied in policy or inter-governmental-tribal relationships (so even though acknowledging or incorporating tk is usually an intent to be inclusive of Native peoples' perspectives, it may limit knowledge /interactions solely to certain kinds of tribal members with scientists still 'in control' of the dialogue). Whether you include any critique of the use of tk or not, I think that its holistic perspective should be emphasized in potential adaptations to climate change.Furthermore, the climate change initiatives that are highlighted in the map/its caption (which I think are informative), could also be presented at the end for more impact (?), but with definitely more info AND perhaps an	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources				While the comment suggests a good specific example, the authors feel the existing examples are appropriate and adequate. We have discussed TK at the onset of the chapter, defining it from both scientific and grey literature, and it is a common thread throughout all chapter findings. Furthermore, limited space prevented us from providing more numerous or more specific examples. The author team has deliberated and agreed on the most important information/illustrations to include, including placement of the graphics.

		acknowledgment of resources/funding that Native peoples could tap into for future initiatives.					Lastly, TK is defined locally and is numerous as the cultures that define them. It is extremely difficult to comprehensively delineate TK applications or discuss TK limitations per Native group.
Gene	Fry	To keep carbon levels in the atmosphere at levels below the catastrophic, large-scale CDR from the atmosphere will be required. However, CDR is barely mentioned in the Mitigation chapter, mostly on pages 958-961. The chapter mentions only one active means: ocean fertilization. Other means should be discussed, including active sequestration by livestock in (prairie) soils, active sequestration in rocks / minerals, pumping carbon to deep oceans, burying biochar, and active sequestration in forests and croplands. In light of the permafrost (and seabed methane hydrate) situation, developing such means of CDR must be given top priority. Allan Savory developed CDR into prairie soils. This is detailed in his 1999 book, Holistic Management. Livestock graze on prairie grass in ways that imitate buffalo herds. They graze for a few days on one patch, then move on to another. Eventually, after a year or two, they return to the original patch, to repeat the cycle. Meanwhile, the munched grass grows new roots and stalks. The roots pull carbon from the air and put it in soil. Also, dung beetles move cow dung underground, also adding carbon to the soil. Jim Laurie (2008) estimated this method can remove 1-2 tons of carbon per acre per year, or 3 GT per year worldwide, using 10 billion acres of degraded rangeland. Klaus Lauckner in the 1990s suggested speeding up Nature's process of rock weathering to accelerate CDR. CO2 in the air reacts with magnesium or calcium silicate (ultramafic) minerals to form stable carbonate minerals (Krevor 2009). Natural rates are far too slow to balance fossil fuel emissions, but Keleman and Matter (2008) suggested this process could be speeded up greatly. Keith (2008) used one type of artificial tree, a tower 4 feet wide and 20 feet tall, with a fan at the bottom that sucks air into rocks with amine, to remove half the CO2 from the air. Much research and development remains to be done. Lovelock (2007) proposed using vertical pipes 10 meters across to pump up cool nutrient-rich water from 100-200 meters down to the surface, fertilizing algae that would remove CO2 from the air. Many others have proposed seeding iron-poor areas of the ocean with iron filings to fertilize algae that would remove carbon from the air. At least 8 experiments have been tried to do so, with only a little success. Problems have arisen, such as toxicity of algae.Keith, David (by Anne Eisenberg), 2008. "Pulling Carbon Dioxide Out of Thin Air", New York Times www.nytimes.com/2013/01/06/business/pilot-plant-in-the-works-for-carbon-dioxide-cleansing.html?ref=business&_r=1&Kelemen, Peter B.; Jürg Matter, 2008. "In situ carbonation of peridotite for CO2 storage", Proceedings of the National Academy of Sciences 105:45, 17295-17300. doi:10.1073/pnas.0805794105Krevor, S., Graves, C., Lackner, K. et al., 2008. "Delineation of Magnesium-rich Ultramafic Rocks Available for Mineral Carbon Sequestration in the United States", Proceedings of the 9th International Conference on Greenhouse Gas Control Technology (GHGT-9) Energy Procedia 1(1):4915-4920. doi:10.1016/j.egypro.2009.02.322Laurie, Jim, 2008. personal communicationLovelock, James E.; Chris G. Rapley, 2007. "Ocean pipes could help the Earth to cure itself", Nature 449(403). doi:10.1038/449403aSavory, Allan, with Jody Butterfield, 1999. Holistic Management. Island Press, Washington. ISBN 1-55963-488-X	27. Mitigation				Reference to land use practices, and a citation, have been added to the geoengineering box. We have also added a brief mention of direct air capture. Discussion of mitigation measures has been added to the chapter, but limited space prevents discussion of these more speculative suggestions.
Sarah	Quick	The climate change initiatives that are highlighted in the map/its caption, could also be presented at	12.	12.2	443		The text has been revised to

		the end (for more impact?) with more info AND perhaps an acknowledgment of resources/funding that Native peoples could tap into for future initiatives. Could also include a reference to the Great Plains chapter's mention of such an initiative by the Lakota.	Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources				incoporate the suggestion to point to the Oglala Lakota example in the Great Plains chapter. We have also added a couple sentences that point to examples and clarification in the caption to Figure 12.2. However, due to limited space, we are unable to include further detail on climate change mitigation initiatives. We have provided the reference to the Department of Energy's Tribal Energy Program for details on examples of such initiatives.
Sarah	Quick	I think this section is VERY important, and I think the governance issues/complexities could be highlighted even more so. So the Navajo-Hopi's lack of control over the Little Colorado River and access to clean water...and the various other stake-holders (Arizona, coal mining entities) in this debate, this could be highlighted even more as well as the long-term impacts of not having control over their access to water (affecting Hopi's traditional agriculture, etc. etc.).	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources		447	1	The text has been revised to incorporate this suggestion, in both the wording in Key Message #2 and by adding a couple sentences and citations in two different places in the main text. Due to limited space we cannot provide further detail, but have provided the citations to reference for more in-depth discussion.
H	WITTE	Many dates, how to line 28 mentions 50 years line 35 says since 1980 (or past 30 years) line 41 says since the 1980s And on the it is since 1900, and over the last three to five decades, since the early 1980s, since 1880,I know the data sets cover different time periods but for an introductory chapter is there some way to denote range of time and then get into details in subsequent pages? Or perhaps add a line time graphic depicting the time periods with relevant changing variables.1880----------1950---1960----1980-----2012 Temperature ---------- +1.5 F temperature /------ + 1.2 F Sea level ---------- +8" Frost Free /----- x days	2. Our Changing Climate		25		These are key messages and the specific statements are tied to papers or analyses that are time-specific. While this can be complex, we consider it important to reflect the underlying work as accurately as possible. No change made.

		Heavy downpours /...../----------					
H	WITTE	R. Mayer's Cognitive Multimedia Learning Theory might posit that with the simple addition of the word "Increasing" ("decreasing") above each appropriate label within the graphic a viewer would not have to take the extra time to read down to the third line of the caption to realize what the arrows signify. As is the arrows might be the elements are rising in altitude.CMMLT would posit that the addition of the rain cloud is distracting.	2. Our Changing Climate	2.1	30		We appreciate the suggestion, but space is limited. The author team has deliberated and agreed on the most important information/illustrations to include. The caption explains the up and down arrows.
H	WITTE	By merely placing "by 2070-2099" as a subtitle this image would be faster to read. Projected Temperature Change by 2070-2099	2. Our Changing Climate	2.7	37		We appreciate the suggestion, but space is limited and we think the figure is clear as is.
H	WITTE	Why should reader have to read the caption down to the 6th line before discovering what the figure is about: Temperature change by 2050. Figures are meant to speed comprehension.Add "by 2050" to the title: New Simulations for Projected Temperatures by 2050 (CMIP5 models).	2. Our Changing Climate	2.8	38		We have modified the caption but the comment mistakenly interpreted the figure also. The figure shows that different emissions scenarios produce different responses in US temperature. The caption describes those differences.
H	WITTE	Here again why not put the time period for the forecast, "2070-2090" as a subtitle for ease of comprehension. We are showing the readers SO MANY graphs that any aids to reading should help.	2. Our Changing Climate	2.10	41		This information is in the caption and commenter's suggestion seems unnecessary.
H	WITTE	place a subtitle of "1991-2011 compared to 1901-1960" below title	2. Our Changing Climate	2.11	42		This information is already in the caption. For stylistic consistency with other similar figures, we have not made the suggested change.
Chris	Heuer	Responding to some of the comments may be beyond the scope of remaining work. If so, the comments should be considered suggestions for future work.	22. Alaska and the Arctic				Due to the size of the topic, and the page limit for the chapter, we focused on broad trends rather than delving too deeply.
Chris	Heuer	The National Climate Assessment Strategy – Summary (20 May 2011) states that one purpose of the report is: "Develop, from a variety of sources, sound, integrated and relevant scientific information about climate change, to support the public and private sectors at local, state, regional levels as they develop policies and strategies for climate change mitigation and adaptation."	22. Alaska and the Arctic				This comment does not seem to raise any question or suggest any revision.
Chris	Heuer	The executive summary states: "The goal of this assessment report is to establish a scientific and credible foundation of information that is useful for a variety of science and policy applications related to managing risk and maximizing opportunities in a changing climate."	22. Alaska and the Arctic				This comment does not seem to raise any question or suggest any revision.
Chris	Heuer	To meet the above purpose/goal, the report should provide local and state climate data and projections. For Alaska, that can be done by referencing the web sites for the Scenarios Network for Alaska Planning (SNAP) and the Alaska Climate Research Center (ACRC). Both web sites are mentioned by Stewart, but the reader may not be familiar with that reference.	22. Alaska and the Arctic				Due to the size of the topic, and the page limit for the chapter, we focused on broad trends that document climate impacts and societal implications in Alaska. Space limitations preclude including detailed

							information on local climate data and projections. This information is available in Markon 2012. The SNAP website is cited.
Chris	Heuer	It should be assumed that a significant portion of the audience for the report is skeptical about the accuracy of GCM's for predicting future climate for Alaska. Skeptical not that some warming may occur but skeptical of the accuracy of the amount. The chapter should present a strong case for the accuracy of the GCM's for Alaska. The best way to do that is to present comparisons between measured and predicted air temperatures over a long period for several specific locations. The period of comparison should ideally be at least twice as long as any "extrapolation" into the future. Barrow and Fairbanks would be good selections because they have longer records than other locations. They are also representative of continuous and discontinuous permafrost. The temperature at Barrow is also useful for assessing seasonal ice thickness in the Beaufort.	22. Alaska and the Arctic				Due to the size of the topic, and the page limit for the chapter, we focused on broad trends rather than delving too deeply or providing such a level of specificity. Chapter 2 (Our changing Climate) addresses issues related to climate projections.
Chris	Heuer	"Extrapolation" is used instead of "projection" because the parameterizations in the GCM's are extrapolated to higher carbon dioxide concentrations.	22. Alaska and the Arctic				Due to the size of the topic, and the page limit for the chapter, we focused on broad trends rather than delving too deeply or providing such a level of specificity. Chapter 2 (Our changing Climate) addresses issues related to climate projections.
Chris	Heuer	SNAP performed a validation for five GCM's and 32 locations. Unfortunately, the comparison period was only 1980 to 2007. The major changes in climate during the 1970's were not include. Lots of statistics were generated but straightforward comparisons of measured and predicted temperature versus time were not presented. Such comparisons should be generated from at least 1949 through 2012 and updated as more data becomes available.	22. Alaska and the Arctic				Due to the size of the topic, and the page limit for the chapter, we focused on broad trends rather than delving too deeply or providing such a level of specificity. Chapter 2 (Our changing Climate) addresses issues related to climate projections.
Chris	Heuer	Consider deleting the subjective adverb "rapidly". Rapidly compared to what? Present the data and compare to historical data to objectively assess rate.	22. Alaska and the Arctic				The text has been revised to incorporate this suggestion. References are provided for speed of glacier melt.
Chris	Heuer	Very little information on observed air temperature is given here or by Stewart.	22. Alaska and the Arctic		760	26	Due to the size of the topic, and the page limit for the chapter, we focused on responses to climate change. Chapter 2 (Our Changing Climate) presents the requested information on Alaskan climate change.
Chris	Heuer	The stated annual and winter temperature increases come from Table 1 in Stewart where they are described as "total changes". The reader might infer that the changes were observed rather than calculated. However, going to the next level of reference (ACRC), the latter appears to be the case. Even though the long-term temperatures shown in Stewart Figure 4 are described as "clearly nonlinear", the stated temperature increases appear to be from linear fits.	22. Alaska and the Arctic		760	26	Due to the size of the topic, and the page limit for the chapter, we focused on responses to climate change. Chapter 2 (Our Changing Climate) presents the requested information on Alaskan climate change.
Chris	Heuer	Since temperature versus time is not very linear, the slope of a linear fit (warming rate) is sensitive to the time period selected. Why was 60 years used? Was it because the record for Alaska is better after about 1950?	22. Alaska and the		760	26	Due to the size of the topic, and the page limit for the chapter, we focused on responses to climate change.

			Arctic				Chapter 2 (Our Changing Climate) presents the requested information on Alaskan climate change.
Chris	Heuer	Add a figure comparing mean annual temperature versus time for Alaska and the continental U.S. Include the linear fits. This will illustrate significant uncertainty.	22. Alaska and the Arctic		760	26	Due to the size of the topic, and the page limit for the chapter, we focused on responses to climate change. Chapter 2 (Our Changing Climate) presents the requested information on Alaskan climate change.
Chris	Heuer	Table 1 in Stewart indicates significant variation in warming across the state (3°F ± 2°F). Figure 2.6 from Chapter 2 of this report indicates significant variation in warming for different regions of the U.S. This illustrates the need for site specific information for local decisions. Global and national trends can be quite different from local trends.	22. Alaska and the Arctic		760	26	Due to the size of the topic, and the page limit for the chapter, we focused on responses to climate change. Chapter 2 (Our Changing Climate) presents the requested information on Alaskan climate change.
Chris	Heuer	Stewart discusses the "stepwise shift" in mean annual temperature between 1976 and 1977 due to the shift in the PDO phase from negative to positive (p. 15). It is not reasonable to fit a linear function across the step change. For example, for Fairbanks, a linear fit from 1909 to 1976 gives a cooling rate of 0.12°F/decade. A linear fit from 1977 to 2012 gives a cooling rate of 0.48°F/decade. The step increase between the two linear fits is 3.2°F. Consistent with Stewart Table 1, a linear fit from 1949 to 2011 gives a warming rate of 0.53°F/decade. A linear fit from 1909 to 2012 gives a warming rate of 0.20°F/decade. Similar results were published by Hartmann and Wendler 2005 ("The Significance of the 1976 Pacific Climate Shift in the Climatology of Alaska", Journal of Climate, 18, 4824-4839).	22. Alaska and the Arctic		760	26	Due to the size of the topic, and the page limit for the chapter, we focused on responses to climate change. Chapter 2 (Our Changing Climate) presents the requested information on Alaskan climate change.
Chris	Heuer	The difference in warming/cooling rates for different time periods is important when extrapolating the observed trends to estimate future air temperatures. Extrapolating the trend in Stewart Table 1 probably over estimates temperature. Wendler et al. 2012 ("The First Decade of the new Century: A Cooling Trend for Most of Alaska", The Open Atmosphere Science Journal, 6, 111-116) discusses a cooling trend in Alaska.	22. Alaska and the Arctic		760	26	Due to the size of the topic, and the page limit for the chapter, we focused on responses to climate change. Chapter 2 (Our Changing Climate) presents the requested information on Alaskan climate change.
Chris	Heuer	Carbon dioxide concentration increases smoothly with time for the entire globe. Mean annual air temperature for a specific location increases irregularly with time because of many types of natural variabilities lasting from years to decades. Nevertheless, if carbon dioxide is the major driver for climate warming, a linear fit for temperature versus carbon dioxide over a long time period must show an increasing trend. The R-squared value may be low, as for temperature versus time, but the trend can still be judged reasonable. The trend could be used to extrapolate to higher carbon dioxide concentrations. This simple approach is much more transparent than GCM predictions.	22. Alaska and the Arctic		760	26	Due to the size of the topic, and the page limit for the chapter, we focused on trends for AK. Chapter 2 (Our Changing Climate) presents the requested information the global climate system.
Chris	Heuer	The PDO has now shifted negative again, and there was a small step decrease in Fairbanks temperature around 2006.	22. Alaska and the Arctic		760	26	Due to the size of the topic, and the page limit for the chapter, we focused on responses to climate change. Chapter 2 (Our Changing Climate) presents the requested information on Alaskan climate change. PDO detail is available in Markon 2012 reference.
Chris	Heuer	In a 2008 report to the National Park Service ("Climate Data Analysis of Existing Weather Stations in around the Central Alaska Network"), Keen concluded that every major shift in PDO has affected central Alaska air temperatures back to 1900.	22. Alaska and the		760	26	Due to the size of the topic, and the page limit for the chapter, we focused on responses to climate change.

			Arctic				Chapter 2 (Our Changing Climate) presents the requested information on Alaskan climate change. PDO detail is available in Markon 2012 reference.
Chris	Heuer	Stewart states that "the Interior region has experienced the greatest overall warming". Actually, the Arctic region has experienced the most warming. Unfortunately Stewart Table 1 only has one station in the Arctic region, Barrow.	22. Alaska and the Arctic		760	26	Due to the size of the topic, and the page limit for the chapter, we focused on responses to climate change. Chapter 2 (Our Changing Climate) presents the requested information on Alaskan climate change.
Chris	Heuer	Barrow also experienced a change in 1976/77. A linear fit from 1921 to 1976 gives a cooling rate of 0.33°F/decade. A linear fit from 1977 to 2012 gives a warming rate of 1.29°F/decade. Consistent with Stewart Table 1, a linear fit from 1949 to 2011 gives a warming rate of 0.78°F/decade. For Barrow, extrapolating the Stewart Table 1 rate probably under estimates temperature. Note that a quadratic fit captures both the cooling and warming with an R-squared two times higher than a linear fit.	22. Alaska and the Arctic		760	26	Due to the size of the topic, and the page limit for the chapter, we focused on responses to climate change. Chapter 2 (Our Changing Climate) presents the requested information on Alaskan climate change.
Chris	Heuer	It would be useful to provide information on paleoclimate for Alaska, at least by reference. Knowing the temperature in Alaska during the Medieval Warming Period and the Little Ice Age would be useful benchmarks for assessing future climate change.	22. Alaska and the Arctic		760	26	Due to the size of the topic, and the page limit for the chapter, we focused on responses to climate change. Chapter 2 (Our Changing Climate) presents the requested information on Alaskan climate change.
Chris	Heuer	State that the temperatures are averages for the indicated 30-year periods. That is consistent with climate normals. Illustrate how climate normals have been changing with time based on measurements.	22. Alaska and the Arctic		761	1	We have added a citation in our chapter assessment to Stewart et al 2013. Due to the size of the topic, and the page limit for the chapter, we focused on responses to climate change. Chapter 2 (Our Changing Climate) presents the requested information on Alaskan climate change.
Chris	Heuer	Discuss how the boundaries for the different temperature regions were determined. The boundaries are smooth curves which do not follow latitude and longitude which were used to determine GCM cell boundaries.	22. Alaska and the Arctic		761	1	Due to the size of the topic, and the page limit for the chapter, we focused on responses to climate change. Chapter 2 (Our Changing Climate) presents the requested information on Alaskan climate change.
Chris	Heuer	Give Figure 17 in Appendix 2 as a reference for carbon dioxide concentration versus time for the two emissions scenarios. Stewart shows emission but not concentration. Note that emissions are global emissions and not U.S. emissions. The reduction in emissions is by the end of the century.	22. Alaska and the Arctic		761	1	Due to the size of the topic, and the page limit for the chapter, we focused on responses to climate change. Chapter 2 (Our Changing Climate) presents the requested information on Alaskan climate change.
Chris	Heuer	Explain that the projected temperatures are the mean of 15 different GCM's for A2 and 14 different GCM's for B1. Discuss why so many different GCM's are used. Why not just use the "best" GCM? Illustrate the wide range of results for the different GCM's. An example is Stewart Figure 9. Appendix 2	22. Alaska and the		761	1	Due to the size of the topic, and the page limit for the chapter, we focused on responses to climate change.

		mentions that there are 35 GCM's (p. 1153, l. 13). How were the 15 GCM's used for this figure selected? SNAP decided to use the mean of 5 GCM's. Comment on the different approaches.	Arctic				Chapter 2 (Our Changing Climate) presents the requested information on Alaskan climate change.
Chris	Heuer	According to Category 3 as described by Stewart on p. 25, 33% of the GCM results should show cooling instead of warming. How many actually showed cooling?	22. Alaska and the Arctic		761	1	Due to the size of the topic, and the page limit for the chapter, we focused on responses to climate change. Chapter 2 (Our Changing Climate) presents the requested information on Alaskan climate change.
Chris	Heuer	Were the same simulations used for Figure 2.3 for global temperature? How do the 15 different GCM's individually compare with the measured data?	22. Alaska and the Arctic		761	1	Due to the size of the topic, and the page limit for the chapter, we focused on responses to climate change. Chapter 2 (Our Changing Climate) presents the requested information on Alaskan climate change.
Chris	Heuer	Define "sea ice extent" in terms of minimum coverage.	22. Alaska and the Arctic		762	7	The text has been revised to incorporate this suggestion.
Chris	Heuer	Is the decrease in summer ice extent due to in-place melting or to changes in ocean currents that flush ice out of the Arctic Ocean? What data are available for maximum first-year ice thickness, for ice melting from the top and bottom, and for open-water surface temperature?	22. Alaska and the Arctic		762	7	"We appreciate this suggestion, but space is limited. We did clarify the text to specify that the ice was thinner due largely to melting in place. However, for the reviewer, the reduction in summer sea ice extent appears to be largely in-place melting although export of ice ice out of the Arctic Ocean and onto the North Atlantic via winds and ocean currents (primarily through Fram Strait) has certainly played a role. There is evidence that, during the late 1980s through the mid 1990s, the pattern of winds favored a particularly strong export of the Arctic's store of thick ice into the North Atlantic through Fram Strait, leaving thinner ice that is more apt to melt out in summer. Other episodes of strong ice export have occurred more recently. A new generation of mass balance buoys is now providing information at both the top and the bottom of the ice cover. It is apparent that thinning of the sea ice cover reflects both top and bottom melt. [References for this commentary (not to be added to chapter): Rigor, I.G. and

							Wallace, J.M. [2004]. Variations in the age of Arctic sea-ice and summer sea-ice extent. Geophy. Res. Lett. 31, L09401, DOI:10.1029/2004GL019492. Wang, J., Zhang, J., Watanabe, E., Ikeda, M., Mizobata, K., Walsh, J.E., Bai, X. and Wu, B. 2009. Is the dipole anomaly a major drier to record lows in Arctic summer sea ice extent. Geophys. Res. Lett. 36, L05706, doi:10.1029/2008GL036706. Stroeve, J.C., Serreze, M.C., Holland, M.M., Kay, J.E., Maslanik, J. and Barrett, A.P. 2011. The Arctic's rapidly shrinking sea ice cover: a research synthesis. Climatic Change, doi: 10.1007/s10584-011-0101-1.]"
Chris	Heuer	Refer to Stewart Figure 28 for predictions of sea ice extent.	22. Alaska and the Arctic		762	7	We appreciate the suggestion, but feel the current references are appropriate and adequate given the chapter's space limitations.
Chris	Heuer	Mention the decrease in multi-year ice thickness and opening/closing dates for the Northwest Passage. One of the major impacts of a seasonally ice-free Arctic Ocean would be the total elimination of thick multi-year ice (excluding ice islands), which would greatly reduce design ice loads on offshore structures.	22. Alaska and the Arctic		762	7	The text has been revised to incorporate this suggestion.
Chris	Heuer	The comment on polar bear population decline appears to be limited to the Hudson Bay area. What is the status of the global population?	22. Alaska and the Arctic		764	21	The text has been revised to incorporate this suggestion.
Chris	Heuer	What is the status of the global walrus population?	22. Alaska and the Arctic		765	1	While the comment suggests a good specific example, the authors feel the existing examples are appropriate and adequate since the impacts of climate change on global walrus population are too uncertain to warrant discussion, given the space available.
Chris	Heuer	The increase in wave energy due to increased fetch is much more important for increasing erosion than warming permafrost. Even for cold permafrost, coastal thaw rate is high if the thawed soil is continuously removed by erosion. If properly designed, erosion control measures will work, but the cost increases as wave energy increases.	22. Alaska and the Arctic		765	8	The text has been revised to incorporate this suggestion.
Chris	Heuer	The stated 5°F warming must be for mean annual surface temperature on the North Slope. Explain that in the text. Because the permafrost is cold, the warming would not lead to much thawing. Note that figures such as Figure 34 in Markon show much less warming because the measurements were made at a depth of 20 m. The deeper permafrost is not yet in thermal equilibrium with the surface temperature.	22. Alaska and the Arctic		767	8	The text has been revised to incorporate this suggestion.
Chris	Heuer	"Acceptable" thaw settlement depends on the amount of differential settlement and the application, e.g., building foundation, road, pipeline. "Variable-to-high" ice content is subjective. It would be better	22. Alaska		767	8	This comment does not appear to be relevant to the cited page and lines.

		to provide a range of moisture contents by volume.	and the Arctic				
Chris	Heuer	Permafrost is never "present at the surface". There is always a seasonal active layer.	22. Alaska and the Arctic		768	3	The caption has been clarified.
Chris	Heuer	Are the results based on GILP 1.0 or GIPL 2.0. The latter calculates a one-dimensional temperature profile to a depth > 100 m. Therefore, the modeling could provide thaw depth and settlement, which would be much better than the mean annual temperature at a depth of 1 m. Results using GIPL 2.0 were published by Jakarov et al. 2012 ("Numerical Modeling of Permafrost Dynamics in Alaska Using a High Spatial Resolution Dataset", The Cryosphere, 6, 613-624).	22. Alaska and the Arctic		768	3	The text has been revised to clarify which model. To estimate ground surface settlement it is necessary to have data on ice content in the upper permafrost. These data are largely unavailable for most of Alaska, so this issue is not addressed quantitatively in the chapter.
Chris	Heuer	The two examples of thaw settlement are probably not due to climate warming. The surface disturbance (warming) due to a building or a road can be several degrees equivalent to several decades of climate warming. The examples are extreme and not representative of 70% of permafrost.	22. Alaska and the Arctic		769	1	The caption has been clarified.
H	WITTE	This is graphic may be a bit confusing to the lay reader So just how does one read this chart of Observed U.S. Trends in Heavy Precipitation" with the y-axis units of "relative number of extreme events"?Compared to the period 1901-1960 in the decade of the 2000 there were 1.4 "events" (occurrences) of "heavy" rain?Would it be helpful to give such a description in the caption?	2. Our Changing Climate	2.14	48		The y-axis units were indeed confusing and not well-described in the caption. We have changed the units to percent. This has the straightforward interpretation that there were 40% more events in the decade of the 2000s compared to the average number during the reference period of 1901-1960.
H	WITTE	Is the y-axis "percentage"? Units? By 2100 we might expect 0.3%, or less than one percent of the US and Mexico combined to be in extreme drought? Might double check where the decimal goes along the y-axis	2. Our Changing Climate	2.21	57		Note that this figure using PDSI has been moved the appendix. This axis will be labeled in new figure.
H	WITTE	make for faster "reading" by putting time periods in a subtitle?Projected Changes in Atlantic Hurricane Frequency by Category by 2081-2100 compared to 2001-2020	2. Our Changing Climate	2.24	62		This figure has been removed.
H	WITTE	The reader has to read all the way down to the 5th and 6th line of the caption in order to find out the time periods. Make the "reading" of the graph easier by placing the time period as a subtitle to the graph. Changes in Snow, Runoff, and Soil Moisture 2041-2070 compared to 1970-2000	3. Water Resources	3.1	110		Thank you for the suggestion, but we still believe the figure and caption are clear and accurate.
H	WITTE	This is a VERY interesting set of graphics, lots of valuable data, but it is SO tiny, and hard to read. Water resource people will be very interested.	3. Water Resources	3.2	112		Thank you for your suggestion. We will take this into consideration, but space limitations of the overall NCA report

		Why not make this visualization two full pages: 1. map of water sheds/river basins, with locator labels 2. Full page of the set of 8 mini graphs, blown up to a readable size.					may not allow us to expand its size.
John	Schivell	I applaud the great breadth of the range of impacts that you have examined. Climate change will affect so many areas of our lives and our economic well-being. It is important that you have described all of this. I only wish it were possible to get more actual dollar values on the potential harm. But I understand that it is hard to make quantitative predictions.	8. Ecosystems, Biodiversity, and Ecosystem Services				No change. Dollar values were used wherever they could be found. They are indeed hard to come by.
H	WITTE	what is "value"? monetary value? dollars and cents?	6. Agriculture	6.1	229		We appreciate your suggestion. We have modified the figure.
H	WITTE	R. Mayer's Cognitive Multimedia Learning Theory might posit that the "for 2100" could easily be included in the title to make the graphic faster and therefore easier to comprehend.	6. Agriculture	6.5	234		We have changed the figure caption to indicate that it is for 2100.
H	WITTE	R. Mayer's Cognitive Multimedia Learning Theory and Edward Tufte might posit that it would speed comprehension if the "2041-2070, compared to 1971-2000" were placed as a sub-title.	6. Agriculture	163	552		We thank the reviewer for the helpful suggestion, but the figure is being redrawn to show both current and projected temperatures.
H	WITTE	If the image is about the torrential rain why not a rainfall map?	6. Agriculture	16.4	554		After consideration of this point, we still feel the existing graphic conveys the magnitude of the event better than a map., esp since the message is flooding rather than simply rain.
H	WITTE	What is "collision" ? And if it is 100% for everyplace is it significant compared to the two other variables?	6. Agriculture	16.5	555		After consideration of this point, we still feel the existing text is clear and accurate. Collision is defined in the caption 'collision of waves causing erosion' and it's significant as it was a prediction.
H	WITTE	If there are only 3 general variables (NYC, Central Park, and Hudson River) why not make this figure easy to read and comprehend by putting the 3 (general) temperatures for each area? Or add numbers in the caption.	6. Agriculture	16.6	557		After consideration of this point, we still feel the existing legend is required to convey more gradations than 3 - even within those 'variables' there is important variation if you live there.
H	WITTE	What is shown on the left side? What is depicted on the right side? Is this for the same time: 2080?Why not put 2080 as a subtile for easier comprehension?	6. Agriculture	16.9	563		This figure has been completely redrafted to address these issues.
Peter	Carter	Executive Summary Report Findings	1. Executive Summary				Thank you for your comments. The authors believe the current language adequately represents the state of

		In general there is no indication in the assessment of the climate science reality that catastrophic impacts to the world and the US are now unavoidable, because committed unavoidable global warming exceeds 2C. There is no indication we are in a dire state of planetary emergency. Without an all out global emergency response we are committed a warming of above 3C this century. Civilization cannot survive a 3C warming. Unless this dire global emergency is recognized there will be no effective response to unavoidable global warming with the result that world and US agriculture will collapse, which will lead to collapse of civilization. 3. According to the science of atmospheric CO2 climate change will continue to accelerate unless there are very large cuts in emissions. 4. We are already committed to disastrous and catastrophic Impacts because of todays committed unavoidable global warming. 'Food security is emerging as an issue of concern, both within the U.S. and across the globe, and is affected by climate change.' World food productivity and US food production is already committed to decline due to committed global warming. This is a world and US food security emergency right now. '8. Adverse impacts to crops and livestock over the next 100 years are expected.' There is no evidence that US agriculture can be resilient to the multiple adverse impacts of global warming and climate change on crop yields. All evidence indicates world and US crop yields will inexorably decline above a global warming of 1.5C or less. There is no evidence that US agriculture can adapt the climate change and without an emergency response climate change will render the American climate unable to sustain agriculture. It is absurd to assume that US agriculture can be resilient or adapt to increasing disruptions from extreme heat, drought, and heavy downpours, and there are many other unavoidable adverse impacts in addition to these. The only response to mitigate the agricultural losses is emergency drastic emissions reductions.					knowledge on these topics - this is a scientific assessment, not a policy review.
Peter	Carter	' Key Messages 15 1. Climate disruptions to agricultural production have increased in the recent past and are projected to increase further over the next 25 years. By mid-century and beyond, these impacts will be increasingly negative on most crops and livestock.' All projections show that the US will suffer crop losses above 2.0C or less. It is not true that the US will be food production secure till after 2050. This is an extremely dangerous misleading statement. 1. The further increase in climate disruption over the next 25 years will cause unavoidable crop yield losses. Losses by midcentury will render US agriculture unsustainable. We are in a dire world and US committed crop production decline emergency. Current research on the multiple adverse impacts of global warming and climate change on crops shows that temperate Norhern hemisphere agriculture is highly vulnerable.	6. Agricultu re				The key message doesn't imply there is no effect, in fact the statement shows there will be increasing disruptions over the next 25 years and then will become more severe. No change was made in the text. We appreciate the comments.

		Committed warming of over 2C already commits US crop yields to decline. According to climate crop models and drought models - all US crops will decline above a warming of 1.6C or less. Drought projections show most the best food producing US regions will be in severe drought under a warming of 1.8C (Dai 2111). See http://climateemergencyinstitute.com/us_review.html for references. Above a warming of 1.2C multiple combined adverse impacts will almost certainly cause US crop yield losses.3. Conservation methods cannot do anything but slightly delay losses of water and soil quality. 4. Committed increasing extreme events will have disastrous to catastrophic impacts on US crop yields. 5. It is impossible for US agriculture to successfully adapt to a rapidly changing climate that will be outside the narrow climate capacity to sustain agriculture. A very large ignored adverse impact on US food production is the rapid loss of Arctic albedo cooling from the melting of spring/summer Far North snow and summer sea ice cover. The albedo is the air conditioner of the Northern hemisphere. Its loss increases extreme heat and drought, prolongs extremes and increases climate variability. This is catatsrophic for US agriculture impacting on top of direct global warming damages to US food producing regions. The only response to mitigate already committed US crop losses is emergency drastic emissions cuts.					
Peter	Carter	Though some populations are more vulnerable to climate change no US population is not vulnerable to the many health impacts. Public health services cannot protect against climate change. US public health services are not designed to deal with climate change and have little capacity to do so. The services will be overwhelmed. Food security. At already committed global warming the US will suffer crop yield losses and this will affect the entire population. Food price increases followed by less food availability will cause widespread civil unrest which will further impair public health services to respond. This will lead to massive population malnutrition and ill health. See http://climateemergencyinstitute.com/us_review.html for referencesThe only response to mitigate unavoidable increasing US population health disasters is an emergency drastic emissions cut now.	9. Human Health				Thank you for your comment and your concerns. In recognition of the importance of addressing response strategies, the report explicitly addresses adaptation, mitigation, and decision support responses, and associated research needs, in Chapters 26-29. Other chapters also include assessment of adaptation responses. The policy issues, while entirely important, are beyond the defined scope of the National Climate Assessment and this chapter, which are scientific documents that provide the basis for decision-making, but do not address policy.
Peter	Carter	The assessment ignores the enormous world and planetary effects of the melting of Far North spring/summer snow and summer sea ice. This is the single most damaging impact of global warming and it is already at a planetary emergency situation (James Hansen 2008, 2012. The Arctic sea ice past its summer ice free state tipping point in 2007 (T Lenton 2007, 2012) The post 2007 bifurcation new Summer sea ice linear trend by volume and extent have the sea ice headed for summer ice free conditions in a few years not by mid centurty as the assessment says - as	22. Alaska and the Arctic				We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include. This chapter describes the changes in sea ice, albedo, and trace gas releases, and their climatic implication, as the

		the models project. The sea ice models are works in progress that cannot replicate the observed loss of sea ice and should not be relied on for quantitative assessment. Loss of sea ice albedo is a planetary emergency. The loss of spring- summer snow-sea ice albedo cooling is a large amplifying feedback. It is already causing the Arctic to be warming three times as fast as the global average. Acclerating Arctic warming and accelerating Arctic albedo loss is a catastrophic sitation foir two reasons. The first is Arctic methane feedback runaway. This rapid Arctic warming has triggered additional methane to be emitted from all Arctic methane carbon pools and that is contributing to the renewed sustained increase in atmospheric methane. In other words Arctic methane feedback has been triggered with planetary catastrophic implications (runaway). This is a most dire planetary emergency that threatens the survival of humanity and most of life. It is definite and it must be acknowledged as the planetary emergency it is. This is the priority issue of the climate assessment. The other Arctic albedo loss catastrophe is to Northern Hemispehere (NH) food production. The worlds top food porducing regions are in the NH. Arctic albedo summer cooling is what scientists cal the 'air conditoner' of the enmtire NH. Under direct global warming NH food producing regions are projected to suffer increased extreme heat and drought. The loss of Arctic albedo cooling will increase the frequency severity and duration and of these NH extreme events that is devastating to NH, and so world, food production.					reviewer requests. The traceable accounts describes additional basis for the statements in the text. Other chapters address the consequences of the resulting climate changes on other processes and regions.
Marjorie	McGuirk	This line and paragraph refer to NRC 2008. The listing in the Bibliography should perhaps be edited to include: "Special Report 290. Washington, DC: The National Academies Press"The material in the paragraph however, may refer more directly to a paper commissioned by the NRC.Climate Variability and Change with Implications for Transportation. Thomas C. Peterson, Marjorie McGuirk, Tamara G. Houston, Andrew H. Horvitz, National Oceanic and Atmospheric Administration, and Michael F. Wehner, Lawrence Berkeley National Laboratory, Dec. 6, 2006.And more recently, to a paper published by WMO. McGuirk, M., S. Shuford, T.C. Peterson, and P. Pisano, 2009: Weather and climate change implications for surface transportation in the USA. Bulletin of the WMO, 58, 84-93.	5. Transportation		196	16	We have modified the first reference per your suggestion. We have added the Peterson citation.
Beth	Brumbaugh	"Simultaneous exposure to air pollutants" is somewhat vague since it is unclear what the simultaneous exposures are, I would recommend rewording it to be clearer to the reader, such as "Simultaneous exposure to multiple air pollutants"	9. Human Health		335	17	We changed the text to "simultaneous exposure to toxic air pollutants" to distinguish from pollens.
Beth	Brumbaugh	The legend should be labeled (ex. Percentage of emergency room visits for asthma) so that the reader does not have to search through the caption to get a basic sense of what the figure is illustrating. It might also be helpful to make it clearer that these are predicted percentage increases or to include the baseline year these predicted values are compared against.	9. Human Health	9.1	335		Thank you for your suggestions. After consideration of your first point, we still feel the existing title captures the overarching message we wanted to get across. In regards to your second

							point, projections are relative to baseline conditions (1990s), assuming an A2 emissions scenario. The text has been revised to incorporate this clarification.
Beth	Brumbaugh	There should be a period after "temperatures" and before "Increases".	9. Human Health		336	5	Thank you for your comment. We have added a period after "temperatures."
Beth	Brumbaugh	For figures that are images it could be helpful to the reader if they were briefly titled, particularly when the caption explanation is not as straightforward/short as that of Figure 9.4.	9. Human Health	9.5	339		We agree with your suggestion, but have taken out this figure.
Beth	Brumbaugh	The caption begins with the discussion of forest fires in Canada and their impacts on particulate matter concentrations in Baltimore, the transition directly to the overall fire season at line 9 may flow better if the "2012 wildfire season" is defined as just that of the U.S. or if it refers to the combined acres burned in the U.S. and Canada.	9. Human Health		341	9	The 9.2 million acres burned during the 2012 wildfire season is for the U.S. only. The text has been revised to incorporate this clarification.
Beth	Brumbaugh	Assuming that the large red dots are the fires, it might be helpful to include a line from the "Fires" label to one or two of them. There are smaller red dots throughout the map, if they also indicate fires a small inset could illustrate that the size of the dot is proportional to the fire size. A scale bar is also recommended for any map.	9. Human Health	9.6	341		We agree with your suggestion and have edited the figure and caption to address this comment. We did not however add a horizontal scale bar, since none was included in the parent article (Sapkota 2005), nor in the reprint in Kinney (2008).
Lin	Chambers	It would be helpful to overlay or somehow indicate how much population, infrastructure, industry, etc, are contained in the areas that are vulnerable to sea level rise. This might require a table(s) in addition to the figure.	17. Southeast and Caribbean	17.6	590		We appreciate the suggestion, but space is limited and this information is already available in the cited reference.
Lin	Chambers	The scale on this figure makes no sense with the caption. I guess these are changes from 2001? But not just increases, since the scale includes negative numbers?	17. Southeast and Caribbean	17.10	596		The caption has been clarified since in the Southeast, a decrease is projected to occur in a small area of Southeast Florida.
Lin	Chambers	This figure is not interpretable when printed in black and white. If that is a concern then it should be modified somehow.	17. Southeast and Caribbean	17.11	599		We thank the reviewer for the helpful suggestion, but the figure will be in color.
Lin	Chambers	This chapter does not address one particular challenge which I observe as a resident of the southeast. That is the relative lack of education/information about the risks of climate change which seem to be particularly acute for this region.	17. Southeast and Caribbean				The entire NCA effort is focused on increasing knowledge. Adding this specific topic to this chapter is beyond the scope of this chapter.
Minda	Berbeco	Since king tides are due to gravitational forces, including this image has the ability to confuse people and could increase accusations of attempting to mislead the public. A better figure would be a map of areas that would be impacted by rising sea levels. This is a question many people in the public ask and	20. Southwest	20.5	696		We are not able to add such a figure at this time, but have added a link to an interactive one. We feel that king tides

		would be useful to have for the document.					provide an illustration of the impacts of higher sea levels, and have amended the caption to prevent misleading the public in any way.
Minda	Berbeco	This figure seems hyperbolic, particularly including the term "vicious spiral". It would be better to keep images and text limited to direct facts. The ideas included in the spiral are good, but are they supported by the peer reviewed literature? Including the citations would be useful and informative.	20. Southwest	20.6	698		Thank you for your comment. The figure and caption have been completely revised to better illustrate the connection of increased heat and health impacts and will link to supporting text and literature.
Minda	Berbeco	This citation has a typo in it: Bumbaco, K. and P.W. Mote, 2010: Three recent flavors fo drought in the Pacific Northwest.	20. Southwest		748		This reference is not in the SW chapter, but has been repaired in the NW chapter.
Minda	Berbeco	Williams et al. 2010 was cited on line 9, but I could not find it the citations.	20. Southwest		695	9	Thank you for your comment. We checked and found the Williams reference is included in the bibliography.
Minda	Berbeco	Brown et al 2012 are cited twice in a row. Could you find more citations to support your argument and/or cite Brown once at the end of the paragraph.	20. Southwest		699	4	Thank you for your comment. The text has been revised to incorporate this suggestion.
Minda	Berbeco	There are many statements that are not backed by citations. I don't doubt that the statements are true, but this is a document that will be gone over with a fine-toothed comb by many parties (some of which will be looking for any excuse to discount the entirety of the document), so why give them any ammunition. As there is such a wealth of information in the peer-reviewed literature, this should be easy to do. I won't go over all of the places where additional citations would help, but two brief examples:On page 690 "The region has experienced severe, 50-year-long mega droughts...." was not cited. Or on page 695 line 5-7 "Recent policies that allow.....levels seen before the strict fire controls." Is there evidence for this statement? Could you point to it?	20. Southwest				Thank you for your comment. Numerous references have been added throughout to support the statements.
Minda	Berbeco	Sea Level rise:People in California are constantly asking me about sea level rise. A map showing affected areas under different scenarios would be highly used and of great interest to the public.	20. Southwest		695		We appreciate the suggestion, but space is limited. However, we have included a link to an interactive map that shows projected threatened areas.
Minda	Berbeco	Though I understand why you chose this figure, I think it has a high risk of being misinterpreted by the public. More frost-free days = longer growing season = more food = good. I think a better figure would demonstrate expectations for a northward shift in a specific high-cost product like almonds or wine. This figure would be a useful tool for those working with growers.	20. Southwest	20.4	694		We appreciate the suggestion, and have modified the title of the figure and the caption. The responses of specific high-cost products to climate changes will depend to some degree on microclimates, and we do not recommend generalizing these responses in a map.
Minda	Berbeco	Though communication was mentioned several times in the document, I was disappointed that education was left out of the discussion. It also seems that educators were not included in the development process of the document. As educators will no doubt use the document to answer questions regarding regionally specific impacts of climate change, it seems like an oversight not to have					Thank you for your comments. Since this is an assessment of the state of knowledge related to climate change, an assessment of climate literacy is

		included them in the development process.There is ample peer-reviewed literature regarding students' understanding of climate change, common misconceptions and how to best teach about it to a US audience. Similarly, there is ample evidence demonstrating that students' understanding impacts their behavior and choices, which appears to be of interest to the NCA -- particularly when talking about energy. It would be useful to at least mention this research when discussing communication, as it is not just about engaging policymakers.I would encourage you to engage the climate science education community in the final draft preparation. This could include folks from NOAA, TERC, Climate Literacy and Energy Awareness Network (CLEAN), or the National Center for Science Education (NCSE) who have been working with teachers for decades on how to integrate climate change science into the classroom.					one topic that could have been chosen for inclusion. However, it was not possible to cover every topic in this report due to space constraints. Fortunately, many of the topics you suggest have been addressed by many recent publications and programs. The NCA should serve as an excellent foundation for educational efforts in schools, and the electronic delivery format is expected to encourage broad access to the information through web-based capacity and tools.
David	Wang	General comments:This chapter does a good job highlighting connections between three complex topics. The Texas case study is especially helpful, and the Columbia Basin example could be more powerful with more detail on proposed adaptation methods. The technical and physical interactions between water, land, and energy are well-explained, but there is less space devoted to the social aspects, which may be equally challenging. A (perhaps insignificant) note on terminology – chapter 4 exclusively uses the term “heat-trapping,” chapter 13 exclusively uses the term “greenhouse gases” and chapter 3 includes the use of both. Suggested additions: 1. Wind: Most conversations about the energy future of the United States includes wind power, and its omission from this chapter is obvious – beginning from the second sentence of the chapter: “Energy projects – coal-fired power, biofuel, solar farms – require varying amounts of water and land” It is especially noticeable given that wind farms are often associated with large land-use requirements. The decision not to include a section of on wind power is presumably intentional, and it may be helpful to note the rationale. 2. Life cycle water use for different energy production methods: A figure comparing life cycle water consumption or withdrawal (gallons / MWh) of electricity-generating technology types would be extremely helpful (See Meldrum, J., Nettles-Anderson, S., Heath, G., & Macknick, J. (2013). Life cycle water use for electricity generation: a review and harmonization of literature estimates. Environmental Research Letters, 8(1), 015031). A companion figure comparing land-use requirements (acres / MWh) would be similarly helpful. Alternatively, both sets of data can be charted on one figure to show some basic tradeoffs e.g. wind and solar require relatively small amounts of water per MWh, but have relatively high land-use requirements when compared to coal or nuclear. 3. Social aspects of the water, energy, and land intersection: Understanding that there is not enough room to cover all the physical interactions between water, energy, and land, nonetheless it may be useful to mention that the social aspects add another layer of complexity. Jurisdictional issues are already a challenge when dealing with one system. Integrating water, energy, and land use concerns would involve an extraordinary level of cooperation amongst federal agencies. Including relevant state, regional, and local agencies creates a significant challenge to formulating mitigation and adaptation plans that worth noting. The water, energy, and land use chapters identify decisions makers for the respective systems, and a comparison of the decision-makers in each system seems appropriate.	10. Water, Energy, and Land use				The text has been revised to incorporate additional information on wind and on social aspects. The text has been revised to incorporate this perspective. A figure on land-use has been added and we have added the suggested citation. The importance of social and other factors and the impacts on decisions have also been included.
cyd	hamilton	Recommend including percentage of carbon dioxide emitted and captured into 'ppm'. This will be useful to a broader audience and better contextualize the inputs/outputs.	7. Forestry		264		After consideration, we still feel the existing text is clear and accurate. CO2 Tg are the accepted units for this metric.
cyd	hamilton	Image needs to be higher resolution and recommdn using contrasting color to better visualize data. Where did the categories come from - why hurrican/wildfire versus some other pair?	7. Forestry	7.1	265		Due to the size of the sector and the page limit for the chapter, we focused

							on broad trends rather than delving too deeply or providing such a level of specificity. The text has been revised to add information on the nature of the disturbance index and the dates over which the disturbance index was estimated.
cyd	hamilton	Line 11: provide an example of large ecosystem effects line 25, define 'large scales' Has anyone utilized extreme event analyses to determine whether frequency of extreme events can be attributed to climate change versus not?	7. Forestry		266		We have revised the text to clarify the issue and include the most relevant references on analyses of extreme events.
cyd	hamilton	;omes8 & 9 seem somewhat redundant line 15 remove 'recent' and 'that'	7. Forestry		267		The requested change is not entirely clear, but the authors think it is important to make the point clear that recent assessment did not predict the observed severity of die-off that has been occurring; no changes were made to the text.
cyd	hamilton	Recommend adding lables to sink source points on the graph in addition to in the key. Define 'belowground' - how far below ground down to 10cm, 30cm? line 16 convert 270 mt to ppm captured	7. Forestry	7.3	270		The figure has been deleted from the text. This figure is currently in journal review and consequently will not meet the requirements of literature cited for the NCA document. We have replaced this figure with Figure 2.17 from Vose et al. 2012
L. Drew	Hill	The incorporation of human health co-benefits into the overarching narrative of this energy chapter would provide more compelling context for the importance and policy relevance of the energy consequences of climate change, especially to policy makers who may only read selected excerpts of the entire report and who may not have a firm understanding of the connections between energy supply and use and the welfare of their constituents. I have added line-specific suggestions in the passages amenable to the inclusion of health context in my "Text Region" commentary, including commentary on the Chapter Key Messages.	4. Energy Supply and Use				Human health impacts are an underlying theme of the entire NCA Report and is the focus of Chapter 9: Human Health. Responses to each of the text suggestions are provided below.
David	Gassman	This letter is excellent. Like any other product of human beings, I am sure that it can be improved, but not by me. It is short, clear & to the point.	Introduction: Letter to the American People				Thank you for your comment.
L. Drew	Hill	The mention of general health co-benefits in several of the Key Messages would provide more-compelling context for the importance of the energy consequences of climate change. The notion of health co-benefits could also be its own Key Message, for example: “Climate-related disruptions in energy supply stand to have considerable human health consequences. Higher summer peak loads will increase the frequency of blackouts during dangerous heat waves, limiting access to air conditioning and increasing related death tolls; the inundation of coastal energy supply infrastructure will leave	4. Energy Supply and Use		167	12	The focus of this chapter is the Energy Sector and so the projected impacts are described from the perspective of this sector. The perspective of the Human Health is addressed in Chapter 9: Human Health.

		coastal water treatment facilities inoperable, decreasing local communities' access to clean water; and changes in water availability will increase competition between thermal plants and agricultural & municipal regions for fresh water supplies."					
Cato	Institute	Review of the draft National Assessment by the Cato Institute1. IntroductionThis review is a product of the Center for the Study of Science at the Cato Institute. It was largely written by Patrick J. Michaels and Paul C. Knappenberger of Cato. Additional text was supplied by Robert C. Balling, Arizona State University, Mary J. Hutzler, Institute for Energy Research, and Craig D. Idso, Center for the Study of Carbon Dioxide and Global Change.*********I wonder how familiar the 240 authors of the 2013 draft National Assessment are with Karl Popper's famous essay on the nature of science and its distinction from "pseudoscience". The essential difference is that science only explains some things and that its hypotheses forbid others, while a theory that is not refutable by any conceivable event—i.e., one that is universally and comprehensively explanatory—is pseudoscience. For Popper, science is characterized by *risky predictions* (such as gravitational lensing of light in relativity), while pseudoscience does not lend itself to such testing. His favorite examples of pseudoscience were Marxism and Freudian psychology.This National Assessment is much closer to pseudoscience than it is to science. It is as explanatory as Sigmund Freud. It clearly believes that virtually everything in our society is tremendously dependent the surface temperature, and, because of that, we are headed towards certain and inescapable destruction, unless we take its advice and decarbonize our economy, pronto. Unfortunately, the Assessment can't quite tell us how to accomplish that, because no one knows how. In the Assessment's 1200 horror-studded pages, almost everything that happens in our complex world—sex, birth, disease, death, hunger, and wars, to name a few—is somehow made worse by pernicious emissions of carbon dioxide and the joggling of surface average temperature by a mere two degrees. Virtually every chapter in the Assessment perseverates on extreme weather, despite the U.N.s Intergovernmental Panel on Climate Change statement that:There is medium evidence and high agreement that long-term trends in normalized losses have not been attributed to natural or anthropogenic climate changeThe Assessment is woefully ignorant of humanity's ability to adapt and prosper in response to challenges. The quintessence of this is the truly dreadful chapter on human health and climate change. While death, disease, poverty and injustice are all conjured by warming, there is not one mention of the fact that life expectancy in the U.S. is approximately twice what it was in the year 1900, or that per-capita income in real dollars is over ten times what it was then. It emphasizes diseases that will somehow spread because of warming, neglecting the fact that many were largely endemic when it was colder and were eradicated as we warmed a bit. Further, it conspicuously ignores the fact that doubling the life expectancy of some 200 million Americans who lived in the 20th century is *the same as saving 100 million lives*. The society that achieved this powered itself on the combustion of fossil fuels. Does this community of experts understand that the number of lives that it effectively saved is orders of magnitude above and beyond it could possibly cost? It seems, given the panoply of horrors due to start pronto, to prefer that we not have emitted carbon dioxide in the first place. Perhaps they ought to look a place that didn't. Surely part of the $3.5 billion that the US Global Change Research Program (USGCRP) consumes per year could finance a field trip to Chad, so they can see the world without cheap and abundant energy.And what is the purpose of this Assessment? The motto of the USGCRP says it all:"Thirteen Agencies, One Mission: Empower the Nation with Global Change Science."The operative word is "empower," which is the purpose of the Assessment. It is to provide cover for a massive regulatory intrusion, and concomitant enormous costs in resources and individual liberty. History tells us that when scientists willingly endorse sweeping governmental agendas fueled by dodgy science, bad things soon happen. To borrow the meter of Winston Churchill:Never in the history of pseudoscientific consensus will so much be done to so many by so few.					Thank you for providing specific comments on the report chapters, which have been addressed individually under those chapters. Policy issues are beyond the defined scope of the National Climate Assessment, a scientific document that provides the basis for decision making, but does not address policy. In recognition of the importance of addressing response strategies, this report explicitly assesses adaptation, mitigation and decision support responses, in addition to identifying research needs associated with these topics, in Chapters 26-29. Many other chapters include assessment of adaptation responses.

L. Drew	Hill	Include impact of extreme surge events and high tides on costal energy supply, transmission, and distribution infrastructure. Higher rates of coastal erosion, inundation of low-lying highway/road areas (along which power lines are often placed), and increased equipment damage from corrosive salt water and wave action will threaten transmission and distribution infrastructure along coastal regions (Bull 2007, Rosenzweig 2011).Sources:Bull, S., Bilello, D., Ekmann, J., Sale, M., Schmalzer, D. Effects of climate change on energy production and distribution in the United States in Effects of Climate Change on Energy Production and Use in the United States. A report by the U.S. Climate Change Science Program and the subcommittee on Global Change Research. 2007.Rosenzweig, C., Solecki, W., Blake, R., Bowman, M., Faris, C., Gornitz, V., Horton, R., Jacob, K., LeBlanc, A., Leichenko, R., Linkin, M., Major, D., O'Grady, M., Patrick, L., Sussman, e., Yohe, G., Zimmerman, R. Developing coastal adaptation to climate change in the New York City infrastructure-shed: process, approach, tools, and strategies. Climactic Change. 106:93-127. 2011.	4. Energy Supply and Use		169	8	We have revised the text to incorporate this point into our Key Message #4.
Cato	Institute	We have only two specific comments on this chapter. Manifold changes that need to be made to it flow from our voluminous commentaries on the other chapters that we reviewed, which are Chapters 2 through 9.	1. Executive Summary				Thanks for your careful read of the report.
Cato	Institute	You need to add that you also relied upon non-peer-reviewed grey literature produced by advocacy or political organizations. The following examples are just from Chapter 3 (Water Resources):Adams, A., D. Behar, K. Brooks, P. Fleming, and L. Stickel, 2012: Water Utility Climate Alliance's Technical Input to the 2012 NCABarsugli, J., C. Anderson, J.B. Smith, and J.M. Vogel, 2009: Options for improving climate modeling to assist water utility planning for climate change. Final Report., Water Utility Climate Alliance. [Available online at http://www.wucaonline.org/assets/pdf/pubs_whitepaper_120909.pdf]Berry, L., 2012: Florida Water Management and Adaptation in the Face of Climate Change: A white paper on climate change and Florida's resources.City of New York, 2012: PlaNYC Progress Report 2012. A Greener, Greater New York, City of New York. [Available online at http://nytelecom.vo.llnwd.net/o15/agencies/planyc2030/pdf/PlaNYC_Progress_Report_2012_W11eb.pdf]Liverman, D., S. Moser, P. Weiland, L. Dilling, M. Boykoff, H. Brown, D. Busch, E. Gordon, C. Greene, E. Holthaus, D. Niemeier, S. Pincetl, J. Steenburgh, and V. Tidwell, 2012: Climate Choices for a Sustainable Southwest. Assessment of Climate Change in the Southwest United States: a Technical Report Prepared for the U.S. National Climate Assessment. A report by the Southwest Climate Alliance, G. Garfin, A. Jardine, R. Merideth, M. Black, and J. Overpeck, 1 Eds., Southwest Climate Alliance, pp. 684-734Means, E., M. Laugier, J. Daw, L. Kaatz, and M. Waage, 2010a: Decision support planning methods: Incorporating climate change uncertainties into water planning, Water Utility Alliance. [Available online at http://www.wucaonline.org/assets/pdf/pubs_whitepaper_012110.pdf]And, our favorite:Union of Concerned Scientists, 2009: Climate Change in the United States: The Prohibitive Costs of Inaction. [Available online at http://www.ucsusa.org/global_warming/science_and_impacts/impacts/climate-costs-of-inaction.html]	1. Executive Summary		16	1	The authors have included only sources that meet the terms of the Information Quality Act, and an appendix has been added describing our methodology.
Cato	Institute	By citing the 2009 document, Global Climate Change Impacts on the United States, this draft Assessment has re-opened commentary on that document, too. Here is a small portion of our review of the 2009 draft:"Of all of the "consensus" government or intergovernmental documents of this genre that I have reviewed in my 30+ years in this profession, there is no doubt that this is absolutely the worst of all. Virtually every sentence can be contested or does not represent a complete survey of a relevant literature…"…There is an overwhelming amount of misleading material in the CCSP's "Global Climate Change Impacts in the United States." It is immediately obvious that the intent of the report is not to provide a accurate scientific assessment of the current and future impacts of climate change in the United States, but to confuse the reader by a loose handling of normal climate events (made	1. Executive Summary		16	15	Referencing prior reports on similar topics is a common practice.

		seemingly more frequent, intense and damaging simply by our growing population, population movements, and wealth) presented as climate change events. Additionally, there is absolutely no effort made by the CCSP authors to include any dissenting opinion to their declarative statements, despite the peer-reviewed scientific literature being full of legitimate and applicable reports and observations that provide contrasting findings. Yet, quite brazenly, the CCSP authors claim to provide its readers—"U.S. policymakers and citizens"—with the "best available science." This proclamation is simply false…"…The uninformed reader (i.e., the public, reporters, and policy-makers) upon reading this report will be lead to believe that a terrible disaster is soon to befall the United States from human-induced climate change and that almost all of the impacts will be negative and devastating. Of course, if the purpose here is not really to produce an unbiased review of the impact of climate change on the United States, but a political document that will give cover for EPA's decision to regulate carbon dioxide, then there is really no reason to go through the ruse of gathering comments from scientists knowledgeable about the issues, as the only science that is relevant is selected work that fits the authors' pre-existing paradigm."As with the 2013 document, the commentary period was insufficiently long for us to address what we deemed to be all the problems with the 2009 report, even though our comments exceeded 75 single-spaced pages. But, since then, we have produced a comprehensive document, in precisely the same format as the USGCRP document, covering exactly the same material, only including the science the USGCRP left out, or noting when it had improperly cited science, and, in one notable case in the Alaska section, completely misrepresented a refereed paper. The document can be found at:http://www.cato.org/pubs/Global-Climate-Change-Impacts.pdfand we now enter our "Addendum" to it in the official record.					
Cato	Institute	General CommentThe scientific literature is fast becoming populated with studies which show that the equilibrium climate sensitivity is better constrained (especially at the high end) than estimates from the Intergovernmental Panel on Climate Change (IPCC) and, perhaps more importantly for the purposes of this National Climate Assessment (NCA), that the best estimate of the climate sensitivity is considerably lower than the climate model ensemble average. From the recent literature, the central estimate of the equilibrium climate sensitivity is about 2°C, while the CMIP3 climate model average is about 3.3°C (IPCC, 2007). Thus, the recent literature supports an equilibrium climate sensitivity that is some 40% lower than the model average.To the extent that the recent literature ultimately produces a more accurate estimate of the equilibrium climate sensitivity than does the climate model average, it means that, in general, all of the projections of future climate change given in the NCA are, by default, some 40% too large (too rapid) and the associated (and described) impacts are gross overestimates.Our recommendation is that an alternative set of projections is developed for all topics discussed in the NCA which incorporates for the latest scientific findings on the lowered value of equilibrium climate sensitivity. Without the addition of the new projections, the NCA will be obsolete on the day of its official release.	2. Our Changing Climate				A special box on climate sensitivity has been added to the chapter. It clearly explains the state of the science. The bottom line is that the climate sensitivity range is unchanged. There are recent research studies both supporting the lower and higher ends of the range, and there is a strong basis for not accepting the values below that range.
Cato	Institute	Key Message 1"Much of the climate change of the past 50 years is primarily due to human activities.""Human activities" presumably includes a wide range of activities over and beyond emissions of greenhouse gases and other compounds to the atmosphere. Yet throughout the NCA, the observed changes are described and compared with general circulation model (GCM) recreations and projections of climate conditions—and yet these models by and large do not include the majority of the set of "human activities." For example, they do not include the role of irrigation in the Central Valley of California (Lo and Famiglietti (2013) or the Midwestern U.S. (e.g., DeAngelis et al., 2010; Groisman et al., 2012) which has been shown to influence precipitation, soil moisture, and run-off in downstream regions. The models do not include changes to river courses, water flow barriers, or infiltration changes which can act to increase the frequency and magnitude of flood events (e.g. Pielke., Jr., 1999). The models do not include the influence of urbanization which has been shown to increase extreme	2. Our Changing Climate		25	27	Sentence added to the text under the first Key Message relating to the effects of human activities on local climate.

		precipitation events (e.g. Ashley et al., 2011) or the influence of dams which also can act to enhance precipitation (Degu et al., 2011). And the list could on.All these changes are the results of “human activities” and impact the observed climate, yet the NCA treats most of these impacts as if they are the result of human atmospheric emissions, primarily greenhouse gases. This is wrong.Recommendation: The NCA must include a fuller description of observed climate changes that may be caused by things other than anthropogenic global warming (AGW) and how these non-AGW influences complicate the climate change picture and often lessen the ability to identify changes causes by AGW.References:Ashley, W.S., M.L. Bentley, and J. A. Stallins, 2011. Urban-induced thunderstorm modification in the Southeast United States. Climatic Change, doi:10.1007/s10584-011-0324-1.DeAngelis, A., F. Dominguez, Y. Fan, A. Robock, M. D. Kustu, and D. Robinson, 2010. Observational evidence of enhanced precipitation due to irrigation over the Great Plains of the United States Journal of Geophysical Research, 115, D15115, 14 pp., doi:10.1029/2010JD013892.Degu, A. M., F. Hossain, D. Niyogi, R. Pielke Sr., J. M. Shepherd, N. Voisin, and T. Chronis, 2011. The influence of large dams on surrounding climate and precipitation patterns. Geophysical Research Letters, 38, L04405, doi:10.1029/2010GL046482.Groisman, P. Ya., R. W. Knight, and T. R. Karl, 2011. Changes in intense precipitation over the central U.S. Journal of Hydrometeorology, 13, 47-66.Lo, M-H., and J.S. Famiglietti. 2013. Irrigation in California’s Central Valley strengthens the southwestern U.S. water cycle. Geophysical Research Letters 40, doi:10.1002/GRL.50108.Pielke, R.A., Jr., 1999. Nine fallacies of floods. Climatic Change, 42, 413-438.					
Cato	Institute	Key Message 2“The magnitude of climate change beyond the next few decades depends primarily on the amount of heat-trapping gases emitted globally, and how sensitive the climate is to those emissions.”The NCA correctly recognizes that both future emissions AND the climate sensitivity impact the magnitude of future climate change and yet throughout the NCA projections are only shown for different emissions pathways. Where is the set of projections showing the impact of different climate sensitivities? Evidence continues to build that the true equilibrium climate sensitivity (i.e., the best estimate from a collection of recent publications in the scientific literature) is 40% smaller than the average climate sensitivity of the GCMs used in the NCA (see our Comment Page 31, Lines 15-18 for further details).Recommendation: Develop an alternative set of projections for all topics discussed in the NCA which incorporates for the latest scientific findings on the lowered value of equilibrium climate sensitivity.	2. Our Changing Climate		25	30	A special box on climate sensitivity has been added to the chapter. It clearly explains the state of the science. The bottom line is that the climate sensitivity range is unchanged. There are recent research studies both supporting the lower and higher ends of the range, and there is a strong basis for not accepting the values below that range. In response to the reviewer’s recommendation, we note that different global models have different climate sensitivities. By including a suite of model projections from CMIP5 and CMIP3 (as well as NARCCAP), we are effectively including a range of climate sensitivities in the projections presented in this chapter.
Cato	Institute	Key Message 3“U.S. average temperature has increased by about 1.5°F since record keeping began in 1895; more than 80% of this increase has occurred since 1980.”The 80% number is grossly misleading and statistically unjustified (see our Comment on Page 35, lines 8-9, and lines 20-23 for an in-depth analysis). It is a glaring example of the bias which currently exists in the NCA.Recommendation: Entirely remove any references to increases in temperature relative to the overall change as such statements are statistically unsound.	2. Our Changing Climate		25	34	The text has been revised to incorporate this suggestion.
Cato	Institute	Key Message 5“More winter and spring precipitation is projected for the northern U.S., and less for the Southwest, over this century.” While it may be true that the GCMs used in the NCA make these projections, there has been no verification study performed which indicates that these same GCMs have any skill in projecting the observed patterns of precipitation which have taken place to date. In	2. Our Changing Climate		26	8	"After consideration of this point, we still feel the existing text is clear and accurate. At the regional scales, observed changes in seasonal mean

		fact, there are scientific studies which suggest just the opposite (Zhang et al., 2007; Polson et al., 2013).Recommendation: Remove all discussion from the NCA concerning future patterns of precipitation change unless/until the GCMs producing them can be demonstrated to accurately capture observed characteristics (spatial and temporal patterns and magnitudes) of precipitation changes across the U.S.References:Polson, D., G. Hegerl, X. Zhang, and T. Osborn, 2013. Causes of Robust Seasonal Land Precipitation Changes. Journal of Climate, doi:10.1175/JCLI-D-12-00474.1, in press.Zhang, X., et al., 2007. Detection of human influence on the twentieth-century precipitation trends. Nature, 448, 461-466, doi:10.1038/nature06025					precipitation has not been attributed to human factors. This is because of the larger magnitude of natural variations to the amount of human induced change that has been imposed on the system. The future projections of precipitation change is for a human contribution larger than the natural variations in some seasons at some locations. These are the hatched and colored regions. White areas are where projected changes are not larger than natural variations. If one were to make a similar map of observed precipitation changes, the entire map would be white. In other words, the signal has not yet emerged from the noise. Confidence in these projections is based on fundamental understanding of how the climate system works. Model results reinforce that understanding but are not its sole source. The traceable account has been expanded to more clearly articulate the basis for this key message and references Sorojini et al. 2012 and Polson et al. 2013 have been added.
Cato	Institute	Key Message 6Changes in heavy precipitation have been shown to be influenced by things other than AGW. Influences include among other things, anthropogenic aerosol emissions (e.g., Rosenfeld and Bell, 2011; Li et al., 2011; Koren et al., 2012; Heiblum et al. 2012; Fan et al., 2012), changes in irrigation (e.g., DeAngelis et al., 2010; Groisman et al., 2012), water impoundments (e.g., Degu et al., 2011), changes in land use/urbanization (e.g., Ashely et al., 2011), and natural variability (e.g., Balling and Goodrich, 2012). Until these other influences can be accounted for, it is misleading to imply that AGW is the cause and thus GCM projections of future changes are applicable, much less reliable.Recommendation: Discuss the broader array of influences on heavy precipitation and how influence other than AGW may impact the reliability of GCM projections.References:Ashley, W.S., M.L. Bentley, and J. A. Stallins, 2011. Urban-induced thunderstorm modification in the Southeast United States. Climatic Change, doi:10.1007/s10584-011-0324-1.Balling, R.C., and G.B. Goodrich, 2011. Spatial analysis of variations in precipitation intensity in the USA. Theoretical and Applied Climatology, 104, 415-421, doi:10.1007/s00704-010-0353-0.DeAngelis, A., F. Dominguez, Y. Fan, A. Robock, M. D. Kustu, and D. Robinson, 2010. Observational evidence of enhanced precipitation due to irrigation over the Great Plains of the United States Journal of Geophysical Research, 115, D15115, 14 pp., doi:10.1029/2010JD013892.Degu, A. M., F. Hossain, D. Niyogi, R. Pielke Sr., J. M. Shepherd, N. Voisin, and T. Chronis, 2011. The influence of large dams on surrounding climate and precipitation patterns. Geophysical Research Letters, 38, L04405, doi:10.1029/2010GL046482.Groisman, P. Ya., R. W. Knight, and T. R. Karl, 2011. Changes in intense precipitation over the central U.S. Journal of Hydrometeorology, 13, 47-66.Fan, J., D. Rosenfeld, Y. Ding, L. R. Leung, and Z. Li, 2012. Potential	2. Our Changing Climate		26	10	The possible link to aerosols is an interesting hypothesis and the several papers on the subject show a link to heavy precipitation. However, they do not show how aerosols would be causing the TREND in extreme rainfall. There is no evidence that aerosol concentrations have been rising during the last 20-30 years in sync with observed heavy precipitation increases. Thus there appears to be no basis for suggesting a link. Likewise with irrigation. There has been no increase in irrigation in the Great Plains since 1970 while extreme precipitation occurrences have gone up. The same is true for large reservoirs. Urban-induced convection could have local effects as urban areas expand but there is no consideration

		aerosol indirect effects on atmospheric circulation and radiative forcing through deep convection, Geophysical Research Letters, doi:10.1029/2012GL051851.Heiblum, R. H., I. Koren, and O. Altaratz, 2012. New evidence of cloud invigoration from TRMM measurements of rain center of gravity. Geophysical Research Letters, 39, L08803, doi:10.1029/2012GL051158.Koren, I., O. Altaratz, L. A. Remer, G. Feingold, J. V. Martins, and R. H. Heiblum, 2012. Aerosol-induced intensification of rain from the tropics to the mid-latitudes, Nature Geosciences, 5, 118–122, doi:10.1038/ngeo1364.Li, Z., F. Niu, J. Fan, Y. Liu, D. Rosenfeld, and Y. Ding, 2011. The long-term impacts of aerosols on the vertical development of clouds and precipitation. Nature Geoscience, doi: 10.1038/NGEO1313.Rosenfeld, D., and T. L. Bell, 2011. Why do tornados and hailstorms rest on weekends? Journal of Geophysical Research, 116, D20211, doi:10.1029/2011JD016214.					in this paper whether there could be corresponding decreases in adjacent rural areas. The one mechanism in this comment that may be relevant is a link with natural variations, such as the Atlantic Multidecadal Oscillation. We have added a sentence (and references) including this potential effect in the supporting text for KM 8.
Cato	Institute	Key Message 7Again, this is another example of where the NCA discusses changes in the frequency and intensity of some types of climate events without any formal attribution, and then follows the descriptions up with future GCM projections. There are a host of potential causes for the observed changes (including natural variability) and many do not necessary support future projections made from GCMs run under increasing greenhouse gas emissions pathways. Additionally, new research suggest that finer scale models project less drying in the Southwest than do coarser GCMS (Gao et al., 2011; Gao et al., 2012, Lo and Famiglietti, 2013).Recommendation: A broader exploration of the reasons behind the observed changes needs to be made and a discussion as to how these causes, as well as new finer-scale models, may impact the reliability of GCM projections.References: Gao, Y., J. Vano, C. Zhu, and D. P. Lettenmaier. 2011. Evaluating climate change over the Colorado River basin using regional climate models. Journal of Geophysical Research 116, D13104, doi:10.1029/2010JD015278.Gao, Y., et al. 2012. Moisture flux convergence in regional and global climate models: Implications for drought in the southwestern United States under climate change. Geophysical Research Letters 39, L09711, doi:10.1029/2012GL051560.Lo, M-H., and J.S. Famiglietti. 2013. Irrigation in California's Central Valley strengthens the southwestern U.S. water cycle. Geophysical Research Letters 40, doi:10.1002/GRL.50108.	2. Our Changing Climate		26	14	The text with Key Message 7 gives extensive discussion of the associated literature backing up the conclusions. No effect on the key message or the text.
Cato	Institute	Key Message 8There is a complete lack of discussion as to the potential changes to hurricane tracks under AGW, yet there are many studies in the scientific literature that find that hurricane tracks will be shifted eastward, reducing the frequency of tropical cyclones which make landfall in the U.S. (e.g., Wang and Lee, 2008; Wang et al, 2008; Murakami and Wang, 2010; Wang et al., 2011; Murakami et al., 2012). As the overwhelming impact from Atlantic tropical cyclones on U.S. interests is associated with systems which make landfall, as it stands now the NCA is terribly remiss not to discuss this most important topic.Recommendation: Add a discussion on potential AGW influences on the preferred tracks of Atlantic basin tropical cyclones.ReferencesMurakami, H., and B. Wang, 2010. Future Change of North Atlantic Tropical Cyclone Tracks: Projection by a 20-km-Mesh Global Atmospheric Model. Journal of Climate, 23, 2699–2721. doi:10.1175/2010JCLI3338.1.Murakami, H., et al., 2012. Future Changes in Tropical Cyclone Activity Projected by the New High-Resolution MRI-AGCM. Journal of Climate, 25, 3237–3260. doi: 10.1175/JCLI-D-11-00415.1.Wang, C., and S.-K. Lee (2008), Global warming and United States landfalling hurricanes, Geophysical Research Letters, 35, L02708, doi:10.1029/2007GL032396.Wang, C.L., S-K. Lee, and D.B. Enfield, 2008. Atlantic Warm Pool acting as a link between Atlantic Multidecadal Oscillation and Atlantic tropical cyclone activity. Geochemistry, Geophysics, Geosystems, 9, Q05V03, doi:10.1029/2007GC001809.Wang, C., L. Hailong, S-K. Lee, and R. Atlas, 2011. Impact of the Atlantic warm pool on United States landfalling hurricanes. Geophysical Research Letters, 38, L19702, doi:10.1029/2011GL049265.	2. Our Changing Climate		26	20	Thank you for your comment. We agree that a discussion of track variability is appropriate in the main text, and have now addressed this in the supporting text for the Key Message.
Cato	Institute	Key Message 9In discussions of the projections of global sea level rise, it is imperative to discuss the impacts of new evidence that suggests that the equilibrium climate sensitivity is 40% lower than the	2. Our Changing		26	30	A special box on climate sensitivity has been added to the chapter. It clearly

		GCM average used in the NCA projections. Almost certainly, models with a 40% lower equilibrium climate sensitivity will project less sea level rise.See our Comment Page 31, Lines 15-18 for further details.	Climate				explains the state of the science. The bottom line is that the climate sensitivity range is unchanged. There are recent research studies both supporting the lower and higher ends of the range, and there is a strong basis for not accepting the values below that range.
Cato	Institute	Key Message 11While certainly there is “concern” about marine ecosystems in a changing climate, there is also mounting evidence that marine ecosystems are not as fragile as they are often made out to be and that they can adapt to changing environmental conditions (e.g., Schmidt, 2013).Reference:Schmidt, C., 2013. As threats to corals grow, hints of resilience emerge. Science, 339, 1517-1519.	2. Our Changing Climate		26	34	The comment does not affect the Key Message on acidification as written. While the suggested reference provides an interesting discussion, the authors have chosen not to include it. The authors of the NCA Report have written it based upon a variety of sources, all of which were assessed under Guidance on Information Quality Assurance to Chapter Authors of the National Climate Assessment: Question Tools (2/21/2012), to assure for each source (1) utility, (2) transparency and traceability, (3) objectivity, and (4) integrity and security. All sources were assessed for IQA compliance.
Cato	Institute	There seems to be an implication here that carbon dioxide is primarily responsible for most of the observed warming since 1950. But this is grossly misleading.A recent study (Bond et al., 2013) has shown that black carbon (soot) emissions have a positive forcing that is equivalent to about 70% that of carbon dioxide (about 3 times more than generally realized). Wigley and Santer (2012) show that about 10% of the warming since 1950 has been due to ENSO. Taken in combination, these results imply that CO2 is responsible for less than one-third of the warming since 1950.(Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Relative warming influence of the major anthropogenic emissions (whiskers are the 90% uncertainly bounds) (from IPCC AR4, and Bond et al., 2013).Recommendation: Change text to reflect that most the warming in the past 50 years can be explained by things other than carbon dioxide.References:Bond, T.C., et al., 2013. Bounding the role of black carbon in the climate system: A scientific assessment. Journal of Geophysical Research, in press.Wigley, T.M.L., and B.D. Santer, 2012. A probabilistic quantification of the anthropogenic component of twentieth century global warming. Climate Dynamics, doi: 10.1007/s00382-012-1585-8.	2. Our Changing Climate		28	27	The text has been revised for clarity. The sentence does not refer to CO2 specifically. "Human-caused emissions" include carbon dioxide, black carbon, methane, nitrous oxide and other human related emissions of gases and particles.
Cato	Institute	“Natural variations can be as large as human-induced climate change over timescales of up to a decade or two at the global scale.”While this is no doubt true, for periods longer than about 15 years, it is contrary to climate model projections. For example, not a single run from any of the CMIP3 models under the A1B scenario has a two-decade long trend in global average annual surface temperature that is less than or equal to zero with a start date at the beginning of the model run.Why discuss the period 1998-2007? It is now 2013, and data is available at least through 2012. In fact, the trend is global average surface temperature from 1998-2012 is lower than it was from 1998-2007. As this current period of minimal surface temperature rise continues to grow, it increasingly challenges the climate model projections (your references on line 43 and page 28, line 1 can confirm this—for instance, see	2. Our Changing Climate		28	38	The text has been revised to incorporate additional explanation of why the recent slowdown in the increase in air temperature is consistent with the author team's thorough assessment of the science.

		where a 16-year temperature change of 0.072°C (the change in the HadCRUT4 from 1997-2012) falls in the distribution of Knight et al., 2009.)Recommendation: Change the text to say that the current (and growing) period of the general lack of warming is increasingly challenging climate model projections.					
Cato	Institute	"The magnitude of climate change beyond the next few decades depends primarily on the amount of heat-trapping gases emitted globally, and how sensitive the climate is to those emissions."This is perhaps the generally most glaring problem with the entire NCADAC draft—that is, the failure to address the growing number of recently published findings that suggest that the climate sensitivity is much beneath those contained in the climate models that the projections throughout this entire report have been made.The following figure which shows the extent of the problem.(Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Climate sensitivity estimates from new research published since 2010 (colored), compared with the range given in the IPCC Fourth Assessment Report (black). The arrows indicate the 5 to 95% confidence bounds for each estimate along with the mean (vertical line) where available.The mean equilibrium climate sensitivity of the climate models from the CMIP 3 is 3.3°C. The "best estimate" of the equilibrium climate sensitivity in the IPCC AR4 is 3.0°C. The mean equilibrium climate sensitivity from a collection of recent papers (illustrated in the above figure) lies close to 2.0°C—or about 40% lower than that from the climate models used in this report. This has major implications for the projected climate changes and their associated impacts as described in the NCADAC draft report—as such, it is not an issue which can be swept under the rug. Instead, new estimates of climate sensitivity must be prominently discussed and the implications of a 40% lower equilibrium climate sensitivity incorporated throughout the report.Recommendation: Discuss the new estimates of climate sensitivity and for each and every graphic in NCA report illustrating future projected change include a companion graphic showing the projection assuming a 40% lower climate sensitivity.References:Aldrin, M., et al., 2012. Bayesian estimation of climate sensitivity based on a simple climate model fitted to observations oh hemispheric temperature and global ocean heat content. Environmetrics, doi:10.1002/env.2140.Annan, J.D., and J.C. Hargreaves, 2011. On the genera¬tion and interpretation of probabilistic estimates of climate sensitivity. Climatic Change, 104, 324-436.Hargreaves, J.C., et al., 2012. Can the Last Glacial Maximum constrain climate sensitivity? Geophysical Research Letters, 39, L24702, doi:10.1029/2012GL053872.Lindzen, R.S., and Y-S. Choi, 2011. On the observational determination of climate sensitivity and its implica¬tions. Asia-Pacific Journal of Atmospheric Sciences, 47, 377-390.Ring, M.J., et al., 2012. Causes of the global warming observed since the 19th century. Atmospheric and Climate Sciences, 2, 401-415, doi:10.4236/acs.2012.24035.Schmittner, A., et al., 2011. Climate sensitivity estimat¬ed from temperature reconstructions of the Last Glacial Maximum, Science, 334, 1385-1388, doi: 10.1126/science.1203513.van Hateren, J.H., 2012. A fractal climate response function can simulate global average temperature trends of the modern era and the past millennium. Climate Dynamics, doi:10.1007/s00382-012-1375-3.	2. Our Changing Climate		31	15	A special box on climate sensitivity has been added to the chapter. It clearly explains the state of the science. The bottom line is that the climate sensitivity range is unchanged. There are recent research studies both supporting the lower and higher ends of the range, and there is a strong basis for not accepting the values below that range.
Cato	Institute	This bit about the 80% increase since 1980 is cherry-picking through and through. The temperature increase in the U.S. has not been linear, but a combination of multi-decadal ups and downs. As such, it is hard to know even how to go about performing such a calculation.Probably the best way to do this would be to simply take the overall rate of temperature rise (0.13°F/decade) and multiply it by the number of decades between 1980 and now (3.3) and then divide by the overall temperature change (1.5°F). When you do this, you get 29% of the overall rise has occurred since 1980. Since 29% is nowhere close to being "more than 80%," clearly this is not how the NCADAC authors made their determination.Another way to do it would be to find the maximum amount of temperature rise that occurred at any time before 1980 and then determine how much more the temperature since 1980 has risen above that amount. For example, from 1895 through 1940, the U.S. annual average temperature increased at a rate of 0.27°F per decade for 4.5 decades for a total rise of 1.2°F. That only leaves 0.3°F	2. Our Changing Climate		35	8	The Key Message and text have been revised for clarity. We do agree that there has been a combination of multidecadal ups and downs amidst the long-term temperature increase.

		of the total overall rise of 1.5°F left over. So the maximum proportion of temperature rise that could have occurred since 1980 is 20%. Again, 20% is nowhere close to being more than 80%, so clearly this is not how it was done.Another way would be to calculate the linear temperature rise between 1895 and 1979, subtract that from the 1.5°F total rise and assign whatever is left over to the period 1980 to 2012. When you do this, you get that 77% of the rise occurred since 1980. At least this is starting to get close to the USGCRP number.Or, you could calculate the linear rise from 1980 to 2012 and compare this to the total rise. When you do this, you find that the rise from 1980 to 2012 was 1.58°F. Or, 105% of the total rise! 105% is definitely more than 80%, so maybe that is what they did.Or perhaps the NCADAC authors did something completely different. Who knows?Now, before we go any further, let's get something straight—none of these methods for determining the proportionate amount of warming is statistically sound because the nature of temperature rise in the U.S. during the last 118 years is not strictly linear. Instead, there are multi-decadal periods of rising and falling temperatures. So attempting to describe the proportional change over some period of time is cherry-picking by design. As we show in the examples above, you have a wide variety of answers at your disposal depending on your analysis method. The NCADAC authors clearly wanted to choose a method that produced the appearance of a lot of rise since 1980 (and thereby completely disregarding a more rapid warming from 1910-1940).It is unclear to us why such an unscientific motive should exist at the NCADAC. This needs to be rectified immediately.Recommendation: Entirely remove any references to increases in temperature relative to the overall change as such statements are statistically unsound.					
Cato	Institute	"and length of the ragweed pollen season (Ziska et al. 2011)."Why on earth did you cherry pick ragweed to single out from virtually every single other plant which benefits from a longer growing season? Is it because there is some implication that ragweed doing better is actually a negative (for reasons to reconsider this see our Comment on Page 336, lines 1-12)—contrary to other kinds of plants doing better?If this is the case, are we to take it that you desire to provide at least one example of a scientific research result which describes an impact counter to what you consider the prevailing one? Recommendation: Keeping the precedent set here, provide examples of positive impacts for all the environmental changes you negatively describe throughout the report.	2. Our Changing Climate		39	22	We have added some three additional references, two of which point to the enhanced productivity associated with a longer growing season. The third additional reference is an example where productivity is negatively impacted by the greater soil moisture associated with a longer growing season. Our original intention was to show the positive benefits of this change, but without ignoring the published work that does indicate some negative impacts. We have modified the order of presentation somewhat to insure that the positive benefits are not under-emphasized.
Cato	Institute	"A longer growing season can mean greater evaporation and loss of moisture through plant transpiration associated with higher temperatures so that even with a longer frost-free season, crops could be negatively affected by drying."There is a lot wrong with this sentence. First of all, you seem to have left out any reference to overwhelming and widely accepted scientific evidence that increased atmospheric carbon dioxide levels increase the water use efficiency of plants.In lines 23-26 you set forth a hypothesis that longer growing seasons could negatively affect crops. In lines 28-32, you describe differential changes to the lengths of the growing season across the country. So this sets up a good test of whether crops are negatively affected. For example, in the figure below I plot the annual wheat yields from Washington state where the growing season increased by (according to Figure 2.9) some 18 days, and the wheat yields in Georgia where the growing season increased by only 5 days. According to the hypothesis that you all laid out above, wheat yields in Washington should have declined relative to wheat yields in Georgia. But, it turns out they are practically indistinguishable	2. Our Changing Climate		39	23	We have removed the phrase that, according to the reviewer, implies that a longer growing season will negatively impact crop yields. It was not our intent to make this general assertion. However, the possibility that a longer growing season can lead to decreased soil moisture and resulting negative impacts on productivity is supported by a recent field study, which has been added. Therefore we have kept this possible outcome in our discussion.

		(actually linear trend in increasing yield is slightly greater in Washington than in Georgia) over the past 60+ years. So, it appears that your hypothesis that increased growing season will lead to reduced crop yields is readily falsifiable. (Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Annual statewide average wheat yields from Washington and Georgia, 1950-2012 (data source: National Agricultural Statistics Service, USDA)Recommendation: Remove the contention that longer growing seasons will negatively impact crops.					Also, the statement: "First of all, you seem to have left out any reference to overwhelming and widely accepted scientific evidence that increased atmospheric carbon dioxide levels increase the water use efficiency of plants." is incorrect. This is marginally true for only a limited category of plants. It is untrue for many plants.
Cato	Institute	"However, if emissions of heat-trapping gases continue their upward trend, clear patterns of precipitation change are projected to emerge."Is there any way to assess the validity of these projections? Otherwise, are they not pure speculation? How do the models perform over the 20th century? What is the size of natural variability? Is it possible that the precipitation changes depicted in Figure 2.11 already exceed those projected to occur in Figure 2.12 and Figure 2.13 (for example, based on a visual averaging of the projections depicted in Figure 2.12, it looks like the observed changes in the upper Midwest already exceeded those projected to occur by the end of the 21st century)? To help better assess this, and to give the reader a sense of the size of natural variability vs. model projections, either the observed changes should be shown for each season, or the model projections shown for the annual change. As it stands now, you show observed changes in annual precipitation and model projections for seasonal precipitation. Why? You did not do this in section on "Recent U.S. Temperature Trends,"—there you showed annual observed changes and annual projections.Additionally, to better allow the reader to understand the size of the "noise" of natural variability compared with the "signal" of AGW, you should include some information as to whether the projected changes in Figure 2.12 are expected to emerge from the noise of natural variability by the verifiable time period (i.e. 2070-2099). Otherwise, the projected changes, even if correct, will be largely undetectable and potentially inconsequential during the projected time period. To help with that task, we have prepared the following Table showing how many years it will take before the projected precipitation change will be larger than natural variability. To prepare it, we looked only at the high-confidence state-season combinations (i.e. those which are hatched in Figure 2.12). From that Figure, we estimated the percentage change in projected seasonal precipitation for each state so identified (dividing the total percentage change from Figure 2.12 by the time over which it occurred, 155 years (the difference in midpoints from the projected period 2070-2099 to the base period 1901-1960 in Figure 2.12), gave us the projected precipitation change per year, in percent). We then calculated the standard deviation (in percentage of the mean) around the observed (1901-2011) precipitation data for each state identified above (using data from McRoberts and Nielsen-Gammon, 2011). Dividing the observed standard deviation by the projected change per year gave us the time (in years) until the projected change exceeded 1 standard deviation of observed variability. Those numbers populate our Table.There were 84 separate season-state combinations where confidence is large. In nine of these, the predicted change has already emerged from the noise (some 70 years ahead of time—not sure that is good or bad for the models). Of those nine, eight of them are precipitation increases, with the most in the spring. Farmers should do handstands over that. There were 75 cases where the observed change to date is still less than the model projected change by the 2070-2099 averaging period. During the summer, the average time for the projected changes to emerge from the natural noise (i.e. exceed 1 standard deviation) is 520 years. In the winter, it is 330 years. Averaged across all seasons it will take approximately 297 years before a state's projected precipitation changes emerge from background variability—and this is only for those states where the models agree (i.e. hatched areas in Figure 2.12)—for the majority of the rest of the country, the time	2. Our Changing Climate		43	3	The commenter has confused the magnitudes of precipitation natural variability, observed changes and long term projected changes. At the regional scales, observed changes in seasonal mean precipitation has not been attributed to human factors. This is because of the larger magnitude of natural variations to the amount of human induced change that has been imposed on the system. The future projections of precipitation change is for a human contribution larger than the natural variations in some seasons at some locations. These are the hatched and colored regions. White areas are where projected changes are not larger than natural variations. If one were to make a similar map of observed precipitation changes, the entire map would be white. In other words, the signal has not yet emerged from the noise. Additionally, any replication of observed regional precipitation changes or lack thereof by a modeled result is meaningless as no human influence at these scales has been identified. Hence, the type of validation proposed by the comment has no merit. Rather confidence in these projections is based on fundamental understanding of how the climate system works. Model results reinforce that understanding but are not its sole source. No change to text.

		for emergence from the noise is longer still. This needs to be made readily apparent to the reader of the NCA.(Table emailed to comments@usgcrp.gov)TABLE: Years until projected change (in Figure 2.12) exceeds one standard deviation (calculated using the 1896-2011 data) from the 1991-2011 average value (calculated using McRoberts and Nielsen-Gammon, 2011). A “n/a” indicates that no consistent projection was made, “achieved” means that the projected change has already been exceeded (that is, the change from 1901-1960 to 1991-2011 was larger than the climate model projected change from 1901-1960 to 2070-2099). Also it would be instructive to present the observed time series of U.S. precipitation changes along with the time series of the same quantity from climate models. I would suggest doing this on a seasonal basis as well as an annual one. This would again allow the reader to get an idea about the ability of climate models to simulate precipitation on scales of the U.S. or smaller. The 2000 National Assessment Report included such a comparison. Not sure why it was removed in this Assessment (other than perhaps that it doesn’t show favorable results for the models).Recommendation: Produce verification statistics for the model precipitation fits of 20th century precipitation changes for seasons and subregions of the U.S. Also include figures showing the climate model precipitation changes across the U.S. during the 20th century for each season and compare with the observed patterns of change.Reference:McRoberts, D.B. and J.W. Nielsen-Gammon, 2011. A New Homogenized Climate Division Precipitation Dataset for Analysis of Climate Variability and Climate Change. Journal of Applied Meteorology and Climatology, 50, 1187-1199.					
Cato	Institute	“However, if emissions of heat-trapping gases continue their upward trend, clear patterns of precipitation change are projected to emerge.”Is there any way to assess the validity of these projections? Otherwise, are they not pure speculation? How do the models perform over the 20th century? What is the size of natural variability? Is it possible that the precipitation changes depicted in Figure 2.11 already exceed those projected to occur in Figure 2.12 and Figure 2.13 (for example, based on a visual averaging of the projections depicted in Figure 2.12, it looks like the observed changes in the upper Midwest already exceeded those projected to occur by the end of the 21st century)? To help better assess this, and to give the reader a sense of the size of natural variability vs. model projections, either the observed changes should be shown for each season, or the model projections shown for the annual change. As it stands now, you show observed changes in annual precipitation and model projections for seasonal precipitation. Why? You did not do this in section on “Recent U.S. Temperature Trends,”—there you showed annual observed changes and annual projections.Additionally, to better allow the reader to understand the size of the “noise” of natural variability compared with the “signal” of AGW, you should include some information as to whether the projected changes in Figure 2.12 are expected to emerge from the noise of natural variability by the verifiable time period (i.e. 2070-2099). Otherwise, the projected changes, even if correct, will be largely undetectable and potentially inconsequential during the projected time period. To help with that task, we have prepared the following Table showing how many years it will take before the projected precipitation change will be larger than natural variability. To prepare it, we looked only at the high-confidence state-season combinations (i.e. those which are hatched in Figure 2.12). From that Figure, we estimated the percentage change in projected seasonal precipitation for each state so identified (dividing the total percentage change from Figure 2.12 by the time over which it occurred, 155 years (the difference in midpoints from the projected period 2070-2099 to the base period 1901-1960 in Figure 2.12), gave us the projected precipitation change per year, in percent). We then calculated the standard deviation (in percentage of the mean) around the observed (1901-2011) precipitation data for each state identified above (using data from McRoberts and Nielsen-Gammon, 2011). Dividing the observed standard deviation by the projected change per year gave us the time (in years) until the projected change exceeded 1 standard deviation of observed variability. Those numbers populate our Table.There were 84 separate season-state combinations where confidence is large. In nine of these, the predicted change has already emerged from the noise (some 70 years ahead of time—not sure that is good or	2. Our Changing Climate		43	3	The commenter has confused the magnitudes of precipitation natural variability, observed changes and long term projected changes. At the regional scales, observed changes in seasonal mean precipitation has not been attributed to human factors. This is because of the larger magnitude of natural variations to the amount of human induced change that has been imposed on the system. The future projections of precipitation change is for a human contribution larger than the natural variations in some seasons at some locations. These are the hatched and colored regions. White areas are where projected changes are not larger than natural variations. If one were to make a similar map of observed precipitation changes, the entire map would be white. In other words, the signal has not yet emerged from the noise yet. Additionally, any replication of observed regional precipitation changes or lack thereof by a modeled result is meaningless as no human influence at these scales has been identified. Hence, the type of validation proposed by the comment has no merit. Rather confidence in

		bad for the models). Of those nine, eight of them are precipitation increases, with the most in the spring. Farmers should do handstands over that. There were 75 cases where the observed change to date is still less than the model projected change by the 2070-2099 averaging period. During the summer, the average time for the projected changes to emerge from the natural noise (i.e. exceed 1 standard deviation) is 520 years. In the winter, it is 330 years. Averaged across all seasons it will take approximately 297 years before a state's projected precipitation changes emerge from background variability—and this is only for those states where the models agree (i.e. hatched areas in Figure 2.12)—for the majority of the rest of the country, the time for emergence from the noise is longer still. This needs to be made readily apparent to the reader of the NCA.(Table emailed to comments@usgcrp.gov as per instructions)TABLE: Years until projected change (in Figure 2.12) exceeds one standard deviation (calculated using the 1896-2011 data) from the 1991-2011 average value (calculated using McRoberts and Nielsen-Gammon, 2011). A "n/a" indicates that no consistent projection was made, "achieved" means that the projected change has already been exceeded (that is, the change from 1901-1960 to 1991-2011 was larger than the climate model projected change from 1901-1960 to 2070-2099). Highlighted values indicate two centuries or more.Also it would be instructive to present the observed time series of U.S. precipitation changes along with the a time series of the same quantity from climate models. I would suggest doing this on seasonal basis as well as an annual one. This would again allow the reader to get an idea about the ability of climate models to simulate precipitation on scales of the U.S. or smaller. The 2000 National Assessment Report included such a comparison. Not sure why it was removed in this Assessment (other than perhaps that it doesn't show favorable results for the models).Recommendation: Produce verification statistics for the model precipitation fits of 20th century precipitation changes for seasons and subregions of the U.S. Also include figures showing the climate model precipitation changes across the U.S. during the 20th century for each season and compare with the observed patterns of change.Reference:McRoberts, D.B. and J.W. Nielsen-Gammon, 2011. A New Homogenized Climate Division Precipitation Dataset for Analysis of Climate Variability and Climate Change. Journal of Applied Meteorology and Climatology, 50, 1187-1199.					these projections is based on fundamental understanding of how the climate system works. Model results reinforce that understanding but are not its sole source. No change to text.
Cato	Institute	Just how much confidence does the scientific literature support for patterns and magnitude of precipitation changes driven by anthropogenic climate change over the U.S.? For example, isn't it well established that the observed changes are several times larger than the model projected changes over the 20th century, especially on a local/regional basis? Again, a graphic showing modeled changes over the 20th century in the U.S. would be instructive. How much of the modeled changes over the U.S. are driven by anthropogenic climate alterations? Findings in Polson et al. (2013) suggest the answer to the above question is "not much." The first figure below depicts the observed changes in precipitation by season over land areas (including the U.S) from 1950-2005 from several different observed datasets (from Polson et al., 2013). The hatches show where all the datasets give the same sign of the trend. Over most of the U.S. during most seasons, there is general agreement. The second figure shows the projections of the multi-model mean. The hatched areas are where the multi-model mean and the observed datasets all agree as to the sign. In this case, over much of the U.S., over most seasons, there is not agreement. And this test only assesses the sign of the trend, not the magnitude.(Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Percentage change in precipitation per decade for 1951-2005 for DJF, MAM, JJA and SON. Hatched grid-boxes show where the sign of the change is consistent across all observation datasets with data available for that grid-box. (source: Polson et al., 2013).(Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Percentage change in precipitation per decade for the ALL forced multi-model mean for 1951- 2005 for DJF, MAM, JJA and SON. Hatched grid-boxes show where the sign of the change is consistent across all four observation datasets and the multi-model mean. Note the smaller scale of change patterns as multi-model mean	2. Our Changing Climate		43	1	As noted in our response to comment #32136, we have considerably expanded the traceable account, which provides an expanded discussion of the basis for our statements about precipitation projections.

		changes show a much reduced influence of internal climate variability. (source: Polson et al., 2013)Looking over latitude bands, Sarojini et al. (2012) show that there is no anthropogenic signal in precipitation over land areas with observations in the 30 to 60 N latitude band for any season during the period 1951-2005. Instead, the slight upward trend in modeled precipitation averaged in this latitude band (where the U.S. largely falls) is driven by natural signals (see figure below).(Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Precipitation anomalies in the 30N to 60N latitude band from climate models (masked to match observations) driven by natural (blue) and natural+anthropogenic (red) forcings. Observed changes are in black. Green stars indicate times when there is a statistically significant difference between the NAT and the ALL forcings. Green stars are largely absent indicating that there is no statistically significant difference between NAT and ALL forcings in the modeled precipitation history (1950-2005) of the latitude band which contains the much of the U.S. (Sorojini et al., 2012).The results of Sarojini et al. (2012) indicate that there is no anthropogenic "fingerprint" against which to test the ability of climate models' simulation of anthropogenic changes and it is thus impossible to assess the reliability of future projections from changes in anthropogenic forcings.As mentioned in the NCA text, global climate models are too coarse to capture fine topographic details, especially in mountainous terrain. A good example of this is a paper by Gao et al., (2012) which shows that regional climate models with finer scale terrain show less precipitation decline in the Southwest U.S. that GCMs do.Recommendation: Until the climate models' ability to accurately portray observed precipitation trends across the U.S. is demonstrated, and the anthropogenic climate change signal identified, that future model-based precipitation projections be removed from the NCA, or at least talked about in a general sense indicating that natural variability is much larger than any hypothesized anthropogenic climate change signal both on local as well as regional scales. It is not that I don't think, that all else being equal, higher temperatures should generally lead to more precipitation on a global scale, but that all else is not equal and the magnitude of natural variability likely will overwhelm any anthropogenic climate change signal for many, many years into the future. This should be the point of emphasis for the reader.References:Polson, D., G. Hegerl, X. Zhang, and T. Osborn, 2013. Causes of Robust Seasonal Land Precipitation Changes. Journal of Climate, doi:10.1175/JCLI-D-12-00474.1, in press.Sarojini, B.B., et al., 2012. Fingerprints of changes in annual and seasonal precipitation from CMIP5 models over land and ocean. Geophysical Research Letters, 39, L21706, doi: 10.1029/2012GL053373.Gao, Y., et al., 2012. Moisture flux convergence in regional and global climate models: Implications for drought in the southwestern United States under climate change. Geophysical Research Letters, 39, L09711, doi:10.1029/2012GL051560.					
Cato	Institute	"The patterns of precipitation change in the newer CMIP5 simulations are essentially the same as in the earlier CMIP3 and NARCCAP simulations used in impact analyses throughout this report, increasing confidence in our scientific understanding."Agreement among models is not grounds for scientific confidence unless the models can be shown to replicate observations. As we pointed out above, this has not been shown to be the case. Recommendation: Either provide demonstration that models reliable replicate observations, or drop the discussion about confidence in future projections. For example, Polson et al. (2013) show that the models don't do a very good job in just getting the sign of the observed precipitation change right, much less the magnitude. That does not instill confidence in future projections or our scientific understanding.Reference:Polson, D., G. Hegerl, X. Zhang, and T. Osborn, 2013. Causes of Robust Seasonal Land Precipitation Changes. Journal of Climate, doi:10.1175/JCLI-D-12-00474.1, in press.	2. Our Changing Climate		45	17	There are signs of emerging consistency between observed U.S. precipitation change (see figure under KM 5) and the projected patterns of change (see figures on projected precipitation change by season and on newer simulations for projected precipitation change, under KM 5). However, an over-riding point is that this comment has confused the magnitudes of precipitation natural variability, observed changes and long term projected changes. At the regional scales, observed changes in seasonal mean precipitation has not been attributed to human factors. This

							is because of the larger magnitude of natural variations to the amount of human induced change that has been imposed on the system. The future projections of precipitation change is for a human contribution larger than the natural variations in some seasons at some locations. These are the hatched and colored regions. White areas are where projected changes are not larger than natural variations. If one were to make a similar map of observed precipitation changes, the entire map would be white. In other words, the signal has not yet emerged from the noise yet. No change to text.
Cato	Institute	It is pretty much a fact of climatology that at any location, increases in annual precipitation are driven more by increases in precipitation amounts than by increases in the number of precipitation events. This has the associated consequence that more annual precipitation is accompanied by increases in heavy precipitation events. Such a concept is demonstrated in Michaels et al., 2004, which also shows that fixed bin approaches, like those in the NCA, over emphasize the relative changes in heavy/extreme precipitation. In fact, Michaels et al., 2004 showed that despite an increase in the annual amount of precipitation falling on the wettest day of the year, the percentage of annual precipitation falling on the wettest day of the year was unchanged averaged across the country as a whole, with variations in subregions.In this section, there is a lot of emphasis on changes in extreme events and virtually no mention that this is largely a natural accompaniment to changes in total annual precipitation. The tone of the NCA makes it seem like more precipitation is a bad thing. Is this generally the case (i.e., is there some documentation that shows more precipitation is less beneficial than less precipitation)?Reference:Michaels, P.J., et al., 2004. Trends in precipitation on the wettest days of the year across the contiguous USA. International Journal of Climatology, 24, 1873-1882.	2. Our Changing Climate		47	6	There is conflicting evidence on overall changes in the observed precipitation distirbution. In addition to Michaels et al. (2004), Higgins and Kousky (2013) found increases in the number of events across a wide spectrum of precipitation amounts. On the other hand, Groisman et al (Groisman, Pavel Ya., Richard W. Knight, Thomas R. Karl, 2012: Changes in intense precipitation over the central united states. J. Hydrometeor, 13, 47–66. doi: http://dx.doi.org/10.1175/JHM-D-11-039.1) found that the number of intermediate events decreased while large events increased (for the central U.S.). There is one place in the text where we state that there is a trend in the percentage of precipitation falling in heavy events (third paragraph under Key Message 6). We have changed the text to read "...towards increased heavy precipitation events..." which does not make any claim about the percentage of precipitation in heavy events. We have also added a sentence addressing possible changes in light and moderate rain events. However, it is important to consider that trends due to natural variations that are relatively large in the observed distribution will become less

							important as the climate continues to warm Regarding the assertion that we are making precipitation a "bad thing", there is no value statement in any of this text. We are simply stating the findings.
Cato	Institute	Add a sentence to the end of this paragraph that attributes much of the changes in heavy precipitation in recent decades to changes in ENSO (Higgis and Kousky, 2013).Reference:Higgis, R.W., and V.E. Kousky, 2013. Changes in observed and daily precipitation over the United States between 1950-79 and 1980-2009. Journal of Hydrometeorology, 114, 105-121, DOI: 10.1175/JHM-D-12-062.1.	2. Our Changing Climate		47	13	In the Higgins and Kousky paper, there are regional and seasonal variations in the patterns of changes that appear to be consistent with shifts in ENSO. However, the overall change in extremes does not appear closely correlated with ENSO. In their Figures 11, 12, and 13, there are sizeable increases in the number of heavy events in both El Nino, La Nina, and ENSO-neutral years, with some seasonal variations. For example, in ENSO-neutral years, they show increases in the number of heavy events in winter, spring, and fall. No change made to the text.
Cato	Institute	As we have discussed (for example, see our Comment on Page 43, lines 18-19), there is not a basis for confidence in the “projections” of future summer precipitation trends.	2. Our Changing Climate		53	14	The reviewer is correct with regard to summer precipitation projections in the supporting text for Key Message 5 and accompanying figures. However, in combination with warmer temperatures and increased evapotranspiration, a reduction of soil moisture is a consistent over the south-central U.S. is a consistent feature of model simulations (e.g., Fig. 2.22 on Projected Changes in Soil Moisture for the Western U.S.). We have modified the text to indicate that we are referring to drying of soil.
Cato	Institute	As we have commented on previously (for example, see our Comment on Page 43, lines 18-19) agreement among computer models for future precipitation conditions across the U.S. (when they display an inability to correctly capture past conditions), is not grounds for rising confidence.	2. Our Changing Climate		54	2	The figures presented in Key Message 5 show that the externally-forced (SRES and RCP) changes of precipitation produced by models are broadly consistent with the recently observed changes (areas of decrease in the Southwest, increases from the Great Plains to New England). The basis for the confidence statements and the hatching and white areas in the projection figures comes from the

							size of the projected change is compared to estimates of 20 year natural variability. If the multi-model average change is twice as large as this measure of internal variability and 90% of the models agree on sign, confidence is high that the changes are large (hatched). If the multi-model average change is less than this measure, confidence is high that changes are small (white). This is a more modern way of expressing confidence than was done in NCA2 and AR4.
Cato	Institute	You need to be more careful in your discussion regarding the size of any human-caused climate signal in flood event vs. other types of human-caused signals in flood events (such as surface changes, river course modifications, dykes, etc.). There is a lot of literature on the subject, yet none of it is reflected here.The role that climate change may play in impacts from flooding, over and above that of the natural climate, human changes to waterways and watersheds, and changes in the population living in flood plains and other at risk areas, is difficult to ascertain (Pielke Jr., 1999). However, research studies that have investigated streamflow trends, rather than precipitation trends, have found increases in low to moderate streamflows and little overall changes in high streamflow (Lins and Slack, 1999; Douglas et al., 2000; McCabe and Wolock, 2002; Lins and Cohn, 2003)—the category associated with flooding events. This has been attributed to the seasonality of the observed increases in precipitation, which have been characterized by increases in autumn (the general time of low streamflow) and little change to spring precipitation (the general time of high streamflow) (Small et al., 2006).Studies that have looked specifically at trends in annual peak streamflow find mixed results and inconsistent associations with atmospheric carbon dioxide levels or climate change (Villarini et al., 2009; Hirsch and Ryberg, 2012). Studies that examine trends in damage from flood events generally conclude that changes to population and wealth in vulnerable areas dominate over changes in the climate (Downton, et al., 2005; Changnon, 2003).Observed climate complexity makes it difficult to identify any changed climate signal in flood trends. Such difficulties will persist into the future and likely worsen with increased development in flood prone regions. If you don't believe us, here is what the IPCC SREX had to say:"There is limited to medium evidence available to assess climate-driven observed changes in the magnitude and frequency of floods at regional scales because the available instrumental records of floods at gauge stations are limited in space and time, and because of confounding effects of changes in land use and engineering. Furthermore, there is low agreement in this evidence, and thus overall low confidence at the global scale regarding even the sign of these changes."References:Pielke, R.A., Jr., 1999. Nine fallacies of floods. Climatic Change, 42, 413-438.Lins, H.F., and J.R. Slack, 1999. Streamflow trends in the United States. Geophysical Research Letters, 26, 227-230.Douglas, E.M., R.M. Vogel, and C.N. Kroll, 2000. Trends in floods and low flows in the United States: Impact of spatial correlation. Journal of Hydrology, 240, 90-105.McCabe, G.J., and D.M.A. Wolock, 2002. A step increase in streamflow in the conterminous United States. Geophysical Research Letters, 29(24), 2185-2188.Lins, H.F., and T.A. Cohn, "Floods in the Green House: Spinning the Right Tail," in Thorndycraft, V.R., G. Benito, M. Barriendos, and M.C. Llasat, 2003: Palaeofloods, Historical Floods and Climatic Variability: Applications in Flood Risk Assessment (Proceedings of the PHEFRA Workshop, Barcelona, 16-19 October 2002), http://www.ica.csic.es/dpts/suelos/hidro/images/chapter_40_phefra.pdf.Small, D., S. Islam, and R.M. Vogel, 2006. Trends in precipitation and streamflow in the eastern U.S.: Paradox or	2. Our Changing Climate		55	9	We modified the text to point to the seasonal difference in timing between the annual flood (spring) and the increase in extreme precipitation events, which has been primarily in the summer (particularly late summer) and fall when soil moisture is low.We added three recent studies by Villarini and colleagues (those published since the last national climate assessment report). These studies reported on analyses of the observational streamflow records. We had already included the Hirsch and Ryberg reference, but we have revised the text to more clearly state their findings.

		perception? Geophysical Research Letters, 33, L03403, doi:10.1029/2005GL024995.Villarini, G., et al., 2009. On the stationarity of annual flood peaks in the continental United States during the 20th century. Water Resources Research, 45, W08417, doi:10.1029/2008WR007645.Hirsch, R.M., and K.R. Ryberg, 2012. Has the magnitude of floods across the USA changed with global CO2 levels? Hydrological Sciences Journal, 57:1, 1-9, http://dx.doi.org/10.1080/02626667.2011.621895.Downton, M.W., J.Z.B. Miller, and R.A. Pielke Jr., 2005. Reanalysis of U.S. National Weather Service flood loss database. Natural Hazards Review, 6, 13-22, doi:10.1061/(ASCE)1527-6988(2005)6:1(13).Changnon, S.A., 2003. Shifting economic impacts from weather extremes in the United States: A result of societal changes, not global warming. Natural Hazards Review, 29, 273-290.					
Cato	Institute	Isn't it inappropriate to include the Figure from Hirsch and Ryberg, 2012 in support of your assertion that flood increases in some regions of the U.S. are related to human-caused climate change? Here is how Hirsch and Ryberg (2012) described their findings:"What these results do indicate is that except for the decreased flood magnitudes observed in the SW there is no strong empirical evidence in any of the other 3 regions for increases or decreases in flood magnitudes in the face of the 32% increase in GMCO2 that has taken place over the study period."Perhaps you ought make note of that.Reference:Hirsch, R.M. and K.R. Ryberg, 2012. Has the magnitude of floods across the USA changed with 9 global CO2 levels? Hydrological Sciences Journal, 57, 1-9 doi: 10 10.1080/02626667.2011.621895	2. Our Changing Climate		56	1	This text has been rewritten to more accurately reflect the Hirsch and Ryberg paper.
Cato	Institute	You write that "Precipitation has already declined in some areas within the Southwest and the Rocky Mountain states"What do you mean by "already?" Are you implying here that declines in "some areas of the Southwest and Rocky Mountain states" are due to anthropogenic climate changes? What about in "some" other areas of the Southwest and Rocky Mountain states where precipitation has increased (See your Fig. 2.11)? Are precipitation increases signs of anthropogenic climate changes? Or are "some" areas getting wetter due to natural variability while "some" nearby areas are getting drier because of AGW?!? If this this is the case, then as they say, extraordinary claims require extraordinary proof, so let's see it.	2. Our Changing Climate		56	7	The sentence has been eliminated and the paragraph revised.
Cato	Institute	"…and decreases in precipitation are projected to intensify in those areas and spread northward and eastward in summer (see Key Message 5)."Is the decrease in precipitation projected to "intensify" in those areas of the Southwest and Rocky Mountain states which are currently seeing precipitation increases (see Figure 2.11)? Do the climate models that you are relying on to project decreases in precipitation in the future accurately capture the current precipitation increases experienced in some portions of the Southwest and Rocky Mountain states (see Figure 2.11). Are you all relying on a "gut" feeling that climate models that do not capture 20th century behavior (in fact get the sign wrong in some regions of the Southwest and Rocky Mountain states, see Polson et al., 2013) will start producing accurate projections for the 21st century? Is the signal-to-noise ratio of precipitation in the Southwest and Rocky Mountain states and areas "northward" and "eastward" in the summer large enough to identify the projected changes even if they were to happen within the projected timeframe? Recommendation: These questions must be answered and the answered used to modify the existing NCA text.	2. Our Changing Climate		56	8	This is essentially the same response as to the preceding comment (and to comment 138 / 32236). We now state (explicitly in the text) that natural variations in space and time are present in the pattern of historical trends and in the pattern of change in any single model simulation. However, compositing of models (as in KM 5) removes much of the natural variability, providing an estimate of the externally forced change in which we can have increased confidence.
Cato	Institute	"However, even in areas where precipitation does not decrease, projected higher air temperatures will cause increases in surface evaporation and loss of water from plants, leading to drier soils."How many variables did you leave out in getting from "higher air temperatures" to "drier soils" (hint: see NCA page 110 lines, 9-14 and page 111 lines 1-15)? Did you consider higher atmospheric CO2 concentration improves the water use efficiency of plants? Did you consider changes to the wind speed, humidity, or radiation? See Sheffield et al., (2012) as to why you should. Recommendation: Remove this gross oversimplification or else describe the complex situation more thoroughly, explaining that temperature increases do not necessarily lead to increased water loss.Reference:Sheffield, J., et al., 2012. Little	2. Our Changing Climate		56	10	We have added to the text the caveats about the potentially offsetting effects of changes in humidity, windspeeds and radiation. However, the notion that higher summer temperatures favor drying of the soil is supported by an abundant literature (of which we cite a subset at the end of our

		change in global drought over the past 60 years. Nature, 491, 435-438, doi:10.1038/nature11575.					paragraph) as well as by the experience of the average reader -- hotter summer temperatures lead to drier soil and vegetative stress. There are no peer-reviewed references to support the notion that CO2-driven increases in plant efficiency will outweigh the effects of higher temperatures (and/or changes in windspeed and humidity).
Cato	Institute	Admitting, as you do, that the PDSI "may overestimate the magnitude of drought increases" seems reason enough not to include Figure 2.21 and any other subsequent quantitative discussions of future drought change based on the PDSI.Here is how Sheffield et al. (2012) described the continued use of the PDSI in assessing change in drought:Despite the long-standing consensus that the underlying science for temperature-based estimates of PE is flawed, compounded by the results of this and other studies that the flaws are manifested in errors in the estimations of the impact of warming on drought and hydrology in general, the reasons for the long and continued use of the PDSI_Th for climate studies in essentially its original form are a curiosity.As it now stands, the NCA remains such a "curiosity."Further, Hoerling et al., 2012 specifically point to the future drought values in Wehner et al. 2011—the source for Figure 2.21—as being too sensitive to changes in temperature and being "unreliable."Recommendation: Remove Figure 2.21 as it is provides an "unreliable" projection of future drought in the U.S. and Mexico.Reference: Hoerling, M., et al., 2012. Is a Transition to Semi-Permanent Drought Conditions Imminent in the U.S. Great Plains? Journal of Climate, 25, 8380-8386, doi:10.1175/JCLI-D-12-00449.1.Sheffield, J., et al., 2012. Little change in global drought over the past 60 years. Nature, 491, 435-438, doi:10.1038/nature11575.	2. Our Changing Climate		57	1	Section has been rewritten and parts moved to the appendix. Both the limitations of PDSI and its statutory implications are described. The PDSI figure has been removed from the chapter and will be discussed in the appendix.
Cato	Institute	After line 9, add something like the following:"But whether or not any detectable human influence is ever identified for these types of extreme weather events, the largest factor behind increases in the impacts from these types of events is human demographic changes such as population size, wealth, and location (e.g., Pielke, Jr., 2008; Simmons et al., 2012)References:Pielke, Jr., R. A., Gratz, J., Landsea, C. W., Collins, D., Saunders, M. A., and Musulin, R., 2008. Normalized Hurricane Damages in the United States: 1900-2005. Natural Hazards Review, 9, 29-42.Simmons, K.M., et al., 2012. Normalized tornado damage in the United States: 1950-2011. Environmental Hazards, http://dx.doi.org/10.1080/17477891.2012.738642	2. Our Changing Climate		59	1	We are dealing with physical changes in this section, and not changes in demographic pressure. We certainly agree with your point that demographic changes greatly affect impacts, but since we did not make any statement about trends in impacts, we don't feel that there's a need to introduce this separate idea here.
Cato	Institute	Why does this discussion only include data "since the 1970s"?Why is there no discussion about the most important characteristics of Atlantic hurricanes for U.S. interests—the number and intensity of storms that make landfall along the U.S. coast?Why is there no discussion of how human-caused climate changes may impact the number and intensity of hurricanes making landfall in the U.S.?Are the taxpayers really getting their money's worth from the USGCRP when the NCA neglects any mention of the most important aspects for the future impacts of hurricanes in the in the U.S.? Reliable data on U.S. landfalling storms pre-dates the 1970s and in fact, extends back into the 19th century. There is no overall trend in the number of landfalls (e.g., Wang and Lee, 2008; Pielke Jr., 2009; Villarini et al., 2010) nor is there a trend in the intensity of U.S. landfalling storms (Landsea et al., 2005 and updates). In fact, we are currently experiencing the longest trend since reliable records began between major hurricane landfalls (Wienkle et al., 2012).And, despite the lack of mention in the NCA, there is a lot of evidence that suggests that AGW will act to reduce the frequency of landfalling hurricanes along the U.S. coasts.	2. Our Changing Climate		59	17	Extensive changes have been made to the Hurricane section, and we have provided a new Key Message just for hurricanes. Our goal here was to focus on the observed changes since the 1970s. We have shored up the text to be more clear and emphatic about attribution. Questions about previous periods of high activity in the Atlantic, data quality, and the fidelity of century-scale trends have been addressed a number of times in a

		For example, Murakami and Wang (2010) compared the tracks of Atlantic basin tropical cyclones generated from a high resolution general circulation model (MRI/JMA AGCM v3.1) for a 25-yr simulation of the present day with those of the future under the SRES A1B emissions scenario. They found a significant eastward shift in the tropical cyclone genesis region in the Atlantic Ocean. This eastward shift had the impact of decreasing the frequency of storms which tracked into the U.S. Southeast Atlantic and Gulf coasts and reducing the probability of landfall, while only slightly increasing the influence of tropical cyclones on the northeastern U.S. In follow-up work using a newer version of the high resolution climate model (MRI/JMA AGCM v3.2), Murakami et al. (2012), find that overall, the frequency of tropical cyclones approaching the U.S. coastline declines by nearly 20% while the average maximum intensity of storm approaching the coast increases by less than 0.5 m/s.In other work, Wang et al. (2008) established that the size of the Atlantic Warm Pool (AWP) plays a strong role in hurricane activity in the Atlantic Ocean. The size of the AWP is influenced by annual-to-multiannual ENSO variability, the multi-decadal variability of the Atlantic Multidecadal Oscillation (AMO) and a general overall "global warming" (which leads to a larger AWP). Larger AWPs are associated with more intense Atlantic hurricanes. However, in a follow-up study, Wang et al. (2011) investigated the relationship between AWP size and U.S. landfalling hurricanes. Wang et al. (2011) found that while large AWPs were associated with more storms, large AWPs also altered atmospheric steering currents such the storms which did form had a tendency to recurve northwards and remain out to sea without making landfall in the U.S. Conversely, in years with small AWPs—a condition not favored by global warming—storms were steered more towards the southeastern U.S. Atlantic coast and Gulf of Mexico. Wang and Lee (2008) wrote:"A secular warming of sea surface temperature occurs almost everywhere over the global ocean. Here we use observational data to show that global warming of the sea surface is associated with a secular increase of tropospheric vertical wind shear in the main development region (MDR) for Atlantic hurricanes. The increased wind shear coincides with a weak but robust downward trend in U.S. landfalling hurricanes, a reliable measure of hurricanes over the long term."The lack of an observed long-term trend in the frequency and/or magnitude of U.S. hurricane landfalls, and the recent lack of Category 3 or stronger U.S. landfalling hurricanes is consistent with these findings for a world with increased AGW.Recommendation: It is either oversight or willful neglect that the topic of future U.S. hurricane landfalls under anthropogenic climate change was not covered in the NCA. In either case, it is imperative that this deficit be remedied.References:Murakami, H., and B. Wang, 2010. Future Change of North Atlantic Tropical Cyclone Tracks: Projection by a 20-km-Mesh Global Atmospheric Model. Journal of Climate, 23, 2699–2721. doi:10.1175/2010JCLI3338.1.Murakami, H., et al., 2012. Future Changes in Tropical Cyclone Activity Projected by the New High-Resolution MRI-AGCM. Journal of Climate, 25, 3237–3260. doi: 10.1175/JCLI-D-11-00415.1.Wang, C., and S.-K. Lee, 2008. Global warming and United States landfalling hurricanes, Geophysical Research Letters, 35, L02708, doi:10.1029/2007GL032396.Wang, C.L., S-K. Lee, and D.B. Enfield, 2008. Atlantic Warm Pool acting as a link between Atlantic Multidecadal Oscillation and Atlantic tropical cyclone activity. Geochemistry, Geophysics, Geosystems, 9, Q05V03, doi:10.1029/2007GC001809.Wang, C., L. Hailong, S-K. Lee, and R. Atlas, 2011. Impact of the Atlantic warm pool on United States landfalling hurricanes. Geophysical Research Letters, 38, L19702, doi:10.1029/2011GL049265.Weinkle, J., R. Maue, and R. Pielke, Jr., 2012. Historical global tropical cyclone landfalls. Journal of Climate, doi:10.1175/JCLI-D-11-00719.1.Pielke, R. A., Jr., 2009. United States hurricane landfalls and damages: Can one- to five-year predictions beat climatology? Environmental Hazards, 8, 187–200.Landsea, C. W., 2005. Hurricanes and global warming. Nature, 438. doi:10.1038/nature04477.Villarini, G., G.A. Vecchi, and J.A. Smith, 2012: U.S. landfalling and North Atlantic hurricanes: statistical modeling of their frequencies and ratios. Monthly Weather Review, 140, 44-65.					number of reports, including the AR5 now in progress. To address these again here would serve little purpose. Instead we have chosen to focus on the highly active research topics related to the relative contributions of natural internal and external forcing on the observed tropical Atlantic climate variability. This brings in discussions of regional aerosol forcing as well as the ideas of local vs. remote SST changes. These topics are highly relevant for assessing past and projected changes in Atlantic TCs, and this is where we are focusing. Additional references and discussion of active research areas have been added.The Hurricane KM now includes statements that explicitly acknowledge natural variations and the Atlantic Multidecadal Oscillation as possible factors in an attribution issue that is an active area of research.
Cato	Institute	Screen and Simmons (2013) do not provide overwhelming support for the Francis and Vavrus theory about blocking events.For example, from Screen and Simmonds (2013):"It is of interest to compare our	2. Our Changing		60	24	Text has been tempered as suggested, by citing Screen and Simmonds (2013)

		results to those of [Vavrus and Francis, 2012; FV12] for the case of meridional amplitude over the NAmAtl region. We find statistically insignificant positive trends in all seasons, in contrast to the comparatively larger (and significant) increases in JAS and OND suggested by FV12. These differences appears to relate to the precise metric analysed and can be understood using the idealised example above. FV12 effectively measure the poleward shift of the most northerly point on the wave (marked by the red arrow in Figure 4c) which is larger than the change in meridional amplitude (difference between the two black arrows in Figure 4c). Thus, we argue that the observed changes in the meridional extent of planetary-wave meanders are smaller than those implied by FV12. However, both studies agree on the sign of the meridional amplitude trends over NAmAtl, if not their magnitude or statistical significance."Recommendation: Clearly there is still a lot of work to be done on the topic, so I would suggest tempering your enthusiasm for the Francis and Vavrus result.Reference:Screen, J.A., and I Simmonds, 2013. Exploring links between Arctic amplification and mid-latitude weather. Geophysical Research Letters, doi: 10.1002/GRL.50174.	Climate				and the findings that call into question the conclusion of Francis and Vavrus (2012). We note that uncertainties remain about the effect of Arctic changes on the mid-latitudes.
L. Drew	Hill	Adding health context to Key Message would provide useful context for policy makers: e.g. " Higher summer peak loads will increase the frequency of blackouts and electricity deficits during dangerous heat waves, limiting access to air conditioning and increasing related death tolls, especially among the elderly, young, poor, and sick" (Luber 2008, McGeehin 2001, Miller 2008). A bit of background: prolonged exposure to high temperatures can result in heat cramps, heat syncope, heat exhaustion, heat stroke, and death. The demographics most at risk are the elderly, secluded, and those living without access to air conditioning. Those with preexisting health conditions (e.g. CVD) or those participating in manual labor are also at higher risk (note: it is especially important for hospitals to retain access to cooling). Sources:Luber, G., McGeehin, M. Climate change and extreme heat events. American Journal of Preventative Medicine. 35(5): 429-435. 2008.McGeehin, M., Mirabelli, M. The potential impacts of climate vulnerability and change on temperature-related morbidity and mortality in the United States. Environmental Health Perspectives. 109(S2): 185-189. 2001.Miller, N., Hayhoe, K., Jin, J., Auffhammer, M. Climate, Extreme Heat, and electricity Demand in California. Journal of Applied Meteorology and Climatology. 47(6): 1834-1844. 2008.	4. Energy Supply and Use		170	2	The focus of this chapter is the Energy Sector and so the projected impacts are described from the perspective of this sector. The perspective of the Human Health is addressed in Chapter 9: Human Health.
L. Drew	Hill	Adding health context to the importance of rising summer peak energy demand would add gravitas and urgency. The increased energy use mentioned in line 6 is expected to lead to energy deficits and more frequent blackouts, which will limit access to air conditioning when it is needed most. This will increase rates of related deaths and sicknesses (e.g. heat stroke), especially among the elderly, young, poor, and sick (Luber 2008, McGeehin 2001, Miller 2008). Luber, G., McGeehin, M. Climate change and extreme heat events. American Journal of Preventative Medicine. 35(5): 429-435. 2008.Sources:McGeehin, M., Mirabelli, M. The potential impacts of climate vulnerability and change on temperature-related morbidity and mortality in the United States. Environmental Health Perspectives. 109(S2): 185-189. 2001.Miller, N., Hayhoe, K., Jin, J., Auffhammer, M. Climate, Extreme Heat, and Electricity Demand in California. Journal of Applied Meteorology and Climatology. 47: 1834- 1844. 2007.	4. Energy Supply and Use		172	6	The focus of this chapter is the Energy Sector and so the projected impacts are described from the perspective of the this sector. The perspective of the Human Health is addressed in Chapter 9: Human Health.
L. Drew	Hill	The health co-benefits of reducing direct fossil fuel use in the energy sector are massive. Including a sentence or two on the general health and health-related economic benefits of decarbonizing the energy sector adds social and political context that is of use to policy makers. Emissions from burning fossil fuels are an important cause of illness and death in the United States: fine particulate matter emissions cause sizable increases in cardiopulmonary, lung cancer, and all-cause mortality and considerable reductions in life expectancy (Pope 2002, Pope 2009), fugitive and combustion-created methane emissions as well as directly-emitted volatile organic compounds (VOCs) contribute heavily to the formation of hazardous ground-level ozone (Smith 2009), coal combustion sources release mercury	4. Energy Supply and Use		174	17	The focus of this chapter is the Energy Sector and so the projected impacts are described from the perspective of the Energy Sector. The perspective of the Human Health is addressed in Chapter 9: Human Health. The advantages and disadvantages of lower carbon-content fuels are

		and other hazardous chemicals into the air (IEA 2011, Pacyna 2007), and sulphur and nitrogen oxides acidify water and soil systems (Hertwich 2010) and react in the atmosphere to create secondary particulate matter of great respiratory and cardiovascular health consequence (Smith 2002). Further reductions in such emissions will yield co-benefits for health (Smith & Haigler 2008, Markandya 2012) while decreasing the burden on and cost of U.S. healthcare and lead to millions of recuperated person workdays (USEPA 2011).Sources:Hertwich, E.G., van der Voet, E., Hujibregts, M., Sangwon, S., Tukker, a., Kamierczyk, T., Lenzen, M., McNeely, J., and Moriguchi, Y. Environmental impacts of consumption and production: priority products and materials. UNEP, Paris. 2010.IEA. World energy outlook. International Energy Agency. 2010.Markandya, A., Armstrong, B.G., Hales, S., Chiabai, A., Criqui, P., Mima, S., Tonne, c., Wilkinson, P. Public health benefits of strategies to reduce greenhouse-gas emissions: low-carbon electricity generation. The Lancet. 374: 2006-2015. 2009.Pacynam E.G., Pacyna, J.M., Fudala, J., Strzelecka-Jastrzab, E., Hlawickza, S., Panasiuk, D., Nitter, S., Pregger, T., Pfeiffer, H., and Friedrich, R. Current and future emissions of selected heavy metals to the atmosphere from anthropogenic sources in Europe. Atmospheric environment. 41: 8557-8566. 2007.Pope, C.A., Burnett, R., Thun, M., Calle, E., Krewski, D., ito, K., Thurston, G. Lung cancer, cardiopulmonary mortality, and long-term exposure to fine particulate air pollution. The Journal of the American Medical Association. 287(9) 1132- 1141. 2002.Pope, CA., Ezzati, M., Dockery, D. Fine-particulate air pollution and life expectancy in the United States. The New England Journal of Medicine. 360(4): 376-386. 2009.Smith, K.R. and Haigler, E. Co-benefits of climate mitigation and health protection in energy systems: scoping methods. Annual Review of Public Health. 29:11-25. 2008.Smith, K.R., Jerrett, M., Burnett, R., Stone, V., Derwent, R., Atkinson, R., Cohen, A., Shonkoff, S., Krewski, D., Pope, C.A., Thun, M., Thurston, G. Public health benefits of strategies to reduce greenhouse-gas emissions: health implications of short-lived greenhouse pollutants. 56- 68.2009.USEPA.. The benefits and costs of the Clean Air Act from 1990 to 2020. United States Environmental Protection Agency, Washington, D.C. 2010.					addressed in Chapter 27: Mitigation.
L. Drew	Hill	Policy makers may be interested to know in greater detail the consequences of the impacts of extreme surge events and high tides on costal energy supply, transmission, and distribution infrastructure. Damage to coastal infrastructure may amplify energy deficits in coastal regions during summer heat events, increasing the health and health-related economic burden of heatwaves along the coast (Luber 2008, McGeehin 2001, Miller 2008). The same climate mechanisms that impact coastal energy infrastructure will also affect waste-water treatment plants and, consequently, access to fresh water. The flooding, coastal erosion, inundation of low-lying coastal areas (near which wastewater plants are strategically placed), and increased equipment damage from corrosive salt water and wave action will increase the frequency with which coastal treatment plants are overloaded at precisely the same time as these climate forces are reducing the capacities of coastal energy infrastructures to supply them with power (Bull 2007, Rosenzweig 2011).Sources:Bull, S., Bilello, D., Ekmann, J., Sale, M., Schmalzer, D. Effects of climate change on energy production and distribution in the United States in Effects of Climate Change on Energy Production and Use in the United States. A report by the U.S. Climate Change Science Program and the subcommittee on Global Change Research. 2007.Luber, G., McGeehin, M. Climate change and extreme heat events. American Journal of Preventative Medicine. 35(5): 429-435. 2008.McGeehin, M., Mirabelli, M. The potential impacts of climate vulnerability and change on temperature-related morbidity and mortality in the United States. Environmental Health Perspectives. 109(S2): 185-189. 2001.Miller, N., Hayhoe, K., Jin, J., Auffhammer, M. Climate, Extreme Heat, and electricity Demand in California. Journal of Applied Meteorology and Climatology. 47(6): 1834-1844. 2008.Rosenzweig, C., Solecki, W., Blake, R., Bowman, M., Faris, C., Gornitz, V., Horton, R., Jacob, K., LeBlanc, A., Leichenko, R., Linkin, M., Major, D., O'Grady, M., Patrick, L., Sussman, e., Yohe, G., Zimmerman, R. Developing coastal adaptation to climate change in the New York City infrastructure-shed: process, approach, tools, and strategies. Climactic Change. 106:93-127. 2011.	4. Energy Supply and Use		176	12	The focus of this chapter is the Energy Sector and so the projected impacts are described from the perspective of the Energy Sector. The perspective of the Human Health is addressed in Chapter 9: Human Health. The impacts to coastal wastewater treatment plants is addressed in Chapter 25: Coastal Zone Development and Ecosystems and Chapter 3: Water Resources.

L. Drew	Hill	If the authors do intend to include the previously-recommended health consequences of damaged coastal energy infrastructure, a side-by-side visual comparison of California coastal power plants at risk from sea level rise with California coastal wastewater treatment plants at risk from sea level rise would be informative. I believe the figure in question (4.5 of this chapter) was taken from the Pacific Institute, which has created a similar figure for treatment plants. This can be found as Figure 24 of Herberger 2009, entitled "Wastewater treatment plants on the Pacific coast vulnerable to a 100-year flood with a 1.4 m sea-level rise."Source:Herberger, M., Cooley, H., Herrera, P., Gleick, P., Moore, E. The impacts of sea-level rise on the California coast. Pacific Institute, Oakland, CA. May 2009.	4. Energy Supply and Use	4.5	177		The focus of this chapter is the Energy Sector and so the projected impacts are described from the perspective of the Energy Sector. The perspective of the Human Health is addressed in Chapter 9: Human Health. The impacts to coastal wastewater treatment plants is addressed in Chapter 25: Coastal Zone Development and Ecosystems and Chapter 3: Water Resources.
Ellen	Waggener	I am pleased to see this strong statement supporting the evidence of global warming, and clearly pointing to human activity as the root cause. As a clinical psychologist, I am keenly aware of the human tendency to underestimate the danger and impact of slowly unfolding events. We are far more responsive to short-term costs and benefits. At the age of 66, I see clear evidence of the warming of the Northeast where I grew up and currently live.The projected rises in global temperature and sea levels will, as you so clearly stated, cause dire changes. We as a global community should have already taken action to mitigate carbon emissions, as well as other greenhouse gases. I strongly support national policies and international cooperation to reduce global carbon emissions, as well as the development of methods to remove existing CO2 from the atmosphere.Thank you for this carefully drafted report.	1. Executive Summary				We appreciate your comments.
Peter	Carter	The B1 scenario will not prevent global climate catastrophe because it leads to an equilibrium warming higher than 2C and 2C is certain catastrophe. The definite essential science (not mentioned) is that only zero carbon emissions can possibly stabilize global temperature or oceamn acidification. That means the all essential target is virtual zero carbon and that has to be supplemented by some amount of negative emissions. The 25 year delay to peaking is dangerously unacceptable. There needs be no delay in peaking (ie peak within one year). Delaying peaking makes safe stabilization less likely. There is no justification and it is wrong to permit fiurther increases in carbon emissions (peaking). The B1 delay of close to zero carbon emissions at 2100 will incur large added carbon feedback emissions and make stabilization impossible. This mitigation section is a formula for planetary catatsrophe and does not meet the requirements of the science.	27. Mitigation				The climate effects of the B1 scenario are covered in the Science chapter, and space limitations forbid re-discussion in this chapter. The mitigation chapter makes clear, in several places that U.S. efforts, given its implied role in meeting such a target, are not consistent with this scenario.
Benjamin	Gutierrez	Page 872, line 12, Figure Caption for Figure 25.4: Item 'b', Risk of Shoreline Change (probability of a shoreline change >1m/yr) is based on methods described in Gutierrez et al. (Gutierrez 2011) with data as the basis for the mapped probabilistic information supplied by Thieler and Hammar-Klose (Thieler and Hammar-Klose 1999, 2000a; Thieler and Hammar-Klose 2000b).Should read: Probability of shoreline erosion > 1 m/yr	25. Coastal Zone Development and Ecosystems	25.4	872		We understand risk more broadly as the product of probability and consequence (not only monetary loss). We have otherwise taken up the suggestions and edited the caption accordingly.

		calculated based on methods described in Gutierrez et al., (Gutierrez 2011) with input data from Thieler and Hammar-Klose (Thieler and Hammar-Klose, 1999, 2000a; Thieler and Hammar-Klose 2000b).Comment: Formally, “risk” is the probability of some phenomenon multiplied by the cost.					
Peter	Carter	Global climate will continue to change for over a thousand years because global warming lasts over 1000 years. We are already committed to a 3C warming by 2100 and over 5C equlibrium warming due to: time to stabilize atmospheric GHGs, ocean heat lag, unmasking of aerosol cooling deferred heat, and incurred carbon feeback emissions warming. The amount of warming over that depends on an emergency response. The amount of warming depends on how long the delay to peaking is and how fast emissions are reduced. It depends on a target of zero carbon emissions. Catastrophic climate change impacts are now unavoidable.	2. Our Changing Climate				This comment provides a number of opinions about future climate change but there is nothing in the comment that has any effect on this chapter's aim at discussing the state of the science.
Marjorie	McGuirk	Transit vehicles such as buses are nomarly included.	5. Transportation		195	35	Thank you. We have made changes to the text to incorporate this suggestion.
Marjorie	McGuirk	Fixed route infrastructure normally includes light rail and subways. (Figure 5.4 on page 205 is a case in point, NYC flooded subways during Super Storm Sandy).	5. Transportation		195	34	Thank you. We have made changes to the text to incorporate this suggestion.
Marjorie	McGuirk	This paragrach mixes emissions and fuel use. Did cars and trucks account for 65% of 93% or 65% of 27%? It may be more clearly written:Besides being impacted by changes in the climate, transportation systems also cause changes in the climate through emissions. In 2010, the U.S. transportation sector accounted for 27% of total U.S. greenhouse gas emissions (also called heat-trapping gas emissions), with cars and trucks accounting for 65% of that total (EPA 2011). Petroleum accounts for 3 93% of the nation’s transportation energy use (EIA 2011).	5. Transportation		196	1	Thank you. We have replaced the wording with your suggested change.
Marjorie	McGuirk	Given the definitions on page 195, the line "Transportation systems require expensive and long-lived infrastructure" might be more clearly written "Transporation infrastructure is expensive and designed for long life (typically 50 to 100 years)." While weather influences operating transport systems, climate effects the design of transport infrastructure.	5. Transportation		196	12	Thank you. We have made changes to the text to incorporate this suggestion.
Cato	Institute	Replace Figure 2.23 with one that is more germane to climate impacts in the United States—i.e. observed trend in hurricane intensity for U.S. landfalling hurricanes, shown below, or available here (http://rogerpielkejr.blogspot.com/2012/11/us-hurricane-intensity-1900-2012.html). Additionally, this figure does not suffer from the short -period bias that the current Figure 2.23 suffers from.(Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Figure updated by C. Landsea from Landsea et al., 2005Reference:Landsea, C. W., 2005. Hurricanes and global warming. Nature, 438, doi:10.1038/nature04477.	2. Our Changing Climate	2.23	61		We will consider adding both figures. However, there is no claim of a detectable anthropogenic influence on TCs in the report. As such, inclusion of the suggested figure would have no impact on the conclusions of the report.
Cato	Institute	This figure gives a misleading impression. Instead of showing changes in the percentage change in frequency of storms, show the projected change in the actual number of storms in each category along with the observed variability. Also, include a figure showing the projected changes in the number of U.S. landfalling hurricanes in each category.	2. Our Changing Climate	2.24	62		Category 4-5 hurricanes are much more important for hurricane damage potential than tropical storms. The decision to use a plot which emphasizes the behavior of the more

							intense (and important for impacts) storms was deliberate and entirely appropriate. Regarding the suggestion of a US landfalling hurricane version of these, such a figure is not possible because the Bender et al. study did not investigate the behavior of landfalling storms. This is due to the fact that they used an operational model designed to run only five-day experiments, not longer ones, and often the simulations ended before the storms reached land. Bender et al. will need to expand their study to look at the specifics of landfalling storms. No change needed to the figure.
Cato	Institute	"..faster still." You mean the sea level rise during the short period (~20 years) satellite record is faster than the average tide gauge rise since 1880? That is hardly a fair comparison! You should compare the satellite rise with periods of similar length during in the tide gauge record. That would allow the reader to see the magnitude of the short-term variability in the sea level data set and judge the satellite-observed trend against this variability (for instance in the Church and White sea level dataset, there is a 20-yr period ending around 1930 during which the trend was greater than that currently observed in the satellite record). References:Church, J. A., and N. J. White (2006), "A 20th century acceleration in global sea-level rise", Geophys. Res. Lett., 33, L01602, doi:10.1029/2005GL024826.Nerem, R. S., D. Chambers, C. Choe, and G. T. Mitchum, 2010. Estimating Mean Sea Level Change from the TOPEX and Jason Altimeter Missions. Marine Geodesy, 33 (1), 435, and updates available at http://sealevel.colorado.edu/	2. Our Changing Climate		63	11	In the more recent reference cited in the text (Church and White, 2011a), evidence for acceleration during the 20th century is clearly presented and the rate during the satellite era is shown to be higher than the rate for the 20th century and make a clear case for acceleration since the late 1800s. In fact, in Figure 8 of Church & White (2011a), you can see that the rate in the 1930s was closer to 2 mm/yr and at no other time in the record did the estimate approached the 3 mm/year rate observed during the altimeter era.
Cato	Institute	To the end of the sentence, "It is not clear, however, whether these statistical relationships will hold in the future" add the phrase "or that they are appropriate in modeling past behavior, thus calling their reliability into question (Gregory et al., 2012)."Reference:Gregory, J., et al., 2012. Twentieth-century global-mean sea-level rise: is the whole greater than the sum of the parts? Journal of Climate, doi:10.1175/JCLI-D-12-00319.1, in press.Relevant excerpt from Gregory et al. (2012):"The implication of our closure of the [global mean sea level rise, GMSLR] budget is that a relationship between global climate change and the rate of GMSLR is weak or absent in the past. The lack of a strong relationship is consistent with the evidence from the tide-gauge datasets, whose authors find acceleration of GMSLR during the 20th century to be either insignificant or small. It also calls into question the basis of the semi-empirical methods for projecting GMSLR, which depend on calibrating a relationship between global climate change or radiative forcing and the rate of GMSLR from observational data (Rahmstorf, 2007; Vermeer and Rahmstorf, 2009; Jevrejeva et al., 2010)."	2. Our Changing Climate		63	24	The text has been changed to incorporate this suggestion.
Cato	Institute	Does the data in this figure square with the text on page 63, lines 15-17 stating "Even the most sophisticated climate models, which explicitly represent Earth's physical processes, cannot simulate recent rapid changes in ice sheet dynamics, and thus tend to underestimate sea level rise"?Figure 2.26 makes it seem like the observed sea level rise falls well within the model bounds and doesn't obviously	2. Our Changing Climate	2.26	65		The scenarios for future projections shown in this figure do not come from models, but rather were simply generated based on feasible numbers

		suggest that models “tend to underestimate sea level rise.” Perhaps the description on page 63 is inaccurate?					selected from the literature. This has been clarified in the figure caption.
Cato	Institute	What is the significance of “since the early 1970s”? Is there no good Great Lakes ice coverage prior to then (e.g., Bai et al., 2012, show Great Lakes ice coverage back to 1963)? If not, then, since you tie ice loss to temperature, you could examine the regional winter temperature history prior to the early 1970s. The 1970s were a relative low point for the winter temperature in the Great Lakes region—thus making the change “since the early 1970s” seem larger than if the change were measured from average Lake ice conditions. Remember that 1976-7, 77-8, and 78-9 were the three coldest consecutive winters in the region in the entire NCDC record. So starting from near then will certainly give a big drop in ice coverage. Perhaps you could discuss the influence of ENSO and NAO on the Lake ice coverage (Bai et al., 2012)?Reference:Bai, X., et al., 2012. Interannual variability of Great Lakes ice cover and its relationship to NAO and ENSO. Journal of Geophysical Research 117, C03002, doi:10.1029/2010JC006932.	2. Our Changing Climate		66	6	The reviewer makes a good point, and we have added to the text a statement that the cold winters of the 1970s make the Great Lakes ice trend more negative than when an additional decade of prior data is included. We also added a statement about the influences of ENSO and the NAO, together with a reference to Bai et al. (2010)
Cato	Institute	What’s the point of the two photos in the lower panel of Figure 2.27? Are you implying that Lake Superior was completely ice covered in all Marchs prior to 2003 and has lost all of its March ice cover in the past 10 years? Or are they just two random photos in time? Were there no Marchs prior to 2003 that had ice free conditions? What about 1987, or 1983, or 1964? What if you showed largely ice free conditions of Lake Superior in March 1987 and ice covered conditions in March 2003 with the caption “Satellite images show Lake Superior in a high ice year and an earlier low ice year.” That would be accurate as well, correct? Are your cherries better than mine?Recommendation: Remove the satellite photos and extend the Great Lakes ice coverage time series back into the early 1960s and include the mean ice coverage line (see Bai et al, 2012). Also include a time series of the Great Lakes basin winter temperature series back to 1895 to give the reader an idea of the character of the variability in the record.Reference:Bai, X., et al., 2012. Interannual variability of Great lakes ice cover and its relationship to NAO and ENSO. Journal of Geophysical Research-Oceans, 117, C03002, doi:10.1029/2010JC006932	2. Our Changing Climate	2.27	66		As recommended, we removed the two photos from the figure. We have also added to the discussion of the trends by citing Bai et al. (2010) and noting that the inclusion of earlier years in the record results in a smaller trend (cf. first paragraph of revised KM 11).
Cato	Institute	The Francis and Vavrus stuff needs to be tempered by the recent findings from Screen and Simmonds (2013) that there are no significant changes in blocking in the North Atlantic sector. See our additional comment, on page 60, lines 24-27.Reference:Screen, J.A., and I Simmonds, 2013. Exploring links between Arctic amplification and mid-latitude weather. Geophysical Research Letters, doi: 10.1002/GRL.50174.	2. Our Changing Climate		67	4	We have added a cautionary statement that conclusions about trends in blocking depend on the method of analysis, and we added a citation to Screen and Simmonds (2013). See also response to Comment #32281.
Cato	Institute	This section on Greenland ice loss is incomplete. For instance, no mention is made of the findings of Moon et al. (2012) which includes statements like (which leave a markedly different impression about future sea level rise than the NCA):“Finally, our observations have implications for recent work on sea level rise. Earlier research used a kinematic approach to estimate upper bounds of 0.8 to 2.0 m for 21st-century sea level rise. In Greenland, this work assumed ice-sheet–wide doubling of glacier speeds (low-end scenario) or an order of magnitude increase in speeds (high-end scenario) from 2000 to 2010. Our wide sampling of actual 2000 to 2010 changes shows that glacier acceleration across the ice sheet remains far below these estimates, suggesting that sea level rise associated with Greenland glacier dynamics remains well below the low-end scenario (9.3 cm by 2100) at present. Continued acceleration, however, may cause sea level rise to approach the low-end limit by this century’s end.”Recommendation: Include a more thorough assessment of recent scientific findings concerning ice loss in Greenland which, together indicate that sustained period of rapid ice loss is unlikely and that the sea level contribution during the 21st century is likely to be small.Reference:Moon, T., I. Joughin, B. Smith, and I. Howat, 2012. 21st-century evolution of Greenland outlet glacier velocities. Science, 336, 576-578, doi:10.1126/science.1219985	2. Our Changing Climate		69	1	The paragraph on Greenland's ice loss has been modified to convey Moon et al.'s findings about contrasting velocity trends of maritime-terminating glaciers and glaciers terminating on ice shelves and land. We removed the statement about Greenland's mass loss being an increasingly large percentage contribution to sea level rise, with a reference to Moon et al. (2012). At the reviewer's suggestion, we added a statement about the need for a more thorough assessment of the rate of mass loss from Greenland.

Cato	Institute	We suggest you temper your methane findings—too many people are exaggerating the impact of methane releases from the Arctic (see http://www.realclimate.org/index.php?p=10412). You need to be careful not to find yourself among them.	2. Our Changing Climate		69	9	We have added two sentences at the end of Key Message 11, toning down the methane findings as suggested. Specifically, we note the long timescales required for a response of frozen methane hydrates to climate change. We also added a reference to Archer (2010), but it is difficult to directly reference the blogosphere article cited by the reviewer (even though it contains some good points) because it is not peer-reviewed literature.
Cato	Institute	"…and scientists are unsure whether and how quickly ocean life could adapt to such rapid acidification."There is much more to the ocean acidification story being told in the NCADAC. The scientific literature in this area has been expanding rapidly, and when evaluated in its entirety reveals a future that does not so full of negative impacts as the NCA implies. Negative outcomes are based primarily upon abiotic physical-chemical reactions that do not take account of the processes of life, which can greatly modify simply inorganic chemical processes. Many of the experiments examining this issue that actually do deal with living creatures are often of very short duration and do not account for longer-term adaptation, acclimation, or evolution.Longer-term studies often demonstrate the ability of marine species to adapt to changing conditions. For example, a reconstruction of seawater pH spanning the period 1708-1988, based on the boron isotopic composition (δ11B) of a long-lived massive Porites coral from Flinders Reef in the western Coral Sea of the southwestern Pacific (Pelejero et al., 2005) indicated that there has been no notable trend toward lower δ11B values over the 280-year period. Instead, they say "the dominant feature of the coral δ11B record is a clear interdecadal oscillation of pH, with δ11B values ranging between 23 and 25 per mil (7.9 and 8.2 pH units)." In addition, they calculated changes in aragonite saturation state from the Flinders pH record that varied between ~3 and 4.5, which values encompass, in their words, "the lower and upper limits of aragonite saturation state within which corals can survive." Yet in spite of this fact, they determined that "skeletal extension and calcification rates for the Flinders Reef coral fall within the normal range for Porites and are not correlated with aragonite saturation state or pH."A study of historical calcification rates determined from coral cores retrieved from 35 sites on Australia's Great Barrier Reef, found that there was a statistically significant correlation between coral calcification rate and local water temperature, such that a 1°C increase in mean annual water temperature increased mean annual coral calcification rate by about 3.5% (Lough et al., 1997). Nevertheless, it was reported that there were "declines in calcification in Porites on the Great Barrier Reef over recent decades." The researchers were quick to note, however, that their data depicted several extended periods of time when coral growth rates were either above or below the long-term mean, cautioning that "it would be unwise to rely on short-term values (say averages over less than 30 years) to assess mean conditions." Notably, they reported that "a decline in calcification equivalent to the recent decline occurred earlier this century and much greater declines occurred in the 18th and 19th centuries," long before anthropogenic CO2 emissions made a significant impact on the air's CO2 concentration. In fact, the researchers report that "the 20th century has witnessed the second highest period of above average calcification in the past 237 years." Similar findings were reported by another research team that reconstructed a history of coral calcification rates from a core extracted from a massive Porites coral on the French Polynesian island of Moorea that covered the period 1801-1990 (Bessat and Buigues, 2001).	2. Our Changing Climate		70	7	Much of the work on acidification has involved short-term laboratory experiments on single species, and over time it will be important to reconcile this class of experiments with observational and manipulation studies of complete natural communities as well as paleo-reconstructions of, for example, coral calcification and paleo-pH. The paelo-coral studies need to be assessed, however, in the context of tropical coral mesocosm and laboratory manipulation studies, which consistently show declining calcification rate as a function of declining CaCO3 saturation state (e.g., meta-analysis by Kroeker et al., 2010 and 2013). Further, studies in isolated high-CO2 environments, such as shallow volcanic vents, that tend to support these laboratory findings showing dramatic declines in the areal cover and diversity of tropical corals under elevated CO2 (Fabricius et al., 2011). Warming above local threshold temperatures has been shown to result in a wide range negative impacts on corals including thermal bleaching and increased disease levels (see NCA Chapter 24), and a number of studies indicate that warming and acidification together can interact synergistically leading to larger negative impacts than those expected for either factor

		They performed this work, they wrote, because “recent coral-growth models highlight the enhanced greenhouse effect on the decrease of calcification rate,” as well as the similarly projected negative effect of CO2-induced ocean acidification on calcification rate; and rather than relying on theoretical calculations, they wanted to work with real-world data, stating that the records preserved in ancient corals “may provide information about long-term variability in the performance of coral reefs, allowing unnatural changes to be distinguished from natural variability.” Similar to other studies, they found that a 1°C increase in water temperature increased coral calcification rate at the site they studied by 4.5%, which result stands in stark contrast to the 6-14% decline in calcification that had earlier been computed should have occurred over the past 100 years, based solely on physical-chemical considerations (Kleypas et al., 1999). In addition, they observed patterns of “jumps or stages” in the record, which were characterized by an increase in the annual rate of calcification, particularly at the beginning of the past century “and in a more marked way around 1940, 1960 and 1976,” stating once again that their results “do not confirm” those predicted by the purely physical-chemical model upon which the ocean acidification hypothesis is ultimately based.In another study devoted to corals that involves a much longer period of time another research team determined the original growth rates of long-dead Quaternary corals found in limestone deposits of islands in the Wakatobi Marine National Park of Indonesia, after which they compared them to the growth rates of present-day corals of the same genera living in the same area (et al., 2006).This work revealed that the Quaternary corals grew in a comparable environment to modern reefs -- except, of course, for the air’s CO2 concentration, which is currently higher than it has been at any other time throughout the entire Quaternary, which spans the past 1.8 million years. Most interestingly, therefore, their measurements indicated that the radial growth rates of the modern corals were 31% greater than those of their ancient predecessors in the case of Porites species, and 34% greater in the case of Favites species. Similar findings are ubiquitous, showing increasing rates of coral calcification in the face of rising temperatures and atmospheric CO2 concentrations (e.g. Clausen and Roth, 1975; Coles and Jokiel, 1977; Kajiwara et al., 1995; Nie et al., 1997; Reynaud-Vaganay et al., 1999; Reynaud et al., 2007). Recommendation: The ocean acidification sections needs to be reworked so as to reflect more long-term real-world studies tha indicate that marine species are not as susceptible to ocean acidification as is implied in the current NCA.References:Pelejero, C., Calvo, E., McCulloch, M.T., Marshall, J.F., Gagan, M.K., Lough, J.M. and Opdyke, B.N. 2005. Preindustrial to modern interdecadal variability in coral reef pH. Science 309: 2204-2207.Lough, J.M. and Barnes, D.J. 1997. Several centuries of variation in skeletal extension, density and calcification in massive Porites colonies from the Great Barrier Reef: A proxy for seawater temperature and a background of variability against which to identify unnatural change. Journal of Experimental and Marine Biology and Ecology 211: 29-67.Bessat, F. and Buigues, D. 2001. Two centuries of variation in coral growth in a massive Porites colony from Moorea (French Polynesia): a response of ocean-atmosphere variability from south central Pacific. Palaeogeography, Palaeoclimatology, Palaeoecology 175: 381-392.Kleypas, J.A., Buddemeier, R.W., Archer, D., Gattuso, J-P., Langdon, C. and Opdyke, B.N. 1999. Geochemical consequences of increased atmospheric carbon dioxide on coral reefs. Science 284: 118-120.Crabbe, M.J.C., Wilson, M.E.J. and Smith, D.J. 2006. Quaternary corals from reefs in the Wakatobi Marine National Park, SE Sulawesi, Indonesia, show similar growth rates to modern corals from the same area. Journal of Quaternary Science 21: 803-809.Clausen, C.D. and Roth, A.A. 1975. Effect of temperature and temperature adaptation on calcification rate in the hematypic Pocillopora damicornis. Coral Reefs 33: 93-100.Coles, S.L. and Jokiel, P.L. 1977. Effects of temperature on photosynthesis and respiration in hermatypic corals. Coral Reefs 43: 209-216.Kajiwara, K., Nagai, A. and Ueno, S. 1995. Examination of the effect of temperature, light intensity and zooxanthellae concentration on calcification and photosynthesis of scleractinian coral Acropora pulchra. Journal of the School of Marine Science and Technology 40: 95-103.Nie, B., Chen, T., Liang, M., Wang, Y., Zhong, J. and Zhu, Y. 1997. Relationship between coral growth rate and sea surface temperature in the northern					individually. On longer time-scale, there may be the potential for species to acclimate or even evolve to deal with lower pH, as reflected in the Key Message on ocean acidification in the Oceans and Marine Resources Chapter.

		part of South China Sea. Science in China Series D 40: 173-182.Reynaud-Vaganay, S., Gattuso, J.P., Cuif, J.P., Jaubert, J. and Juillet-Leclerc, A. 1999. A novel culture technique for scleractinian corals: Application to investigate changes in skeletal δ18O as a function of temperature. Marine Ecology Progress Series 180: 121-130.Reynaud, S., Ferrier-Pages, C., Meibom, A., Mostefaoui, S., Mortlock, R., Fairbanks, R. and Allemand, D. 2007. Light and temperature effects on Sr/Ca and Mg/Ca ratios in the scleractinian coral Acropora sp. Geochimica et Cosmochimica Acta 71: 354-362.					
Cato	Institute	General CommentWhile Zhang et al. (2007) concluded globally that they had detected an anthropogenic influence on the overall latitudinal patterns of precipitation trends (although not in the magnitude of the trends) using the CMIP 3 models, in the latitude band that included the majority of the United States population, a mismatch between model projections and precipitation trends was found (model predicted a downwards trend while observations show and upwards trend).(Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Latitude bands of the earth where observed precipitation trends (1925-1999) are of the same sign as model predicted trends. Green shading means increases in both observations and models, yellow shading means decreases in both observations and models, white areas are regions with insufficient observations, and gray area (which include most of the U.S.) are areas in which the observed trends and the modeled trends were of opposite signs (figure from Zhang et al., 2007).More recently, Sarojini et al. (2012) examined the performance of the CMIP5 models and found much the same as Zhang et al. (2007). Of most relevance to the NCA, Sarojini et al. (2012) found little if any AGW signal in the observed annual of seasonal precipitation trends in land areas in the latitude band which contains the majority of the U.S.(Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Precipitation anomalies in the 30N to 60N latitude band from climate models (masked to match observations) driven by natural (blue) and natural+anthropogenic (red) forcings. Observed changes are in black. Green stars indicate times when there is a statistically significant difference between the NAT and the ALL forcings. Green stars are largely absent indicating that there is no statistically significant difference between NAT and ALL forcings in the modeled precipitation history (1950-2005) of the latitude band which contains the much of the U.S. (Sarojini et al., 2012).The Zhang et al. (2007) results have a high degree of internal consistency. Where large increases (high northern latitudes and southern tropics) or large decreases (tropics) are predicted, the signs of the modeled and observed trends are in agreement. In the intermediate zones, where projected changes are small, the signs are of the two are different.Sarojini et al. (2012) find that the natural influence on precipitation over land areas with observations in the 30 to 60N latitude band is indistinguishable from the natural+anthopogenic signal indicating that anthropogenic forcing has played no detectable role in the evolution of seasonal precipitation in this latitude band either in seasonal or annual totals.Obviously, forecasts that differ in sign from what is observed, or are indistinguishable from natural changes possess no skill and should not be used in a National Assessment. And while Zhang et al. (2007) and Sarojini et al. (2012) looked only at latitude bands, Polson et al. 2013 showed more specific results. Across the U.S., Polson et al. (2013) find that for most of the country during all seasons, that the sign of the observed precipitation changes (since 1950) differ from the sign of the climate model projected changes over the same period. (Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Percentage change in precipitation per decade for the ALL forced multi-model mean for 1951- 2005 for DJF, MAM, JJA and SON. Hatched grid-boxes show where the sign of the change is consistent across all four observation datasets and the multi-model mean. Note the smaller scale of change patterns as multi-model mean changes show a much reduced influence of internal climate variability. (source: Polson et al., 2013)It is impossible to present reliable future projections for precipitations changes across the U.S. (seasonal or annual) from a collection of climate models which largely cannot even get the sign (much less the magnitude) of observed changed	3. Water Resources				In our response to comment #32136 on Chapter 2 langugage about precipitation projections, we have considerably expanded the traceable account, which provides an expanded discussion of the basis for our statements about precipitation projections and includes some of the suggested references.

		correct.As a consequence, unless/until the GCMs can be demonstrated to accurately capture observed characteristics (spatial and temporal patterns and magnitudes) of precipitation changes across the U.S., all discussion from the NCA concerning future patterns of precipitation change should be removed. References:Polson, D., G. Hegerl, X. Zhang, and T. Osborn, 2013: Causes of Robust Seasonal Land Precipitation Changes. Journal of Climate, doi:10.1175/JCLI-D-12-00474.1, in press.Sarojini, B.B., et al., 2012. Fingerprints of changes in annual and seasonal precipitation from CMIP5 models over land and ocean. Geophysical Research Letters, 39, L21706, doi: 10.1029/2012GL053373.Zhang, X., et al., 2007. Detection of human influence on twentieth-century precipitation trends, Nature, 448, 461–465, doi:10.1038/nature06025.					
Reese	Cloud	Thank you for writing this report. It is an important piece of information for decision makers and the public. I hope that it is used to spur action on the issue of climate change at all levels of government and in the private sector.	Introduction: Letter to the American People				Thank you for your comment.
Cato	Institute	The quote from Cousteau immediately reveals the political bias of the editors and writers. Try to be a little subtle and leave it out.	3. Water Resources		107	13	After consideration of this point, we don't consider this quote to be political in nature but rather helps to illustrate the importance of the water cycle to living systems.
Cato	Institute	Key Message 1There is general mismatch between the seasonal/annual patterns of observed precipitation changes and climate model expectations of those same changes across the U.S. during the past 50 to 100 years (see our General Comment of this Chapter for more detail) (Zhang et al., 2007; Sarojini et al., 2012; Polson et al., 2013). Given this mismatch, it is imprudent to discuss projections of future changes to the seasonal/annual pattern of precipitation change made by these very same climate models. References:Polson, D., G. Hegerl, X. Zhang, and T. Osborn, 2013. Causes of Robust Seasonal Land Precipitation Changes. Journal of Climate, doi:10.1175/JCLI-D-12-00474.1, in press.Sarojini, B.B., et al., 2012. Fingerprints of changes in annual and seasonal precipitation from CMIP5 models over land and ocean. Geophysical Research Letters, 39, L21706, doi: 10.1029/2012GL053373.Zhang, X., et al., 2007. Detection of human influence on twentieth-century precipitation trends, Nature, 448, 461–465, doi:10.1038/nature06025.	3. Water Resources		107	18	In our response to comment #32136 on Chapter 2 language about precipitation projections, we have considerably expanded the traceable account, which provides an expanded discussion of the basis for our statements about precipitation projections and includes the suggested references.
Cato	Institute	Key Message 2Projections of summer droughts are typically too sensitive to projected changes in temperature (Hoerling et al., 2012; Sheffield et al., 2012), so care must be taken to insure that the techniques used in such drought projections do not suffer from such over sensitivity.Further, seasonal projections of precipitation changes across the U.S. made by general circulation models are unreliable (Zhang et al., 2007; Sarojini et al., 2012; Polson et al., 2013) and regional climate models with higher spatial resolution indicate less drying in the Southwest than coarse resolution GCMs (Gao et al., 2011; Gao et al., 2012).References:Gao, Y., J. Vano, C. Zhu, and D. P. Lettenmaier. 2011. Evaluating climate change over the Colorado River basin using regional climate models. Journal of Geophysical Research 116, D13104, doi:10.1029/2010JD015278.Gao, Y., et al. 2012. Moisture flux convergence in regional and global climate models: Implications for drought in the southwestern United States under climate change. Geophysical Research Letters 39, L09711, doi:10.1029/2012GL051560.Hoerling, M., et al., 2012. Is a Transition to Semi-Permanent Drought Conditions Imminent in the U.S. Great Plains? Journal of Climate, 25, 8380-8386, doi:10.1175/JCLI-D-12-00449.1.Polson, D., G. Hegerl, X. Zhang, and T. Osborn, 2013. Causes of Robust Seasonal Land Precipitation Changes. Journal of Climate, doi:10.1175/JCLI-D-12-00474.1, in press.Sarojini, B.B., et al., 2012. Fingerprints of changes in annual	3. Water Resources		107	21	Thank you for the comment. The Key Message and supporting text on droughts have been revised in response.

		and seasonal precipitation from CMIP5 models over land and ocean. Geophysical Research Letters, 39, L21706, doi: 10.1029/2012GL053373.Sheffield, J., et al., 2012. Little change in global drought over the past 60 years. Nature, 491, 435-438, doi:10.1038/nature11575.Zhang, X., et al., 2007. Detection of human influence on twentieth-century precipitation trends, Nature, 448, 461–465, doi:10.1038/nature06025.					
James	Tolbert	I strongly support the stated likange between emissions and future impact. Particularly the sentence "Lower emissions mean less future warming and less severe impacts; higher emissions would mean more warming and more severe impacts." This statement could be reflected in other sections of the document, but should remain a central message in the Executive Summary. The sentence is supported by the literature and addressed in later sections of the report.	1. Executive Summary		6	2	Thank you for your comment.
Cato	Institute	Key Message 3There is general mismatch between the seasonal/annual patterns of observed precipitation changes and climate model expectations of those same changes across the U.S. during the past 50 to 100 years (Zhang et al., 2007; Sarojini et al., 2012; Polson et al., 2013). Given this mismatch, it is imprudent to discuss projections of future changes to the seasonal/annual pattern of precipitation change made by these very same climate models. Further, floods are impacted by many factors besides climate or climate change. And the influence of these other factors must be accounted for before projections of climate change impacts are discussed (e.g. Pielke Jr., 1999).References:Pielke, R.A., Jr., 1999: Nine fallacies of floods. Climatic Change, 42, 413-438.Polson, D., G. Hegerl, X. Zhang, and T. Osborn, 2013. Causes of Robust Seasonal Land Precipitation Changes. Journal of Climate, doi:10.1175/JCLI-D-12-00474.1, in press.Sarojini, B.B., et al., 2012. Fingerprints of changes in annual and seasonal precipitation from CMIP5 models over land and ocean. Geophysical Research Letters, 39, L21706, doi: 10.1029/2012GL053373.Zhang, X., et al., 2007. Detection of human influence on twentieth-century precipitation trends, Nature, 448, 461–465, doi:10.1038/nature06025.	3. Water Resources		107	24	We have reviewed the literature suggested by this comment. We have added discussion of non-climate factors that influence flood frequencies. However, we do not agree that no discussion of climate change can be had until those other influences have all be resolved. Our task here is to make sure that climate change is part of the full range of future influences on flooding being considered. The primary conclusions (and key finding) about future floods, as presented herein, do not rely directly upon floods or storm locations simulated by climate models; rather our flood conclusions and discussions rest mostly on broader, more basic process and projections (including changes in storm intensities generally, changes in sea-level baselines, and changes in snow-rain conditions in many mountain watersheds). We have, overall, made the range of possibilities (positive and negative) clearer in responding to this, and other, comments, improving the chapter in the process, and for that appreciate the commenter's input.
Cato	Institute	Key Message 4“Expected” precipitation changes are derived from simulations of precipitation and precipitation-related variables for the future. In science, “change” means a significant difference. So it is worthwhile asking, at what future (or present) point are changes observed or projected to appear? To help answer that question for you (since you all did not address it) we have prepared a Table showing the number of years before your projected changes in precipitation rise above the level of background natural variability. (see our Comment for Page 43, lines 3-7). Please refer to that Table in your discussions of “expected” changes.Also, there are no “expected” changes in “land use” detailed in this chapter. Text needs to be added in the appropriate place rather than just including some vague	3. Water Resources		107	27	We have reviewed the additional literature suggested, and have revised the discussion of groundwater to reflect the suggested expansion of concepts addressed, to the extent possible in the limited space available in this report. We have added some of the suggested references. In

		reference to other sections of the report. Concern exists that groundwater resources in the United States will be negatively impacted by climate change because of increased drought and reduced recharge, increased pumping to keep up with increased potential evapotranspiration rates, and even the intrusion of brackish water related to ongoing sea level rise. There is no question that coherence exists between climate variables and groundwater resources with the interactions occurring at a variety of timescales (Ghanbari and Brave, 2010). Some scientists have found that climate change will be amplified in terms of groundwater response (Ng et al., 2010), while others have found only small responses to climate change scenarios (Scibek et al., 2007). Most investigators agree that groundwater response will strongly depend on local soils, land cover, geology, topography, regional climate, and existing groundwater conditions. Furthermore, groundwater may also respond to a decrease in transpiration from plants associated with elevated atmospheric carbon dioxide concentrations. There is little doubt that groundwater resources of the future will be far more related to human management strategies than by changes in climate. Given the natural variability in climate, the complex response of groundwater to variations in climate, and the enormous impact on groundwater from pumping, groundwater impacts related to human-induced climate change will likely be undetectable for many decades to come (Hulme et al., 1999).References:Ghanbari, R.N. and H.R. Bravo, 2010. Coherence among climate signals, precipitation, and groundwater. Ground Water, 49, 476–490.Hulme, M., E.M. Barrow, N.W. Arnell, P.A. Harrison, T.C. Johns, and T.E. Downing, 1999. Relative impacts of human-induced climate change and natural climate variability. Nature, 397, 688-691.Ng, G.□H. C., D. McLaughlin, D. Entekhabi, and B. R. Scanlon, 2010. Probabilistic analysis of the effects of climate change on groundwater recharge. Water Resources Research, 46, W07502, doi:10.1029/2009WR007904.Scibek, J., D.M. Allen, A.J. Cannon, P.H. Whitfield, 2007. Groundwater–surface water interaction under scenarios of climate change using a high-resolution transient groundwater model. Journal of Hydrology, 333, 165–181.					particular, upon reviewing the literature recommended as well as other literature that followed from that review, we revised the text to make clear several important points: (a) That the nature and magnitudes of groundwater responses are likely to be quite aquifer- and basin-specific, and that the rate or arrival times of the changes will also probably be setting-dependent, so that, if we are not making broad statements about the direction and timing of groundwater effects, it is largely because there are few universal conclusions to be reached. We have expanded the discussion to list several facts that we do know about how groundwater and climate are interlinked. (b) We also recognize that groundwater will continue to be heavily impacted via human interventions like pumping. (c) Indeed, much of our uncertainty as to the likely mechanisms and directions of impacts on groundwater by climate change are associated with how climate change will impact recharge and natural discharges from aquifers, and the text (and key finding) now makes this distinction more clearly. (d) We disagree with the broad statement that climate change impacts on groundwater systems "will be undetectable for many decades to come".
Cato	Institute	Key Message 5Note on sea level rise: According to the IPCC Fourth Assessment Report, “Global average sea level rose at an average rate of 1.8 [1.3 to 2.3] mm per year over 1961 to 2003. The rate was faster over 1993 to 2003: about 3.1 [2.4 to 3.8] mm per year. Whether the faster rate for 1993 to 2003 reflects decadal variability or an increase in the longer-term trend is unclear.” An update to the satellite sea level rise record (Nerem et al., 2010) through 2012 shows that the decadal rate of sea level rise has been slowing. From 2002 to 2012 the rate of sea level rise was 2.7 mm per year (0.09 inches per year). This slowdown in the rate of global sea level rise suggests that the faster rate of rise noted by the IPCC from 1993 to 2003 was influenced in part by short-term natural variability characteristic of the 20th century sea level rise record, rather than a full indication of the increase in the long-term rate of sea level rise.The current rate of sea level rise, 2.7 mm per year, is equivalent to approximately 1 inch per decade—a rate which adaptive and protective responses can keep up with. Note with regard to coastal wetlands: Some of the most extensive wetlands in the U.S are located on the northern Gulf Coast, where sea level rise from non-climatic processes greatly exceeds that from climate change.	3. Water Resources		107	30	We appreciate the reviewer suggestion, but we feel this issue is best addressed by Chapter 25 on the Coastal Zone . Reference to this chapter has been provided in this section.

		Consequently, any attempts to mitigate climate change by emissions reductions repeatedly referred to in the overall report will have little effect. The Gulf Coast is a region which has been experiencing a long-term relative sea level rise that is some 2 to 5 times greater than that of the global average rate of sea level. The rate of relative sea level rise recorded at Galveston, Texas since 1908 has averaged 6.39 mm per year (2.1 feet per century). At Grand Isle, Louisiana the relative level rise has averaged 9.24 mm per year (3.03 feet per century) since measurements began there in 1947. The global average sea level rise during the 20th century has averaged 1.8 mm per year (0.59 feet per century), indicating that the bulk of relative sea level rise being felt in this region is from land subsidence which is not likely to be mitigated by emissions restrictions. Reference:Nerem, R. S., D. Chambers, C. Choe, and G. T. Mitchum, 2010. Estimating Mean Sea Level Change from the TOPEX and Jason Altimeter Missions. Marine Geodesy, 33 (1), 435, and updates available at http://sealevel.colorado.edu/					
Cato	Institute	Key Message 7This statement is woefully incomplete. Whatever changes are occurring are largely driven by consumption. As NCA Figure 2.11 shows, precipitation in recent decades is higher in much of the Southwest, the Southeast, and the Great Plains, while it is lower in Hawaii. Nor has the temperature changed enough in the SE and GP regions to counter the precipitation increases. In the Southwestern United States, where dry periods have been a concern since 2000, the differences between water use and supply is greater than in any other region of the United States. Despite the recent dryness, a large majority of reporting stations in the region exhibit negative trends in dry event length; i.e., the time interval between precipitation events has generally been declining since 1951. Not surprisingly, much of the variability in dry event length is related to El Niño variability, which is strongly coupled to southwestern U.S. precipitation.(Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: In general, the length of dry events have been declining in the western U.S. (downward triangles) (from McCabe et al., 2010).This key finding and the associated text needs to contain the following text: “The majority of these water supply changes are driven by consumption and withdrawal, as precipitation has generally increased, with the exception of a significant drop in Hawaii”. References:Lins, H. F., and E. Z. Stakhiv, 1998. Managing the nation’s water in a changing climate, J. Am. Water Resour. Assoc., 34, 1255–1264, doi:10.1111/j.1752-1688.1998.tb05429.x.McCabe, G. J., et al., 2010. Variability and trends in dry day frequency and dry event length in the southwestern United States, J. Geophys. Res., 115, D07108, doi:10.1029/2009JD012866.	3. Water Resources		108	2	We have added a key message to address the important role of consumption and water withdrawal projections.
Cato	Institute	Key Message 8The draft Assessment often conflates the existence of a change with a bad outcome from change. The statement “Increasing flooding risk affects……in the U.S.” is meaningless unless “affects” is quantified, and there is a very extensive literature, centered on Pielke Jr. and Sr., but also on Chagnon Sr. and Jr., demonstrating little if any net cost increase after allowing for inflation and property value changes.From Changnon et al., (1997): "Frequent and extremely damaging severe weather conditions in the United States during 1991–94 caused $40 billion in insured losses, creating major impacts and eliciting diverse responses in the weather insurance industry. Population, one reason for the growing national sensitivity to storm damage, explained much of the increase in the number of catastrophes (property losses > $10 million) as well as the increases in the amount of losses. The largest increases in storms occurred in areas experiencing the greatest population growth (west, southwest, south, and southeast). Shifts in atmospheric variables (particularly in the frequency of extratropical cyclones) explained most of the 1949–94 fluctuations found in the intensity of catastrophic storms (losses divided by storm frequency)…"Nationally, there has been a significant increase in rainfall measured on the heaviest precipitation-day of the year, but the magnitude is very small—about 0.26 inches in a century (Michaels et al., 2004). While this trend is statistically significant, it is so small as to likely be operationally unimportant.(Figure emailed to comments@usgcrp.gov as per	3. Water Resources		108	7	After consideration of this point we still feel the key messages on floods are clear and accurate. The supporting text has been modified to reflect that increase in national average flood magnitudes has not been documented but is projected. More information has also been added on damage from floods and on adaptation related to flooding risk.

		instructions)CAPTION: Annual average precipitation amount falling on the wettest day of the year across the U.S. (source: Michaels et al., 2004).References:Changnon, S.A., et al., 1997. Effects of Recent Weather Extremes on the Insurance Industry: Major Implications for the Atmospheric Sciences. Bulletin of the American Meteorological Society, 78, 425-435.Michaels, P.J., et al., 2004. Trends in precipitation on the wettest days of the year across the contiguous USA. International Journal of Climatology, 24, 1873-1882.					
Cato	Institute	With respect to annual precipitation in the U.S.:The statement about "recent decades" is true but neglects the fact that the 7% increase observed nationally does not really show an acceleration in recent decades, but instead reflects a situation similar to what has occurred with precipitation on the heaviest day of the year (Michaels et al., 2004).(Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Average annual precipitation averaged across the U.S. (source: NCDC).	3. Water Resources		108	29	Thank you for your comment. We have clarified the supporting text for Key Message #1 such that we think it addresses your comment.
Cato	Institute	"Increases in the north and decreases in the Southwest are projected to continue in this century (Orlowsky and Seneviratne 2012)."What about those place in the Southwest which have seen precipitation increases (See NCA Figure 2.11). Are the increases in those places due to AGW or natural variability? Are the decreases in other locales in the Southwest due to AGW or natural variability? Do climate models get the pattern correct? Will the climate models get the pattern correct 10 years from now? 50 years? 100 years? How do you know?It is imperative that you quantify natural variability and show the model projections against that natural variability (after that is, you have demonstrated the ability for the climate models to accurately capture the temporal and spatial history of precipitation patterns across the U.S.—a demonstration which is currently lacking in the NCA).	3. Water Resources		108	34	Because natural and regional variations in mean precipitation are much larger than in temperature, detection of precipitation trends and attribution to anthropogenic forcing is more challenging and is more sensitive to the limitations of the observational networks. In NOAA Technical Report NESDIS 142, a set of graphs was prepared that compared CMIP3 simulations of annual precipitation with observed changes in the regions. These graphs demonstrate that natural variations of precipitation are large, both in observations and in model simulations. They also show that historical variations of precipitation in the NCA regions are not inconsistent with the historical model simulations. Also, our figures in the climate science chapter on precipitation projections highlight those areas where the human contribution larger than the natural variations in some seasons at some locations. This statement is based on the climate science chapter analysis of model simulations.
Cato	Institute	"Further, the volume of precipitation from the heaviest daily events has increased across the U.S."This is true. In fact, this was demonstrated in Michaels et al., 2004. What was also demonstrated in Michaels et al., 2004 was that when the volume of precipitation delivered on wettest days of the year was divided by the total annual volume of precipitation, that there was no overall increase in the percentage of precipitation falling on the wettest days of the year. The basic conclusion is that as precipitation increases, so too does the amount falling in heavy events. Unless you all provide a cost-benefits analysis that shows that in net, the observed precipitation changes are negative (which is probably going to be challenging since there is no climate change signal in flood damages, for example,	3. Water Resources		108	37	There is conflicting evidence on overall changes in the observed precipitation distribution. In addition to Michaels et al. (2004), Higgins and Kousky (2013) found increases in the number of events across a wide spectrum of precipitation amounts. On the other hand, Groisman et al (Groisman, Pavel

		according to the IPCC SREX “The absence of an attributable climate change signal in losses also holds for flood losses”)—arguably the biggest source of negative impacts from additional precipitation—then you should stop overemphasizing the data on heavy precipitation amounts. Fine, heavy events are increasing. So what? It turns out that it is thus far impossible to identify, much less demonstrate, that they result in a net negative when all effects of precipitation changes are considered.Reference:IPCC, 2012: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, UK, and New York, NY, USA, 582 pp.Michaels, P.J., et al., 2004. Trends in precipitation on the wettest days of the year across the contiguous USA. International Journal of Climatology, 24, 1873-1882.					Ya., Richard W. Knight, Thomas R. Karl, 2012: Changes in intense precipitation over the central united states. J. Hydrometeor, 13, 47–66. doi: http://dx.doi.org/10.1175/JHM-D-11-039.1) found that the number of intermediate events decreased while large events increased (for the central U.S.). Regarding the comment about losses, the statement in the text is only describing the climate signal, not the overall impacts.
James	Tolbert	The term "Midwest" has many different meanings. I suggest defining what states Chapter 18 defines as in the Midwest in the introductory paragraph for the reader instead of making the reader wait for later maps or look in other chapters for this definition.	18. Midwest		618	2	The text has been revised to incorporate this suggestion.
Cato	Institute	Incomplete literature.This brief section is a “high-visibility” aspect of U.S. climate change and should therefore be much more complete in its literature citations.In a paper relating wildfire to snowmelt, Westerling et al. (2006), showed considerable year to year variability in the timing of snowmelt. They also found no significant trend whatsoever over the past four decades. (Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Timing of spring snowmelt (the more negative the value, the earlier in the year the spring snowmelt occurred) (source: Westerling et al., 2006).Longer tree ring records in the West have been shown to be highly related to snow water equivalent in snowpack of the area. Given a long-term tree ring record, a proxy time series of water in the snowpack can be generated. One such record from the Gunnison River basin of western Colorado is well suited for such a reconstruction (Woodhouse et al., 2003), and the record does show a substantial decline in the most recent few decades. But, when viewed over the time frame of 430 years, the recent change appears to be well within the range of natural variability and does not seem exceptional at all. (Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Full reconstruction of Gunnison, Colorado snow water equivalent, smoothed with a 5-weight binomial filter (heavy line), and error bars (thin lines), 1571–1997. The thin line at the bottom of the graph indicates the change in total number of samples in the four chronologies used in the reconstruction over time (right-hand y axis) (source: Woodhouse et al., 2003).For the United States as a whole, the amount of snow has not changed significantly, nor have characteristics of snowfall such as the onset or duration of snowfall (Bartlett et al., 2005). Although the overall snowfall is largely unchanged, many investigators report an increase in snowfall in the Great Lakes area and a reduction in snowfall in the Northwest. The identification of trends in snowfall is difficult given many inconsistencies that badly contaminate long term records. Furthermore, examples can be found of nearby stations having remarkably different trends in snowfall through time that point to problems with the records as opposed to any realistic change in climate (Kunkel et al., 2009). (Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Snowfall trend maps for 1930-31 to 2006-07. Trends are given as a percentage of the 1937-38 to 2006-07 snowfall mean per year. Closed circles: positive trends; open circles and stippling: negative trends (source: Kunkel et al., 2009).(Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Relative trends (% yr_1) in simulated snow water equivalent for three calendar dates for the period from 1916 to 2003 (source: Hamlet et al., 2005).The Mote (2006) citation only invites criticism. Despite his claims, his selective use of data—especially the endpoint—has caused great controversy and it should be avoided. Rather, Stoelinga et al. (2010) provides a much more comprehensive analysis. They note that trend in snowpack in the entire record (1930-2007) is marginally statistically insignificant. If it	3. Water Resources		109	7	We appreciate this comment, but believe that the commenter was misinterpreting our focus and intentions. We have revised the discussion to be more explicit and (we hope) avoid such misintrepretations. We have chosen to focus on the detection-and-attribution study by Barnett et al (2008) and associated references. Westerling analyzed only a subset of the period over which the changes have been witnessed and Soelinga focused on a similar subset (and indeed THAT subset was just the one that shown the least overall trend in observations and in climate-change projections alike, as documented by Pierce et al (2008, referred to in the chapter)). The Woodhouse and Stoelinga references focused on total-snowpack variations rather than on the amount of snowpack per unit of precipitation, and total snowpack is of course very dependent on the large year-to-year precipitation variations that tend to swamp temperature-driven changes. We have revised the text to clarify, in response to this comment. The earlier references are included to illustrate that the changes were not discovered by Barnett et al., rather they had been appearing in the

		were, it would be negative. Also, the trend beginning in 1976, which marks the start of the second global warming of the 20th century, is also insignificant. From 1950-1997 there was a significant decline in snowpack that was largely related to climate patterns over the North Pacific Ocean that have no obvious relationship to global climate change. After removing this factor, the trend in snowpack in the entire record remains marginally statistically insignificant.Climate models, coupled to the observed relationship between lower-atmospheric temperature and snowpack, project a 9% decline between 1985 and 2025, considerably lower than the 29% forecast by the Washington Climate Impacts Group (Elsner et al., 2009). It is noteworthy that this NCA, similar to the last one, continues to rely heavily on it (not surprising, given the senior lead author for the Northwest section!).Given the year-to-year noise in snowpack data, it is not clear whether a 9% decline would be significantly significant. In other words, the decline may not be scientifically distinguishable from no trend. Streamflow in the Northwest is largely modulated by snowmelt. Unfortunately, streamflow data therefore have largely the same year-to-year variation as the snowpack does. Consequently, a prominent study of changes in the timing of Northwest peak streamflow used by the NCA used a statistical criterion for significance that does not meet normal scientific specification (Stewart et al., 2005). The NCA concluded the trends would continue, despite the fact that they cannot be distinguished from no trend whatsoever in reality.References:Bartlett, M.G.,D.S. Chapman, and R.N. Harris, 2005. Snow effect on North American ground temperatures, 1950-2002. Journal of Geophysical Research, 110, F03008, 10.1029/2005JF000293. Elsner, M. M., et al., 2009. Implications of 21st century climate change for the hydrology of Washington State. The Washington Climate Change Impacts Assessment, J. Littell et al., Eds., Climate Impacts Group, University of Washington, 69–106.Hamlet, A.F., P.W. Mote, M.P. Clark, and D.P. Lettenmaier, 2005. Effects of Temperature and Precipitation Variability on Snowpack Trends in the Western United States. Journal of Climate, 18, 4545-4561.Kunkel, K.E.,M.A. Palecki, L. Ensor, K.G. Hubbard, D.A. Robinson, K.T. Redmond, and D.R. Easterling, 2009. Trends in twentieth-century U.S. snowfall using a quality-controlled dataset. Journal of Atmospheric and Oceanic Technology, 26, 33-44.Stewart, I.T., D.R. Cayan, and M.D. Dettinger, 2005. Changes Toward Earlier Streamflow Timing across Western North America. Journal of Climate, 18, 1136-1155Stoelinga, M.T., M.D. Albright, and C.F. Mass, 2010. A new look at snowpack trends in the Cascade Mountains. Journal of Climate, 23, 2473-2491.Westerling, A.L., H.G. Hidalgo, D.R. Cayan, and T.W. Swetnam, 2006. Warming and earlier spring increases western U.S forest wildfire activity. Sciencexpress, July 6, 2006.Woodhouse, C.A., 2003. A 431-yr reconstruction of western Colorado snowpack from tree rings. Journal of Climate, 16, 1551-1561.					literature for a long time, but Barnett et al. conducted the detailed evaluations necessary to be able to conclude that, e.g., up to 60% of the reported changes were rigorously attributable to global climate change with whatever remainder applies for a given variable and location being attributable to natural variability or local influences. We also have added to Water Cycle subsection to note the ongoing attribution research on the mix of natural variability, local human influences, and climate change that likely are reflected in all of the historical changes discussed in the Water Cycle section.
James	Tolbert	The report refers to "salt damage". I am not sure what this is referring to, and I did not see it discussed further in Chapter 18. It may be a sentence copied from a chapter with ocean shoreline, which the Midwest does not have. I suggest removing "salt damage" or discussing and defining it.	18. Midwest		618	18	The text has been revised to incorporate this suggestion.
Cato	Institute	Highly unlikely emissions scenario.The NCA's repeated use of scenario A2 (high emissions), while it creates flashy graphics, has become inappropriate. Any statements that "we are currently above A2 emissions" are misleading because in our era A1B emissions actually exceed those for A2. A2 was generated prior to the shale gas revolution, which has already driven energy-related U.S. emissions back to 1992 levels. The large price reductions that caused this means that the world is likely to follow suit (even if some nations are foolish enough to forbid hydrofracking). Consequently we are likely even come in below A1B, the "midrange" scenario. It is simply misleading to continue to use A2.	3. Water Resources		110	3	The use of the A2 scenario as an example in this chapter was chosen for consistency across the report. We refer the reader to additional explanation of scenarios in the introductory materials and the Climate Science chapter (Ch. 2).
Cato	Institute	In your discussion on evapotranspiration, you left out any reference to overwhelming and widely accepted scientific evidence that increased atmospheric carbon dioxide levels increase the water use efficiency of plants. This section is incomplete without such a discussion.	3. Water Resources		110	9	We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information to include.
Cato	Institute	In your discussion on evapotranspiration, you left out any reference to overwhelming and widely	3. Water		111	1	We appreciate this suggestion, but

		accepted scientific evidence that increased atmospheric carbon dioxide levels increase the water use efficiency of plants. This section is incomplete without such a discussion.	Resources				space is limited. The author team has deliberated and agreed on the most important information to include.
Cato	Institute	Regarding future prediction of soil moisture in the Southwest, your assessment seems to leave out results from Gao et al. (2011) that the enhanced resolution of Regional Climate Models allowed them to better simulate the snow accumulation and ablation at high elevations of the Southwest and consequently "runoff in the Colorado River Basin is less susceptible to a warming climate in RCMs than in GCMs"; results from Gao et al. (2012) that showed that the ability of RCMs to better resolve transient eddies and their interactions with mountains allows RCMs to capture the response of transient flux convergence to changes in stability, and consequently "that limitations in how GCMs represent terrain and its effects on moisture convergence have important implications for their ability to project future drying in the [Southwest] where mountains play an important role in the regional water cycle; and results from Lo and Famiglietti (2013) that showed that irrigation of California's Central Valley increased summertime precipitation, soil moisture, and run-off over the Southwest.As to the Southeast, apart from its drought projections being deemed "unreliable" (Hoerling et al., 2012), Wehner et al. (2011) finds the increase in future drought to be primarily located in the western portions of the Upper Midwest—not the Southeast. Just drop this Wehner et al. (2011) reference here, and anywhere in the NCA that it is referenced—unless you are discussing how future climate impacts are often exaggerated. Further, it is not clear to me that the Georgakakos and Zhang (2011) work referenced is peer-reviewed and I have been unable to track down a copy to see the techniques it employs so I am less than confident as to its results.Recommendation: The discussion on future soil moisture trends in the Southwest needs to be updated with reference to the most current literature. The reference to Wehner et al. (2011) concerning Southeast drought needs to be dropped. And projections of future drought in the Southeast need to be better documented.References:Gao, Y., J. Vano, C. Zhu, and D. P. Lettenmaier. 2011. Evaluating climate change over the Colorado River basin using regional climate models. Journal of Geophysical Research 116, D13104, doi:10.1029/2010JD015278.Gao, Y., et al. 2012. Moisture flux convergence in regional and global climate models: Implications for drought in the southwestern United States under climate change. Geophysical Research Letters 39, L09711, doi:10.1029/2012GL051560.Hoerling, M., et al., 2012. Is a Transition to Semi-Permanent Drought Conditions Imminent in the U.S. Great Plains? Journal of Climate, 25, 8380-8386, doi:10.1175/JCLI-D-12-00449.1.Lo, M-H., and J.S. Famiglietti. 2013. Irrigation in California's Central Valley strengthens the southwestern U.S. water cycle. Geophysical Research Letters 40, doi:10.1002/GRL.50108.	3. Water Resources		111	20	The text on soil moisture has been significantly revised. We have added the suggested references (Gao et al. 2011; 2012; Lo and Famiglietti (2013). Regarding (Wehner et al. 2011), we still feel the reference is appropriate. Regarding (Georgakakos and Zhang 2011), the authors of the NCA Report have written it based upon a variety of sources, all of which were assessed under Guidance on Information Quality Assurance to Chapter Authors of the National Climate Assessment: Question Tools (2/21/2012), to assure for each source (1) utility, (2) transparency and traceability, (3) objectivity, and (4) integrity and security. All sources were assessed for IQA compliance. An additional reference (Hay et al., 2011) has been added, corroborating the results of Georgakakos and Zhang, 2011.
Cato	Institute	The projections of future stream run-off and streamflow are based strongly on climate model projections of future precipitation changes. As we have discussed previously, until/unless climate models can be shown to be able to reliably capture observed precipitation changes across the U.S., future projections should not be attempted, much less discussed. For example, over many regions of the Southwest, climate models expected precipitation decline in the latter half of the 20th century, yet precipitation increase were observed instead (Polson et al., 2013). Perhaps the same will hold true in the future.Reference:Polson, D., G. Hegerl, X. Zhang, and T. Osborn, 2013. Causes of Robust Seasonal Land Precipitation Changes. Journal of Climate, doi:10.1175/JCLI-D-12-00474.1, in press.	3. Water Resources		111	25	We have offered a discussion of this subject under a new section on the relationship between historical and projected water cycle changes. Substantial revisions on streamflow have also been made to address the comment.
Cato	Institute	Figure 3.2 and caption:What emissions scenario is this? If it is A2, see the previous comment (Page 110, lines 3-8).	3. Water Resources		112	1	The text has been revised to note which scenarios these projections are based on.
Cato	Institute	Need to add text at end of paragraph:"There is little doubt that groundwater resources of the future will be far more related to human management strategies than to changes in climate. Given the natural variability in climate, the complex response of groundwater to variations in climate, and the enormous	3. Water Resources		114	13	The text has been revised to incorporate this suggestion. We describe the role of multiple stressors

		impact on groundwater from pumping, groundwater impacts related to human-induced climate change will likely be undetectable for many decades to come."Reference:Hulme, M., E.M. Barrow, N.W. Arnell, P.A. Harrison, T.C. Johns, and T.E. Downing, 1999: Relative impacts of human-induced climate change and natural climate variability. Nature, 397, 688-691.					in affected groundwater supply.
Cato	Institute	Projections of future drought conditions across the US suffer from several limitations; 1) they are based upon future precipitation projections from climate models whose reliability in reproducing observed changes in precipitation across the U.S. cannot be established; 2) they are based on temperature projections from climate models, which on average, have an equilibrium climate sensitivity that is some 40% greater than the mean value from recent estimates appearing in the peer-reviewed literature; 3) they are generally too sensitive to changes in temperature (Hoerling et al., 2012; Sheffield et al., 2012).Recommendation: Discuss the caveats in summer drought projections for the U.S.References:Hoerling, M., et al., 2012. Is a Transition to Semi-Permanent Drought Conditions Imminent in the U.S. Great Plains? Journal of Climate, 25, 8380-8386, doi:10.1175/JCLI-D-12-00449.1,Sheffield, J., et al., 2012. Little change in global drought over the past 60 years. Nature, 491, 435-438, doi:10.1038/nature11575.	3. Water Resources		113	26	We appreciate this comment. With respect to precipitation changes and drought, the climate chapter is playing the key role in this report in documenting the projected changes in precipitation and our key points are that precipitation VARIABILITY will likely increase--impacting drought frequencies and severities--and that rising temperatures ARE likely to reduce the efficiency with which a given amount of precipitation results in runoff. The expectation of greater precipitation variability is a broad global prediction rather than a local or regional finding, and it stems in no small part from basic moist dynamics of the atmosphere, and thus is not entirely a simple reliance on GCM outputs. The question of how much that temperature influence will be is important, and we have modified the discussions of both ET and droughts to acknowledge clearly that: the more complete is the range of water-cycle processes represented, the more complete those representations are, and the more highly temporally and spatially resolved are those representations, then--in the literature, including references mentioned in this comment--the more moderated are the projections of drought change. In the drought discussion, we were NOT relying on any studies that were based on the PDSI (which is what both references that the comment alludes to), and had not done so specifically because we were aware of this overestimations of hydroclimate sensitivities obtained by such analyses. Instead we were specifically describing results from studies that used models with much

							more realistic sensitivities; nonetheless, as stated above, the revised chapter is now much clearer on this potential pitfall. This is a key point that we have now made in the revised text, in recognition of the importance of this tendency in the way that the science of drought projections has been evolving in the past few years.
Cato	Institute	The NCA seems to rely on Hirsch and Ryberg (2012) a lot in this section. Thus it is worth bearing in mind these words from the conclusions of Hirsch and Ryberg (2012):"What these results do indicate is that except for the decreased flood magnitudes observed in the SW there is no strong empirical evidence in any of the other 3 regions for increases or decreases in flood magnitudes in the face of the 32% increase in GMCO2 that has taken place over the study period."Additionally, Villanrini et al., 2019 examined annual maximum peak discharge from 572 stations in the eastern U.S. with at least 75 years of record and concluded:"Trend analyses for the 572 eastern United States gaging stations provide little evidence at this point (2009) for increasing flood peak distributions associated with human-induced climate change."Future flooding in the U.S. depends on a large number of factors, that include seasonal changes in total precipitation and extreme precipitation events, changes in the frequency of landfalling tropical cyclones, and, perhaps above all, human-caused changes to the physical properties of watersheds and stream/river courses. It is not clear that all these factors have been appropriately included in the current NCA analysis and assessment.References:Hirsch, R.M., and K.R. Ryberg, 2012. Has the magnitude of floods across the USA changed with global CO2 levels? Hydrological Sciences Journal, 57:1, 1-9, http://dx.doi.org/10.1080/02626667.2011.621895.Villarini, G., et al., 2009. On the stationarity of annual flood peaks in the continental United States during the 20th century. Water Resources Research, 45, W08417, doi:10.1029/2008WR007645.	3. Water Resources		113	32	The draft chapter used Fig. 1 of the Hirsch and Ryberg reference, rather than their conclusions based on a particular, arbitrary quartering of the CONUS to look for regional scale trends. However, in considering this comment and others, we had the opportunity to obtain from Hirsch the list of gages that had statistically significant trends, which their Fig. 1 did not indicate. We inspected the locations (about a quarter of the gages analyzed) where statistically significant changes were indicated, and revisited the separate Villarini et al (and, subsequent, Villarini and Smith) analyses of historical flood-statistic changes. The Villarini analyses include gages with strong local influences (dams and land use) as well as more natural catchments. Based on this analysis, we have revised the statements on floods. We now indicate that strong directional changes in national average flood magnitudes have not been uncovered. With respect to future floods, we have expanded our discussion to indicate the important roles of nonclimatic factors like human-caused changes in river courses and watersheds. We also have included a mention of the potentially important role of future changes in storm mechanisms in determining the future of floods.
Cato	Institute	Citation in complete disagreement with attribution.The text states, "These aquifers and wetlands…may be at particular risk due to the combined effects of…accelerating sea level rise and greater storm surges	3. Water Resource		115	17	The text has been revised to incorporate this perspective. The

		(Chang et al., 2011…).Chang et al., (2011) actually says:"Climate change effects are expected to substantially raise the average sea level. It is widely assumed that this raise will have a severe adverse impact on saltwater intrusion processes in coastal aquifers. In this study we hypothesize that a natural mechanism, identified here as the ‘‘lifting process,’’ has the potential to mitigate, or in some cases completely reverse, the adverse intrusion effects induced by sea-level rise."	s				reference has been removed.
Cato	Institute	Inaccurate analysis.The frequency of a type of weather anomaly is proportional to reduced vulnerability, which is why, for example, heat-related mortality is virtually unknown in Tampa and Phoenix (Davis et al, 2003).Reference:Davis R.E., et al., 2003. Changing Heat-Related Mortality in the United States. Environmental Health Perspectives, 111, 1712–18.	3. Water Resources		119	12	We have considered this suggestion but are not confident that the heat analogy is completely applicable here, especially because droughts affect people, economy and environment in a more significant and difficult to remedy manner.
Cato	Institute	There is not one word about per-capita water withdrawal and use (the subject of the relevant sentence) in the reference Haley (2001). As Casey Stengel used to say, “you could look it up.”	3. Water Resources		120	115	The text has been revised to remove the Haley reference and the discussion about meat consumption.
Cato	Institute	We repeat: The Assessment’s repeated use of scenario A2 (high emissions), while it creates flashy graphics, has become inappropriate. Any statements that “we are currently above A2 emissions” are misleading because in our era A1B emissions actually exceed those for A2. A2 was generated prior to the shale gas revolution, which has already driven energy-related U.S. emissions back to 1992 levels. The large price reductions that caused this means that the world is likely to follow suit (even if some nations are foolish enough to forbid hydrofracking). Consequently we are likely even to come in below A1B, the “midrange” scenario. It is simply misleading to continue to use A2, although it is good for your budget (and bad for the rest of us).	3. Water Resources		121	4	We have revised the figure and caption. The figure now uses only the A1B scenario.
Cato	Institute	Overblown issue.In its 2009 National Climate Assessment, the USGCRP could only find one report of a significant power plant shutdown because of low water. It that report it was appropriately sourced as “Bull et al., 2007.”Given the warmth and drought of some recent summers, it is obvious that most plants are designed with substantial latitude with regard to cooling water.	3. Water Resources		122	1	After consideration of this point, we still feel the existing text is clear and accurate. Information has been added to the section on recent declines in freshwater withdrawals per kilowatt hour.
Cato	Institute	San Francisco?Sea-level rise on the West Coast is largely muted by tectonic activity, which is why it averages 1-2 mm/year in the area around San Francisco. Saying that, say, three times that will be a problem is a reversion to what Paul Waggoner used to call the “Dumb-Farmer Mistake,” meaning that farmers are too stupid to adapt to change.	3. Water Resources		122	17	This section of text was significantly revised, and the text pertaining to this comment was deleted.
Cato	Institute	“Economic conditions may constrain implementation [of adaptation].”Upon what is this based? That certainly needs a reference!	3. Water Resources		122	22	After consideration of this point, we still feel the current references are appropriate and adequate given the chapter's space limitations.
Cato	Institute	Entire sidebar:Anecdotal.This is remarkable. Anecdotes substitute for science in the National Assessment along with the conflation of one flood and one drought as evidence for pernicious climate change, i.e., at least drop the sophomoric “interestingly” in the fifth line from the bottom.	3. Water Resources		123	1	We have revised the flooding box and first key message on flooding. We also note that no strong directional changes in national average flood magnitudes is documented. We do note that floods may intensify in many regions of the U.S.
Cato	Institute	Neglected significant hydropower in NE US.Quebec-Hydro generates a more power for the Northeast	3. Water		124	1	Thank you for your comment. This

		than we generate domestically, and its contribution is likely to grow because of the Regional Greenhouse Gas Initiative as well as the Assessment's forecast for increasing precipitation in southeast Canada (Figure 2.12).	Resources				section is focused on domestic hydropower production so we have not amended the language.
Cato	Institute	Inappropriate reference.Although we will append a list of the nonstandard references to the end of this chapter review, we should point out that "Union of Concerned Scientists 2009" is particularly egregious and likely to result in some nasty op-eds.	3. Water Resources		124	37	The authors of the NCA Report have written it based upon a variety of sources, all of which were assessed under Guidance on Information Quality Assurance to Chapter Authors of the National Climate Assessment: Question Tools (2/21/2012), to assure for each source (1) utility, (2) transparency and traceability, (3) objectivity, and (4) integrity and security. All sources were assessed for IQA compliance.
Cato	Institute	As we have discussed in several of our comments, precipitation projections need to be taken with a grain of salt, if not eliminated entirely from the NCA. As we have discussed in previous comments, heavy precipitation events have been shown to be impacted by factors besides AGW. As we have discussed in previous comments, run-off and flooding magnitudes are greatly impacted by other man-made changes to the environment (e.g., increase in impervious surfaces, river channelization, etc.).The degree to which climate change (as opposed to climate and other man-made environmental changes) will impact flooding must be discussed with these caveats prominently mentioned.	3. Water Resources		126	4	The text has been revised in multiple places to reflect our understanding of precipitation, other factors influencing floods, and the uncertainty of the projections about floods.
James	Tolbert	The statement that the Midwest has an "increasingly realized potential to reduce" the emissions for gasses responsible for warming the climate is misleading. Within the Midwest, two western states (Iowa and Minnesota) have significantly increased their use of renewable energy, while most of the states are still very reliant on coal. To support this, the following is the ranking of the Midwest states within the 50 states for the proportion of their electricity generation that is generated from renewable resources (and in parentheses the ranking within the 50 states if hydropower is removed from all calculations) [SOURCE: Data for calendar year 2012 was obtained from "Electric Power Monthly, February 2013". Energy Information Administration (EIA) U.S. Department of Energy. Retrieved 3/14/13.] Illinois 36th (22nd) Indiana 39th (28th) Iowa 8th (2nd) Michigan 35th (26th) Minnesota 13th (9th) Missouri 45th (45th) Ohio 48th (47th) Wisconsin 23rd (20th)	18. Midwest		618	26	The text has been revised to incorporate this suggestion but in the text of KM4.

		The renewable electricity generation in Iowa is not what is powering the industrial factories in Michigan, Ohio, and Illinois. Furthermore, Michigan has a relatively low Renewable Portfolio Standard (RPS) goal of just 10% renewable energy by 2015, and Ohio's standard is for "alternate sources" instead of renewable sources.					
James	Tolbert	Suggest adding word "projected" somewhere in the title for clarity since these graphics are projections in the future and not actual changes such as those articulated in Schoof 2009 reference which was also discussed in the text of the report. The caption is clear, but it would help me as a reader to have "projection" in title for ease of use.	18. Midwest	18.2	620		The figure has been clarified.
James	Tolbert	the captuion lists maple/beech/birch, spruce/fir, and aspen/birch forests are projected to disappear from the North Woods. I suggest also calling out that White/Red/Jack pine habitate will be gone or significanlty reduced also. This is relevant because the White Pine is the State Tree in Michigan and will no longer grow there. Also, I do not think that most of the report uses "North Woods" as a proper noun which is capitalized.	18. Midwest	18.4	623		The text has been revised to incorporate this suggestion.
James	Tolbert	This sentence uses a Union of Concerned Scientists publication as a reference (Perera et al. 2012). While I have great respect for UCS, and am a member, I object to this report using a UCS publication as a reference as this is not a neutral source nor a peer reviewed source, nor a governmental body. I do not think the reference supports the neutrallity of the report. Furhtermore, I opened the listed web site, and I am really not sure what you are referencing here.	18. Midwest		624	1	The text has been revised to incorporate this suggestion.
Marjorie	McGuirk	The arctic Council report says that climate change may open both the Northwest passage and the Northern Sea Route. "Year-round navigation has been maintained since 1978-79 in the ice-covered western regions of the Northern Sea Route". Both routes pass through the Bering Sea close to Alaska's shore, potentially impacting the need for more transportation infrastructure there, particularly for the bulk cargo traffic serving the Red Dog mine on the west coast of Alaska. Both routes are important, as they are much shorter than the routes through the Panama and Suez Canels. Climate change impacts opening these sea routes may result in major changes for transportation patterns not only in Alaska but at major ports on both the Atlantic and Pacific coasts of the US.This could possibly be in the Alaska chapter. Opening of the Arctic to regular shipping could substantially change the major transport systems in the US. For this reason, the item may deserve a box.	5. Transportation		197	33	Thank you for your comments. Unfortunately, we do not have space to expand on the statement made in the chapter.
Marjorie	McGuirk	The first two sentences conflate operating decisions with climate change adaptation.Disruptions are offset by operating the systems differently, by using alternate routes, for example. Climate change adaptation is more in the design issues, such as installing flood gates on road tunnels, and step up borders on subway entrances.	5. Transportation		196	29	Thank you for your suggestion. However, the literature on disruptions and climate change has emphasized operational strategies as part of climate adaptation approaches.
Marjorie	McGuirk	Referece should be made to climate change impacts on transportation systems with regards to national secuity. In particulare, this chapter might include specific reference to the transportation facilities at the Norfolk Naval Station and the entire area of Hampton Roads with marine, navy, air force, army, and coast guard facilities make for a good case study, which have been well-studied.http://www.virginia.edu/crmes/fhwa_climate/files/finalReport.pdf	5. Transportation				Thank you for your comment. We added a statement about military installations located in areas vulnerable to climate-related impacts.
James	Tolbert	On Figure 18.5, the units on the y-axis are somewhat difficult to understand. As I read the figure, the three historic black lines show "actual annual heat deaths" for the three listed years of 1995, 1999, and 2006. The blue bars appear to show a number of heat related deaths per year that are the Increase in	18. Midwest	18.5	624		We thank the reviewer for the helpful suggestion and have removed the figure in favor of text explanation.

		deaths over some baseline, and the baseline number of deaths is not presented. This makes a comparison of the black lines to the blue projected increases difficult, and the graphic presenting "total deaths" in three years to a projected "increase in deaths" over some baseline a bit misleading.					
Jan	Dash, PhD	Start with the detrimental impacts, which are most of them. Only a few are beneficial. Starting with the beneficial aspects gives the reader a false emphasis on benefits relative to enormous risks, and is not consistent with the main thrust of the report.	Introduction: Letter to the American People		1	27	The authors intend to provide a balanced summary based on the weight of evidence.
Jan	Dash, PhD	"Longer growing seasons" as beneficial is misleading, since agricultural yields will fall under the myriad impacts of increased drought, insect invasions, and more erratic precipitation.	Introduction: Letter to the American People		1	28	The language includes the word "can" as opposed to "will" be beneficial.
Jan	Dash, PhD	Add "risk management" to this line of the text. Risk management should be the preferred framing. The term "risk management" is neutral and easily assimilated. PLEASE NOTE WHEN WORDS OCCUR IN "QUOTES" THE " " SYMBOL IS MERELY FOR IDENTIFICATION OF THE INSERT	Introduction: Letter to the American People		1	40	The authors appreciate the importance of risk management framing, in fact it is an important component of the NCA approach. However, it is not appropriate to repeat this language every time response strategies are mentioned.
Jan	Dash, PhD	Add: "requiring bold risk assessment and risk management strategies".	Introduction: Letter to the American People		2	1	The authors appreciate the importance of risk management framing, in fact it is an important component of the NCA approach. However, it is not appropriate to repeat this language every time response strategies are mentioned.
James	Tolbert	Figure 18.6 includes two boxes which each have a colored scale bar with a label. I suggest changing the labels for both bars: "number of deaths" is better labeled "reduction in number of deaths per year" and "number of cases" is better labeled "reduction of cases per year". With theses changes, then the "postive values" make sense to the reader.	18. Midwest	18.6	625		The figure has been clarified.
Jan	Dash, PhD	Should read: "which is now primarily driven…"	1. Executive Summary		3	6	This language has been modified.
Jan	Dash, PhD	Add: "Climate impacts will increasingly negatively affect future generations if robust action is not taken."	1. Executive Summary		3	8	This point is made in subsequent sections.
Jan	Dash, PhD	Start with the detrimental impacts, which are most of them. Only a few are beneficial. Starting with the beneficial aspects gives the reader a false emphasis on benefits relative to enormous risks, and is not consistent with the main thrust of the report.	1. Executive Summary		3	10	There is a need for a balanced approach to the assessment that includes both the positive and negative impacts.
Jan	Dash, PhD	"Longer growing seasons" as beneficial is misleading, since agricultural yields will fall under the myriad impacts of increased drought, insect invasions, and more erratic precipitation	1. Executive		3	11	There is a need for a balanced approach to the assessment that

			Summary				includes both the positive and negative impacts; this existing language is caveated by the word "potential" before benefits.
Jan	Dash, PhD	Insert: U.S. temperatures will continue to rise "on the average"	1. Executive Summary		3	26	The authors believe the current language is acceptable.
Jan	Dash, PhD	Insert: "While extreme records of high temperatures are increasingly common, fewer extreme records of low temperatures are being recorded"	1. Executive Summary		3	39	This langauge has been included.
James	Tolbert	"A 2009 National Academy of Sciences study concluded that burning fossil fuels leads to damages of more than $120 billion a year due primarily to increased health care costs (see “Alternative Transportation Options Create Multiple Benefits” above) (NRC 2010)" I am not sure why this is the topic sentence for a paragraph in a section on "Energy-Intensive Economy". It links back to transportation and appears to have broader implications for electrical power generation than just industrial use of power. The proceeding paragraph does not appear to have a consistent theme related to an energy intensive economy.	18. Midwest		626	18	The text has been revised to incorporate this suggestion.
Jan	Dash, PhD	Insert: ...continue to affect "mostly negatively" human health, …	1. Executive Summary		4	6	It is important to have a measured tone in describing the impacts, so no change is recommended here.
Jan	Dash, PhD	Need to explain that "global warming" is the observed average upward temperature trend of climate change. Up to this point, the term "global warming" has not been defined.	1. Executive Summary		4	16	We appreciate the suggestion, but feel the existing text is clear and accurate. Global warming is defined in the Glossary of the report.
James	Tolbert	"Addressing these issues and climate change presents the Midwest’s energy sector with a number of challenges, in part because of its current reliance on coal-based electricity (Pryor and Barthelmie 2012)" The heavy reliance on coal for the production of electricity in the Midwest is extremely important to any discussion of Midwest GHG emissions. I suggest that this one sentence on the reliance on coal deserves an entire Section - maybe a section on "Electricity production". This is significant to other sections beyond the energy intensive economy - such as the discussion of home cooling in the summer. Also, some changes over to natural gas, while still a fossil fuel, will significantly decrease the GHG emissions in the region.	18. Midwest		626	20	We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include, but the issue of coal is discussed more fully in the traceable accounts for this KM.
Jan	Dash, PhD	Insert: weather patterns farther south in the United States, "possibly enhancing the severity of some extreme weather events".	1. Executive Summary		4	17	The authors have concluded that the current language adequately reflects the findings of the full report.
Jan	Dash, PhD	Add: "More generally, climate impacts will increasingly, and mostly negatively, affect economic activities and associated financial systems". Suggest you have separate paragraph for climate economic impacts.	1. Executive Summary		4	22	The economic components of impacts are emphasized wherever possible, but this NCA report does not provide significant conclusions about collective economic impacts. A new section explaining this has been added to the section on topics for future National

							Climate Assessments.
Marjorie	McGuirk	A term used throughout the document.."human activities"...might be replaced. Swimming, eating, and sleeping are human activities. "Human caused" was likely a substitute for "anthropogentic", which polled poorly for understanding. But "human activities" maybe does not convey appropriate meaning either. Repeated on page 1062 line 4 "These changes are primarily the result of human activities". Might this be "industrial activity"? Or possibly, "Primarily the result of putting industrial waste products into the air", or "emitting excess gases". The term "Industrial waste" worked well with the Clean Air Act.There are other references, such as Figure 5 page 1127 where the term "natural" and "human" influences are named. Could the term "un-natural" or "polluting" or "waste" be used instead of "human"?The EPA stie also blames "human activity" but is careful to specify the "release of green house gases" aspect. See http://www.epa.gov/climatechange/basics/ and http://www.epa.gov/climatechange/ghgemissions/global.htm"Over the past century, human activities have released large amounts of carbon dioxide and other greenhouse gases into the atmosphere. The majority of greenhouse gases come from burning fossil fuels to produce energy, although deforestation, industrial processes, and some agricultural practices also emit gases into the atmosphere."	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1060	1060	The text has been revised to incorporate this suggestion.
Jan	Dash, PhD	Replace: "another 1 to 4 feet in this century. A wider range of scenarios, ranging from 8 inches to 6.6 feet of rise by 2100, has been suggested for use in risk-based analyses" by "another 1 to 6 feet in this century consistent with scenarios in risk-based analyses". There are too many numbers here for the lay public.	1. Executive Summary		4	29	The emphasis on the expected range is an important distinction from the range that could be used to consider ways to limit risk, so the existing language is acceptable as it is.
Jan	Dash, PhD	Insert: "and hundreds of billions of dollars of property"	1. Executive Summary		4	34	Language has been modified here.
Jan	Dash, PhD	Change: "from fossil fuel burning" to "from humans burning fossil fuel"	1. Executive Summary		4	35	No change is recommended here.
Jan	Dash, PhD	Insert: "negatively" affecting human health…	1. Executive Summary		5	1	The authors believe the existing language is appropriate. There is a need for balanced language here.The authors believe the existing language is appropriate.
Marjorie	McGuirk	A term used throughout the document "heat trapping", could perhaps be replace with "heat absorbing". A conventional oven traps heat. The heat trapped in an oven escapes when you open the door. Greenhouse gases absorb and hold heat. Gases with three or more molecules, like CO2, CH4, and H2O, absorb and hold infrared heat energy.The popular science web sites, like ones that talk about Tyndall, use the word "absorb" not "trap".	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A		1070	4	The phrase "heat absorbing" is not adequate because the energy is reemitted. It is the net trapping of the energy that is important.

			to Z				
Jan	Dash, PhD	Insert: will "negatively" influence human health	1. Executive Summary		5	8	The context of this sentence already indicates that the effects are negative.
Jan	Dash, PhD	Insert: emissions of "carbon dioxide and other" heat-trapping gases	1. Executive Summary		5	41	The current language is acceptable as written.
Jan	Dash, PhD	Insert: category of "risk-management" response options	1. Executive Summary		6	5	The authors believe the current language is clearer.
Jan	Dash, PhD	Insert: category of "risk-management" response options	1. Executive Summary		6	8	The authors prefer the existing language.
Jan	Dash, PhD	Insert: comprehensive "risk-management" response strategy	1. Executive Summary		6	11	The authors prefer the existing language.
Jan	Dash, PhD	Insert: international "climate" agreements	1. Executive Summary		6	19	Changes have been made.
Garrit	Voggesser	(1) All references to "federal, state and local governments" should be changed to "federal, state, local and tribal governments" where appropriate. (2) Ensure all citations to Chapter 12 use the correct title: "Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources."(3) All regional chapters should incorporate a reference to the tribal chapter (Ch. 12), which addresses impacts on tribal lands and resources across the country. All regional chapters should state the number of tribes within the region and summary of key impacts on native communities. Best practices: Alaska/Arctic Chapter and Great Plains Chapter.					Thank you for these helpful comments. The text has been revised wherever appropriate to incorporate these suggestions.
Jan	Dash, PhD	Add: global emissions is about 20%, "and the US contribution to time-accumulated global emissions is much higher".	1. Executive Summary		6	22	Modifications have been made to address this.
Jan	Dash, PhD	Insert: contributed to reducing "slightly" U.S. Emissions	1. Executive Summary		6	24	The authors believe the current language is acceptable as it is.
Jan	Dash, PhD	Replace: "they are not sufficient" by "they are far from sufficient"	1. Executive Summary		6	28	The authors believe the current language adequately conveys their intent.
James	Tolbert	The section titled “Energy-Intensive Economy” is a compilation on a series of ideas, and I suggest much of the material in this section would be more clearly presented if pulled into their own section. Specifically, I suggest that there should be a separate section discussing electrical production. Some of the discussions in this section, stating that power generation in the Midwest is heavily reliant on coal, or discussing potential to produce energy from zero emissions sources, relate more to a section on electricity generation than a section on “Energy-Intensive Economy”. I suggest that one of the largest impacts on many states in the Midwest (Ohio, Michigan, Indiana, Illinois, Missouri) will be the probable restrictions on carbon emissions in the future. It does not matter if this is through market based procedures such as a carbon tax, or permitting procedures, or just activist procedures (fighting the XLS	18. Midwest		626		The section title has been revised to incorporate this suggestion. However, the current content is appropriate because the vast majority of GHG emissions are from electricty production. Other aspects of this comment move into policy discussions inappropriate for this assessment chapter.

		pipeline and the stiff opposition put up to any new coal fired power generation plant), the reality of climate change will be that the Midwest will need to re-adjust their electrical generating capacity, and this will come with a cost and with both opportunities and some creative destruction. Currently, this chapter on the Midwest appears to duck and not address what I consider the largest impact that the Midwest will be required to face. Furthermore, I do not see any discussion of nuclear power in this section. The Midwest does contain nuclear power plants, and the electrical generation from these plants can continue to provide power with low emissions of carbon dioxide. The Midwest has some tremendous wind energy resources, but these are just beginning to be developed. And after Michigan reaches a 10% renewable portfolio by 2015, the economic driver for the installation of new wind in one Midwest state will be removed. The following is the ranking of the Midwest states within the 50 states for the proportion of their electricity generation that is generated from renewable resources (and in parentheses the ranking within the 50 states if hydropower is removed from all calculations) [SOURCE: Data for calendar year 2012 was obtained from "Electric Power Monthly, February 2013". Energy Information Administration (EIA) U.S. Department of Energy. Retrieved 3/14/13.] Illinois 36th (22nd) Indiana 39th (28th) Iowa 8th (2nd) Michigan 35th (26th) Minnesota 13th (9th) Missouri 45th (45th) Ohio 48th (47th) Wisconsin 23rd (20th) I think the addition of a seperate section on electrical production in the Midwest will also help focus all future Climate Assessment Report updates.					
Jan	Dash, PhD	Inserts: conserve "decreasing" water supplies, protect against insects that "will increasingly" spread disease,	1. Executive Summary		6	37	The authors believe that the existing language is accurate.
Jan	Dash, PhD	Add section on national security concerns, see 2010 Quadrennial Defense Review at http://www.defense.gov/qdr/images/QDR_as_of_12Feb10_1000.pdf	1. Executive Summary		7	8	A section has been added to the Context and Background Section on National Security issues.
Jan	Dash, PhD	Insert: Proactively preparing for climate change "through risk management strategies" can reduce impacts,	1. Executive Summary		7	9	Adding this clause does not clarify the point being made here - there is no need to limit the options to "risk management strategies."

Jan	Dash, PhD	Inserts: corporate, "faith, university" and "other" non-governmental sectors	1. Executive Summary		7	12	The existing language is sufficiently broad to include these categories.
Jan	Dash, PhD	Insert: enhance the "risk-assessment" capacity to estimate future climate change impacts	1. Executive Summary		7	15	Adding "risk-assessment" to this phrase is not consistent with the intent of the authors.
Jan	Dash, PhD	Insert: already "negatively" affecting	1. Executive Summary		8	24	The tone and substance of this finding already indicates that the effects are largely negative.
Jan	Dash, PhD	Insert: is affected by climate change, "for example by decreasing crop yields".	1. Executive Summary		8	39	This language has been modified.
James	Tolbert	"Compared to other regions, the Midwest has huge potential to produce energy from zero- and low-carbon sources, given its vast wind, solar, and biomass resources" First, I am not convinced that the Midwest has vast solar resources. This should be backed up in the text if "solar" is left on this list. Second, the text does not call out nuclear power generating capacity as one of the low-carbon sources of power generation that is present in the Midwest. The Midwest does have nuclear generating capacity which provides energy with very low impact on greenhouse gasses.	18. Midwest		626	26	The text has been revised to incorporate this suggestion.
Jan	Dash, PhD	Insert: ports, "railroads",	1. Executive Summary		9	6	Language has been amended in response to comments.
Jan	Dash, PhD	Insert: "Risk management" planning	1. Executive Summary		10	19	The authors do not believe this change is needed.
Jan	Dash, PhD	Add section on national security concerns, see 2010 Quadrennial Defense Review at http://www.defense.gov/qdr/images/QDR_as_of_12Feb10_1000.pdf	1. Executive Summary		10	28	National security has been added to the Context and Background Section.
Jan	Dash, PhD	MIDWEST Insert: floods. "Long term projections are yields decreasing due to climate stress impacts coupled with rising temperatures."	1. Executive Summary	1.1	11		After consideration of this point, we still feel the existing text is clear and accurate.
Jan	Dash, PhD	OCEANS: Insert: alteration of marine ecosystems "and negative impacts on the food chain, including fish".	1. Executive Summary	1.1	11		The authors prefer the existing language.
Jan	Dash, PhD	Insert: human, social, "economic," and	1. Executive Summary		13	3	The authors are more comfortable with the current language, given that economics are not covered extensively in this report.
Jan	Dash, PhD	Insert: "While having potentially large impact," these “tipping points” are very hard to predict	1. Executive Summary		13	6	Good point, the text has been changed to incorporate the suggestion.
Jan	Dash,	Insert: "Weather generally refers to short-time local phenomena while climate refers to longer time	1.		13	11	Good point, changes have been made.

	PhD	and spatial scales. Nonetheless, the global warming trend of climate change is putting more energy into the weather system and so is increasingly affecting weather." Understanding ...	Executive Summary				Information has been added to the Context and Background section on trends and natural variability.
Jan	Dash, PhD	Change: "Responding" to "Risk-management responses"	1. Executive Summary		16	24	The authors believe the current language is acceptable.
James	Tolbert	Figure 18.7 contains four separate maps, each with a sub-title and a colored scale bar. Figure Title: I suggest changing the title as “When It Rains, It…” does not relate to all of the four maps that make up this figure (as in the fourth map "Dry Days" for example). The first map in the figure is labeled as "Annual Average Precipitation" while the remaining three maps do not clearly state in the title or the scale legend units that the numbers represent values "per year". I suggest editing the map headers or the scale bar legends for clarity that they are all "per year". In this figure, the Caption also does not call out that the last three maps are "per year". The third map "Wettest 5-day Total" should provide include “in a year” or “annual” in the map title, since the "per year" may also be confusing in the legend.	18. Midwest	18.7	628		The caption has been revised to incorporate this suggestion.
Jan	Dash, PhD	Insert: "Risk-management" responses	1. Executive Summary		16	27	The authors believe the current language is acceptable.
Jan	Dash, PhD	Insert: climate change "risk management" strategy	1. Executive Summary		16	41	The authors believe the current language is acceptable.
Jan	Dash, PhD	Inserts: "A standard definition of risk was used" for the purposes of this assessment; "namely" risk was defined	1. Executive Summary		17	22	The authors prefer the existing language.
Jan	Dash, PhD	Insert: future planning "including risk assessment and risk management" in	1. Executive Summary		18	11	The authors prefer the existing language.
Jan	Dash, PhD	Insert: Climate Scenarios "and Climate Models"	1. Executive Summary		19	7	Modifications to the language have been made in response to this comment.
Jan	Dash, PhD	Insert: activities on climate, "thus separating human effects on climate from natural effects".	1. Executive Summary		19	9	After consideration of this point, we still feel the text is clear and accurate.
Jan	Dash, PhD	Change: "an additional 1 to 4 feet " to "an additional 1 to 6 feet "	1. Executive Summary		20	23	There is a deliberate intent here to emphasize the 1 to 4 foot rise as the "projected" level, whereas for use in risk management, 6.6 feet is suggested as an option for consideration.
Jan	Dash, PhD	Remove: "The orange line at right shows the currently 14 projected range of sea level rise of 1 to 4 fe et by 2100, which falls within the larger risk- 15 based scenario range. " There are too many numbers here for the lay public.	1. Executive Summary		21	13	The authors believe the existing language is clear but made changes to the graphic to improve it.

James	Tolbert	The two satellite views of Lake Erie on the bottom would benefit from some title showing year and month or even exact dates of the images. Figure 2.27 in Chapter 2shows a similar graphic WITH the month and year shown. I am not sure why Chapter 18 would use a different graphic than Chapter 2 to show the same material. The caption sates which winter the images at showing (2008-2009 and 2011-2012); I suggest clearly documenting the date do each photo or at a minimum the mont of each photo to document that they are comparable and not from different months. If the 2011-2012 photograph is from March 2012, I strongly caution against using this photograph. March 2012 was an extreme event breaking all records for warmth in Michigan. What did the ice cover look in Feb 2012 compared to other years is a better question? Showing anecdotal visuals with the March 2012 time is the same cherry picking that I constantly argue against when the anti-global warming bloggers state that the last 15 years has not showed an upward trend in earth surface temperature. Do not use the same gimmicks of cherry picking the absolute warmest March that Midwest has ever seen as a single photo representative of a longer period, especially if March did not represent the maximum extent of ice in that winter season.	18. Midwest	18.8	631		We thank the reviewer for the helpful suggestion and have removed the images.
James	Tolbert	Kunkel et al 2012 reference should be updated. I suggest including the NOAA document number: "NOAA Technical Report NESDIS 142-3" and a web address where it can be obtained: http://www.nesdis.noaa.gov/technical_reports/NOAA_NESDIS_Tech_Report_142-3-Climate_of_the_Midwest_U.S.pdf	18. Midwest		648	34	The text has been revised to incorporate this suggestion.
Kathy	Lynn	***NOTE: Through a coordinated review led by the Pacific Northwest Tribal Climate Change Network (kathy@uoregon.edu) and the National Wildlife Federation Tribal Lands Program (Voggesser@nwf.org), comments have been compiled that address tribal issues and perspectives throughout the National Climate Assessment. These comments are intended to assist tribes in reviewing the National Climate Assessment chapters and submitting comments at ncadac.globalchange.gov. Some of the comments submitted may be identical to others submitted by tribal and non-tribal entities that are working with tribal climate change issues around the country. If you have questions about these comments, please contact Kathy Lynn at kathy@uoregon.edu. Some comments submitted by Kathy Lynn have been developed by other reviewers who had trouble entering information in the ncadac.globalchange.gov system. In these cases, Kathy has noted the reviewer that submitted those specific comments.***General Comments on the National Climate Assessment: All references to "federal, state and local governments" should be changed to "federal, state, local and tribal governments" where appropriate. Ensure all citations to Chapter 12 use the correct title: "Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources"All regional chapters should incorporate a reference to the tribal chapter (Ch. 12), which addresses impacts on tribal lands and resources across the country. All regional chapters should state the number of tribes within the region and summary of key impacts on native communities. Best practices: Alaska/Arctic Chapter and Great Plains Chapter.					Thank you for these helpful comments. The text has been revised wherever appropriate to incorporate these suggestions.
Marjorie	McGuirk	This figure, though attractive, could be replaced by the image that is more commonly used, (as noted on comment for figure 11) like the one here: http://science-edu.larc.nasa.gov/EDDOCS/images/Erb/components2.gif or	Appendix: NCA Climate Science - Addressing	15	1081		The figure has been replaced. The replacement figure is on trends in temperature from natural vs. human forcings.

		http://www.epa.gov/climatechange/basics/This is a standard diagram used in 8th grade Earth science class, so it should't be too complex for use. Plus the familiarity might lend to better comprehension.Trenbreth has updated the numbers in a more recent version, showing a relatively larger arrow to account for absorbed infrared radiation.	Commonly Asked Questions from A to Z				
James	Tolbert	I suggest updating this reference. The preferred citation on the paper is: Lofgren, B. and A. Gronewold, 2012: Water Resources. In: U.S. National Climate Assessment Midwest Technical Input Report. J. Winkler, J. Andresen, J. Hatfield, D. Bidwell, and D. Brown, coordinators. Available from the Great Lakes Integrated Sciences and Assessments (GLISA) Center, http://glisa.msu.edu/docs/NCA/MTIT_WaterResources.pdf.	18. Midwest		649	10	The text has been revised to incorporate this suggestion.
Marjorie	McGuirk	Figure 11 adds little. It is similiar in concept to Figure 15 on page 1081. Both of these could be replaced by the image that is more commonly used, like the one here: http://science-edu.larc.nasa.gov/EDDOCS/images/Erb/components2.gif or http://www.epa.gov/climatechange/basics/ This is a standard diagram used in 8th grade Earth science class, so it should't be too complex for use. Plus the familiarity might lend to better comprehension.Trenbreth has updated the numbers in a more recent version, showing a relatively larger arrow to account for absorbed infrared radiation.Another notes, the caption for Figure 11 calles it a "enhanced green house effect". "Enhanced" is one of the words that means something different to lay public and scientists, and perhaps should be avoided.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z	11	1073		The figure has been revised to incorporate this suggestion. We thank the reviewer for the ideas.
Doug	Johnson	I am writing to comment about the treatment of invasive species (IS) in the chapter. It's great that it's included, but it needs to be broadened. One, to include more taxa. Currently, it focuses mostly on plants, but many other taxa of IS will be affected by climate change. Two, with regards to invasive plants specifically, to include a more thorough discussion of how multiple aspects of climate change (not just warming, but precipitation patterns, atmospheric CO2 levels, extreme events, etc.) will affect their spread. Three, a more integrated discussion of their impacts. Currently the chapter simply says, in effect, "some invasive species could get worse." How about the potential for invasive species to interfere with habitat linkages and range shifting? How about interactions between invasive species and extreme events (like wildfire, floods), between invasive species and water supply? Finally, because controlling invasive species spread is something that can be done now to support climate adaptation, I think higher visibility in the entire chapter would be appropriate. For instance, it could be an explicit part of the key messages, especially when talking about how plant and animal communities are going to change extensively. Thanks for your consideration.	8. Ecosystems, Biodiversity, and Ecosystem Services				No change. We agree that invasive species are important and included specific examples as space (which is very, very limited) allowed.
Cato	Institute	Heavy precipitation is impacted by other human-caused environmental changes besides greenhouse gas emissions—a factors which seemed to be ignored in this section. Without direct mention of these other influences, the reader is left with the impression that you are discussing AGW. If so, then you should demonstrate that the magnitude of AGW impacts actually is detectable above all the other influences on heavy precipitation events.	3. Water Resources		129	15	After consideration of this point, we still feel the existing text is clear and accurate.
James	Tolbert	I suggest adding a web address for MacKay, 2012. The suggested citation on the paper is: Mackey, S. D., 2012: Great Lakes Nearshore and Coastal Systems. In: U.S. National Climate Assessment	18. Midwest		649	16	The text has been revised to incorporate this suggestion.

		Midwest Technical Input Report. J. Winkler, J. Andresen, J. Hatfield, D. Bidwell, and D. Brown, coordinators. Available from the Great Lakes Integrated Sciences and Assessments (GLISA) Center, http://glisa.msu.edu/docs/NCA/MTIT_Coastal.pdf. At					
Marjorie	McGuirk	How is it that there at 10 indicators for climate change but 18 aspects of climate altered by excess greenhouse gases?The figure though, is quite niece. Does it indicate further which parameters are used in the global models?The caption for the figure confused the aspects of climate that are changing with the causes. The sentence beginning "while there are undoubtedly many natural factors" seems to be misplaced as it does not refer to the image.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z	13	1077		The 10 indicators were just examples, not all that exist. All of the climate system components are included in models, although some, like streamflow, are greatly simplified in current models. The caption has been clarified.
Cato	Institute	Reference SectionThis chapter contains quite a number of grey literature and nonstandard references, even with a very forgiving screen. As noted above, some could cause quite a lot of trouble.Adams, A., D. Behar, K. Brooks, P. Fleming, and L. Stickel, 2012: Water Utility Climate Alliance's Technical Input to the 2012 NCABarsugli, J., C. Anderson, J.B. Smith, and J.M. Vogel, 2009: Options for improving climate modeling to assist water utility planning for climate change. Final Report., Water Utility Climate Alliance. [Available online at http://www.wucaonline.org/assets/pdf/pubs_whitepaper_120909.pdf]Berry, L., 2012: Florida Water Management and Adaptation in the Face of Climate Change: A white paper on climate change and Florida's resources.Brekke, L.D., 2011: Addressing Climate Change in Long-Term Water Resources Planning and Management: User Needs for Improving Tools and Information. DIANE PublishingBrekke, L.D., J.E. Kiang, J.R. Olsen, R.S. Pulwarty, D.A. Raff, D.P. Turnipseed, R.W. Webb, and K.D. White, 2009a: Climate change and water resources management: a federal perspective. DIANE Publishing.City of New York, 2012: PlaNYC Progress Report 2012. A Greener, Greater New York, City of New York. [Available online at http://nytelecom.vo.llnwd.net/o15/agencies/planyc2030/pdf/PlaNYC_Progress_Report_2012_W11eb.pdf]Foti, R., T.C. Brown, and J.A. Ramirez, 2012: Vulnerability of future United States water supply to shortage. U.S. Forest Service.Heimlich, B.N., F. Bloetscher, D.E. Meeroff, and J. Murley, 2009: Southeast Florida’s Resilient Water Resources: Adaptation to sea level rise and other climate change impacts, Florida Atlantic University. Center for Urban and Environmental Solutions and Department of Civil Engineering, Environmental, and Geomatics Engineering, [Available online at www.ces.fau.edu/files/projects/climate_change/SE_Florida_Resilient_Water_Resources.pdf]Liverman, D., S. Moser, P. Weiland, L. Dilling, M. Boykoff, H. Brown, D. Busch, E. Gordon, C. Greene, E. Holthaus, D. Niemeier, S. Pincetl, J. Steenburgh, and V. Tidwell, 2012: Climate Choices for a Sustainable Southwest. Assessment of Climate Change in the Southwest United States: a Technical Report Prepared for the U.S. National Climate Assessment. A report by the Southwest Climate Alliance, G. Garfin, A. Jardine, R. Merideth, M. Black, and J. Overpeck, 1 Eds., Southwest Climate Alliance, pp. 684-734Means, E., M. Laugier, J. Daw, L. Kaatz, and M. Waage, 2010a: Decision support planning methods: Incorporating climate change uncertainties into water planning, Water Utility Alliance. [Available online at http://www.wucaonline.org/assets/pdf/pubs_whitepaper_012110.pdf]Transboundary Aquifer Assessment Act, 2009: Transboundary Aquifer Assessment Act (U.S. Public Law 109-448), signed	3. Water Resources		149	1	The authors of the NCA Report considered all sources of information and data under the Guidance for Information Quality Act assurance and for each reference determined that the information and data met those guidelines for (1) Utility, (2) transparency and traceability, (3) objectivity and (4) integrity and security

		December 22, 2009. The intent is to provide scientific information useful to policymakers and water managersUnion of Concerned Scientists, 2009: Climate Change in the United States: The Prohibitive Costs of Inaction. [Available online at http://www.ucsusa.org/global_warming/science_and_impacts/impacts/climate-costs-of-inaction.html]					
Cato	Institute	General CommentsThis report suffers from the systematic asymmetry that has plagued National Assessments since the first one. This is largely reflected in emphasis on unlikely emissions pathways (namely A2, which will be obviated by global switching to gas for energy and transportation). It is evident from treatment of heating/cooling degree day issues, and completely ignoring the (unknown) adaptation multiplier with respect to climate change. This last factor makes reports like this seem hopelessly jejune, probably to the point that it will be counterproductive for those favoring expensive and expansive emissions policies. The adaptation multiplier absence is pervasive in all of the Assessments. As an example, consider a simple agricultural model. It is a fact that bad weather affects regional crop yields, and it is certainly plausible (but by no means proven) that warmer temperatures will increase drought frequency and/or magnitude, but it is hardly proven because all other factors are hardly equal. One is adaptation. Let's stipulate that it's getting warmer in the Midwest. Despite this, yields continue to increase at the historical rate established over a half-century ago. The increase is due to changing tillage technology, increasing fertilizer application, and faster improvement of genetic cultivars thanks largely to DNA splicing and plasmid insertions. Both tillage and genetics can respond to changing climate. For example, no-till is much more moisture efficient, especially in the black soils of the corn belt. I am sure that many of the major seed companies are experimenting with DNA manipulations that can result in fewer stomates or increased stomatal resistence, and other moisture-conserving strategies. These adaptations, which result in increasing yields are in part in response to perception that less moisture stress is desirable. Increasing temperature only spurs further innovation. It is very difficult to quantify the positive impacts of climate change, but it is very clear, for example, that heat-related mortality is inversely proportional to heat wave frequency and magnitude. Our cities have run this experiment for us, not even needing global warming, as they warm independent of that. It's hard to believe that there are not similar factors at work at the energy/climate interface. Space cooling technology is becoming increasingly efficient. There's no a priori reason to assume that adaptive technologies do not exist with regard to the issue of cooling water for power plants, but there is very little mention of anything like this in this chapter or in the overall Assessment. It's conspicuously absent and serves to seriously compromise its quality and the public reception it will receive.Another problem concerns both this chapter (and the overall Assessment's) over-reliance on emissions scenario A2. It is hard to believe that this is at all viable given the dramatic shifts to natural gas for electrical generation (and likely for much of the surface transshipment industry) that are occurring or will occur relatively soon. Your predictable counter, that emissions are currently above A2, is irrelevant, as indeed A2 emissions for the current era are projected lower than A1B. Nice slight of hand, but no dice. Using unlikely "extreme" scenario or, increasingly unlikely "extreme" surface warming (see other parts of this review) additionally compromises this (and the previous) Assessments.	4. Energy Supply and Use				The selection of the most credible and judicious scenario emission ranges was a decision made for consistency with chapters across the report, including chapters that address climate science and chapters that address potential sectoral and regional impacts. The increased production of natural gas as an energy source in the U.S. for both electricity production and mobility fuels is a recent trend. As a result, there is a paucity of peer-reviewed reference material on the projected impacts of climate change on that form of energy production. Chapter 27: Mitigation addresses carbon and other greenhouse gas emission reduction issues and Chapter 10: Water, Energy and Land addresses the production of natural gas by hydraulic fracturing. Regarding cooling water systems for power production, the references noted provide the most recent and credible assessment on the state of technology developments.
Marjorie	McGuirk	Figure 2.26 is confusing. When the caption takes up more room than the graph, is the picture saying a thousand words? Does this image indicate that tide gauge data and satellite data are inconsistent?	2. Our Changing Climate	2.26	65		This figure has been simplified. Tide gauge data and altimeter data are consistent to within their uncertainties. Tide gauge estimates have greater uncertainty, but they go back further in time.
Cato	Institute	Key Message 1Message is only partialIt would be appropriate to insert a few quantitative words here, and to at least acknowledge that there are unknown adaptive multipliers that may mean that even the	4. Energy Supply		167	13	Responses to individual comments on specific text selections are provided.

		sign of the net financial impacts of climate change may not be known. More details on this in our review of specific text.	and Use				More quantitative analysis is provided in the referenced source material.
Cato	Institute	Key Message 2Lack of quantitative analysis, again.National studies project that the demand for cooling energy is will increase from 5 to 20 percent per degree (C) of warming (US Climate Change Program, 2008), and the demand for heating energy to drop by 3 to 15 percent for the same change. These ranges reflect different assumptions about factors such as the rate of market penetration of improved building equipment technologies. While the vast majority of space cooling is provided by electricity, the recently exploited abundance of natural gas can certainly alter the current distribution. Indeed, gas air conditioners are now twice as efficient as they were 25 years ago, and inflation-adjusted hardware costs are clearly lower. It is truly odd that somehow this was not even considered worth mentioning.An examination of population-weighted annual cooling degree days over the last 60 years show a marginally significant (p=.047) increase of 6%, and a marginally insignificant (p=.064) change in heating degree days (raw trend, -3.9%) (EIA, 2009). According to the Energy Information Administration, while the total number of households in the United States is expected to increase at a rate of 1.0 percent per year through 2035 and average house square footage is expected to increase at 0.7 percent per year, total energy consumed in BTUs per square foot is expected to decline by 1.3 percent per year (EIA, 2011). The positive efficiencies resulting from new technologies will therefore have more of an effect on energy consumption than any increases that might be caused by warming. (Figure emailed to comments@usgcrp.gov as per instructions) CAPTION: There is a marginally significant increase in cooling degree-days and a marginally insignificant decrease in heating degree-days over the period of record (EIA, 2011).References:U.S. Climate Change Science Program, Effects of Climate Change on Energy Production and Use in the United States, February 2008, http://www.climatescience.gov/Library/sap/sap4-5/final-report/sap4-5-final-all.pdfEnergy Information Administration, Annual Energy Review 2009, http://www.eia.gov/totalenergy/data/annual/pdf/sec1_22.pdf and http://www.eia.gov/totalenergy/data/annual/pdf/sec1_20.pdfEnergy Information Administration, Annual Energy Outlook 2011, http://www.eia.gov/analysis/projection-data.cfm#annualproj	4. Energy Supply and Use		167	17	The increased production of natural gas as an energy source in the U.S. for use in electricity production and mobility fuels is a recent trend. As a result, there is a paucity of peer-reviewed reference material on the projected impacts of climate change on that form of energy production and innovations in natural gas use. More quantitative analysis on the data provided is found in the referenced source material.
Cato	Institute	What “specific risks to energy security”?“Energy security” isn’t threatened by a Gulf hurricane or a Midwestern drought. The nation’s security is much stronger than that. And I don’t think it’s appropriate to raise the specter of the Russian Bear coming along to steal all of our oil in the ice-free Arctic summer.Authors really need to re-think the whole “security” issue in a nation that could easily be a net exporter within ten years, thanks to hydrofracking and horizontal drilling.	4. Energy Supply and Use		167	31	“Energy security” has been replaced with “reliable energy supply.”
Marjorie	McGuirk	Figure 2.1 used here and elsewhere in the report (Appendix CAQ's page 1059) adds little. A bulleted list would be as effective, particularly, if the bulleted list were paired with the 10 indicators graph, shown on page 1061 and elsewhere.	2. Our Changing Climate	2.1	30		We appreciate the suggestion, but space is limited. The author team has deliberated and agreed on the most important information/illustrations to include. We think the pictorial representation of the indicators is effective and more useful than a table would be.
Cato	Institute	One-sidedness.This is the kind of paragraph that gives your detractors ammunition to accuse NCADAC of bias. There are other weather “extremes” that are hardly deleterious and certainly correlated with surface warming. Those would include very warm winters, unusually long growing seasons, etc.	4. Energy Supply and Use		168	15	Extreme weather events are acute events (defined in Chapter 2: Our Changing Climate) rather than seasonal events identified in the comment.
Cato	Institute	Oooh! One inch of rain in a day is bad? We doubt that’s ever caused a significant flood.	4. Energy		168	20	We have removed the relevant

			Supply and Use				sentence.
Cato	Institute	Did you notice how little the power went out in areas of the northern Mid-Atlantic where significant Sandy winds hit, if those same areas had been affected by the June 29, 2012 derecho? Trees don't regrow their branches that fast, and the local power companies were under intense pressure to trim more aggressively around power lines. People adapt, and a perception of increased storminess (real or not) will lead to demands for cleaner power lines. It's the same notion as the fact that the warmest urban areas in the country (i.e. Tampa and Phoenix) have the lowest heat-related mortality. It's called "adaptation".	4. Energy Supply and Use		168	25	Table 4.2 provides suggestions for adaptation actions in the Energy Sector
Cato	Institute	"Economic losses arising from weather and climate events are large and have been increasing."This statement is wrong. Normalized damages from weather events are not increasing as our figures below show. (Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: The annual total of damage from NOAA's identified billion-dollar weather events divided by GDP in billions of current (2012) dollars.(Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: The annual total of damage from NOAA's identified billion-dollar weather events divided by GDP in billions of chained (2005) dollars. (2012 was not available at this writing. Even if it were high, it would have to exceed 2005 by a long shot on the bottom figure to show a (non-robust) trend.)So, even if you have increasing "extreme events" (that wouldn't apply to hurricanes or tornadoes, as you well know), there's no detectable effect. Maybe people adapt?	4. Energy Supply and Use		168	34	The sentence referred to in the comment was deleted.
Cato	Institute	Figure 4.1 and caption:Nice rhetoric, a little short on facts.Oil and natural gas disruptions from hurricanes in the Gulf of Mexico are a fact of business life. 2005 Hurricane Katrina was a memorable storm, a category 3 hurricane at landfall, and a category 5 in Gulf of Mexico. It was the second-costliest hurricane (adjusted for constant dollars and normalized for population) in U.S. history with catastrophic damages estimated at $81 billion to New Orleans and the Mississippi coast (NOAA, 2007). Katrina was, in many ways, a worst-case hurricane for the oil-producing Outer Continental Shelf of the Gulf of Mexico, which is the source for about 30 percent of crude oil production in the United States and about 13 percent of natural gas production EIA). Refining operations in the Gulf were only shut-in for about a month. Shortfalls were made up by refined product imports and crude purchases from the Strategic Petroleum Reserve (CRS, 2006). And, older oil and gas drilling and production equipment that had to be replaced resulted in newer infrastructure that is more resilient and likely to withstand future storms (Rigzone, 2010). Future disruptions to natural gas supplies in the Gulf, if they were to occur regardless of cause, will most likely be countered by the economic production of shale gas onshore in the United States. The Energy Information Administration expects about 50% of total natural gas production to be from shale by 2035 (EIA, 2011).References:National Oceanic and Atmospheric Administration, The Deadliest, Costliest and Most Intense United States Tropical Cyclones from 1851 to 2006, Technical Memorandum NWS TCP-5, April 2007, http://www.nhc.noaa.gov/pdf/NWS-TPC-5.pdfEnergy Information Administration, EIA Special Report-Gulf of Mexico Fact Sheet, http://205.254.135.24/special/gulf_of_mexico/Congressional Research Service, Oil and Gas disruption from Hurricanes Katrina and Rita, April 6, 2006, http://www.au.af.mil/au/awc/awcgate/crs/rl33124.pdf Rigzone Analysis: Gas Prices Immune to Hurricane Disruptions Post-Katrina, Rita, August 31, 2010, http://www.rigzone.com/news/article.asp?a_id=98139Energy Information Administration, Annual Energy Outlook 2011, Table A14, http://www.eia.gov/forecasts/aeo/pdf/tbla14.pdf	4. Energy Supply and Use	4.1	169		We have added statements on the resiliency-building effects of geographically distributed energy sources to this section.
Cato	Institute	Where's the other half (HDD's)?Not to sound like a broken record, but it does not help NCADAC's reputation to only harp on one type of impact. Show the analogous maps for the decline in HDD's.(These figures also suffer from the oft-repeated problem that scenario A2 was developed before hydrofracking and horizontal drilling exploded, and it is no longer plausible—assuming the world responds to economic incentives and displaces coal and gasoline (where economical) with natural gas).	4. Energy Supply and Use	4.3	171		The energy chapter identifies both increased energy for cooling and decreased energy for heating. Since increased cooling demand is an impact that may stress existing energy supply

							systems and require adaptation actions, only the Cooling Degree Day figure has been included.
Marjorie	McGuirk	The continental scale graphs are useful yet the display is somwaht unsatisfactory. Perhaps austrulia should not butt up against S America? Maybe the graphs could be combined, as in Figure 3 page 1061, for ease of reading (as all the graphs are on the same X-Y axis) with little arrows pointing to the (correctly placed) continents.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z	14	1078		We have redone the background map to incorporate this suggestion.
Cato	Institute	Inappropriate reference.The NCA is not required to use references that are inappropriate. The cited study uses only A2 and A1Fi, which is even bigger than A2.	4. Energy Supply and Use		174	2	The emission scenario basis employed in the study is stated. This projection is included to convey the higher end of possible impacts.
Cato	Institute	Real data argue otherwise.McCabe et al. (2010) actually looked to see if the number of dry days was increasing in the Southwest, which has been trending towards increasing drought. Here's what they found:"trends in the fraction of dry days for water years, cool seasons, and warm seasons indicate that most trends are negative [i.e. towards more wet days]. For water years, 18 sites exhibit negative trends in the fraction of dry days, and eight of these trends are statistically significant at a 95% confidence level. In contrast, only four sites indicate positive trends in the fraction of dry days for water years, and none of these trends is statistically significant at p = 0.05. For the cool season, 19 sites exhibit negative trends (12 are statistically significant at p = 0.05), and only 3 sites indicate positive trends (none are statistically significant)."The opposite to what is being forecast is what is occurring. You need to adjust the text to include this.Reference:McCabe, G. J., D. R. Legates, and H. F. Lins. 2010. Variability and trends in dry day frequency and dry event length in the southwestern United States, Journal of Geophysical Research, 115, D07108, doi:10.1029/2009JD012866.	4. Energy Supply and Use		174	30	We have added text that acknowledges that the analyses of observed changes in dry spells show mixed results. Thus there is not a clear observed signal in this climate variable. Nevertheless, future increases in dry spell length in southern regions is a direct outcome of large-scale robust changes in circulation patterns for which there is considerable confidence because of both consistent model simulations and a basic physical understanding of processes that contribute to this outcome. The McCabe et al. study does not provide evidence that the model projections of increased drought in the southwest should not be trusted. First, the 1950s included the worst drought years for many locations in the southwest; by starting their analysis in 1950 they are weighting their results toward downward trends. Had they included the entire 20th Century, their results might well be very different. Second, regional precipitation exhibits high natural variability and the models also show much variability, including

							the near-term projections. In fact, a more important insight from the McCabe et al. paper is the evidence of large variability in the southwest, including the record droughts of the 1950s, the very wet conditions of the 1980s, and the drought conditions of the 2000s. Model projections of drought in the southwest suggest that natural variability should still be dominant at the present time and a consistent anthropogenically-forced drying is still in the future.
Cato	Institute	This map is certainly wrong.Disregarding the inappropriateness of scenario A2, Figure 2.12 from Chapter 2 is supposed to show the same thing—projected seasonal precipitation changes—although for a different period of comparison. Figure 2.12 shows the change from 2070-2099 compared to 1901-60. There is no way that a shorter period in Figure 4.4 (2041-2070 compared to 1971-2000) would have much larger precipitation changes. We don't know what is being used in Chapter 4, but it simply cannot be correct as the precipitation changes are far too large for a period that begins a mere 40 years after the base!Oh. The Chapter 4 version is a model from a less complete source than the CMIP-5 family and shows the most extreme changes. Shades of the first (2000) Assessment, where the most extreme temperature and precipitation models were selected! Doesn't the USGCRP ever learn? The use of those models is one reason that it ran afoul of the Data Quality act. Leaving this model in will invite the same.	4. Energy Supply and Use	4.4	175		We have replaced this figure with an analysis of CMIP3 model data. This analysis is completely consistent with Fig. 2.12 from Chapter 2.
Marjorie	McGuirk	The image on the right is difficult to see while paired with the one on the left. The legend for bleaching would be better placed below a larger, more readible map.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z	22	1093		This image has been reconfigured to incorporate this suggestion.
Cato	Institute	Grammar or meaning problem.Don't get "are in counties with some type of water sustainability (EPRI 2011)." As written this would mean "are in counties with very dependable water."	4. Energy Supply and Use		176	8	Thank you for your comment. We have added the missing word "issue" to the sentence.
Marjorie	McGuirk	The energy consumption by sector might be better placed in question C as an explanation of "human activities" that cause the climate changes. Better yet, a graph with emissions by sector activities would give a good explanation of the link between using energy and emitting heat-absorbing gases. Something like this from the EPA:http://www.epa.gov/climatechange/images/ghgemissions/GlobalGHGEmissionsBySource.pngIn any case, Figure 31 seems to be misplaced with question X.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A	31	1109		This figure has been deleted.

			to Z				
Marjorie	McGuirk	What is the red area of the graph?	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z	32	1110		The figure has been updated and revised for clarity.
Marjorie	McGuirk	Please put the constituents in order of the length of the bars. Distinguish natural and non-natural bars by dots or shading.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z	5	1127		This comment is actually about a figure in the other appendix. The authors appreciate the suggestion, but have decided to keep the bars in their original order (by type of influence).
Marjorie	McGuirk	This figure is just in the document too many times.	Appendix: The Science of Climate Change	9	1131		This figure does not appear in Chapter 2, so therefore is needed in the science appendix. The only other place it appears is the Commonly Asked Questions.
Marjorie	McGuirk	Two diagrams, shown on the same page, depicting the same information, need to be on the exact same scale else the diagrams cannot be compared visually. (Reference Tufte, Few, other peer reveiwed papers on scientific visualization.)	Appendix: The Science of Climate Change	10	1132		The figure has been redrawn to incorporate this suggestion.
Garrit	Voggesser	Change line 21 to: "severe enough that some communities - including Alaska Native communities - are already facing relocation."	Introduction: Letter to the American People		1	21	The authors appreciate the suggestion, but space is limited. Changes experienced by Native Americans are mentioned elsewhere in the Letter. A new Report Finding on Native Peoples has been added to the Executive Summary.
Marjorie	McGuirk	Please label the little lines within the diagram A, B, C for the 3 periods with trend lines, putting the date range within the graph and shortening the Caption accordingly.	Appendix: The Science of	13	1137		Since there are only two periods with "pauses" in trends, we believe the figure is most effectively presented with the years in the caption

			Climate Change				(especially since the precise values of the years are irrelevant to the figure's main message). A sentence about the most recent short-term pause has been added to the figure caption.
Garrit	Voggesser	In paragraph 5 (lines 32-40), add reference to tribal communities or to Ch. 12	Introduction: Letter to the American People		1	32	The authors appreciate the suggestion, but space is limited. Changes experienced by Native Americans are mentioned elsewhere in the Letter. A new Report Finding on Native Peoples has been added to the Executive Summary. The Letter does not include any references to particular chapters.
Marjorie	McGuirk	This figure seems out of context with the seriousness given to the balance of the document. How does it add value to the discussion? The magnifying glass seems trite.	Appendix: The Science of Climate Change	14	1139		The figure is designed to provide an idea of the method underlying attribution and is supporting / supported by the underlying section text. No changes made.
Garrit	Voggesser	Add in-text citation to Chapter 12 at p.4, lines 13, 34, 41; p.5, line 7; p.6, lines 16, 42; p.7, line 8; p.9, line 14; p.10, line 18.	1. Executive Summary		3	21	Chapter 12 has been added to the list of chapter references in multiple locations.
Marjorie	McGuirk	"to identify causes of observed behavior"....What is meant by behavior? observed weather? a weather event? a blocking pattern as in Figure 21 page 1092? a climate event like El Nino?	Appendix: The Science of Climate Change		1139	19	Clarifying edits have been made to this sentence.
Marjorie	McGuirk	"external natural and human drivers"....such as "heat-trapping gases and changes in energy from the sun"should the two be swapped in placement so that natural is equated with sun energy? such as...."Simulations that include changes in natural and un-natural forces that may cause climate change such as changes in energy from the Sun or increases in heat-absorbing gases."	Appendix: The Science of Climate Change		1140	1	The text has been revised to incorporate this suggestion.
cyd	hamilton	lines 17 & 18 - diverse readership so why not include an example or bit of an explanation as to why electricity at peak demand is comparatively more expensive. Simple market forces perhaps but again a diverse readership.	7. Forestry		273		This chapter does not discuss peak rates of electricity.
cyd	hamilton	Change title' Number of fewer extreme..." for clarity	7. Forestry	4.1	273		This comment does not appear to refer to this chapter.
Marjorie	McGuirk	Same comment as Figure 13 page 1077	Appendix: The Science of Climate Change	15	1140		This is a holistic assessment of what variables have had D&A studies undertaken so is not to be conflated with the ten indicators, which are a set of indicators intuitively directly related to a warming world to the lay public.

							The 10 indicators were just examples, not all that exist. All of the climate system components are included in models, although some,like streamflow, are greatly simplified in current models.
Marjorie	McGuirk	Same comment as Fig 14 page 1078	Appendix: The Science of Climate Change	16	1141		We have redone the background map and now show the continents in their correct locations.
Marjorie	McGuirk	This figure shows the parameters used in climate models. It is a good diagraph that could replace Figure 15 page 1140. Is there any need to show the climate variables that are "apparently" influenced by greenhouse gases separately from the climate variable that we measure and model?Retain this figure and eliminate the various occassions where Figure 15 occurs.	Appendix: The Science of Climate Change	21	1155		The first figure mentioned in this comment, on human influences apparent in many climate variables, shows variables in which there are detectable human influences. The second figure, on modeling the climate system, shows processes that are included in climate models. The two are not identical (e.g., ocean bottom topography is important for climate models, but it is not influenced by humans).
Jenna	Zukswert	Though the A1 and B2 scenarios are described elsewhere in the report, I recommend referring to the source of these scenarios to remind readers where these projections came from. This will give readers who choose to read only this chapter a better idea of where these ideas came from and where to find more information.	16. Northeast		552	3	There is insufficient space to cover this topic within each chapter, and so scenarios are discussed in the 'Intro to Regions' and in the initial pages of the report (e.g. Executive Summary).
Marjorie	McGuirk	Please, once GCM is defined, refer to it henceforth as the models, or these models. Please avoid using the GCM acronym . The key message #6 is too long and could be shortened by making reference to the excellent figures 21-23.	Appendix: The Science of Climate Change		1152	1	We have changed "GCMs" to "models in several instances as suggested. However, we cannot make the change everywhere because this section also talks about other types of models (earth system models, regional climate models, statistical models,…). Where the distinction is important, we have retained "GCM" in some statements. This message has also been evaluated to see if any text can be reduced.
Marjorie	McGuirk	Please simplify the legend by using a color bar in standard style that minimizes the amount of numbers used on the legend.	Appendix: The Science of Climate Change	24	1159		The figure currently adheres to NCA guidelines for legends.

Garrit	Voggesser	include an in-text citation to Chapter 12	3. Water Resources		118	14	We have added the suggested citations in our chapter assessment.
Garrit	Voggesser	include an in-text citation to Chapter 12	3. Water Resources		126	22	The text has been revised to incorporate this suggestion.
Garrit	Voggesser	include an in-text citation to Chapter 12	5. Transportation		197	31	Thank you. We have added an in-text citation to Chapter 12.
Garrit	Voggesser	include an in-text citation to Chapter 12	8. Ecosystems, Biodiversity, and Ecosystem Services		291	35	No change. It will take up a lot of space to cross reference all the other chapters.
Garrit	Voggesser	include an in-text citation to Chapter 12	9. Human Health		334	14	We agree with your suggestion and have added a reference to Chapter 12: Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources in our chapter assessment.
Marjorie	McGuirk	It is a bit difficult to identify which area of the US has been in which kind of drought, severe, trend, etc. The section highlights the West drought. Why? Either show all the areas or drop the diagram altogether or say that the trend in the West is typical of other areas? Teh secion is on climate science so is there room to dicuss why drought is increasing in some areas? The lines 14 - 15 seem to indicate that the Southwest is more typical, with low precip and high temp being the causes. Perhaps the section could begin with the text on line 15 page 1170 moving lines 5-1169 to 8-1170 to the end of the Key Message.Some references (Dai 2004, Westerling 2003) predate the previous National Assessment and so could the previous assessment be used as a reference instead of all the individual ones?	Appendix: The Science of Climate Change		1169	5	The discussion on drought has undergone substantial modification. The limitations of and statutory requirements of PDSI are discussed. Also, other measures of drought such as Consecutive Dry Days has been added.
Garrit	Voggesser	include an in-text citation to Chapter 12	9. Human Health		348	25	We agree with your suggestion and have added an in-text citation to Chapter 12.
Jenna	Zukswert	This statement oversimplifies the complexity of the issue presented in Ziska and Runion (2007). They state that weeds exhibit a wider range of physiological responses to CO2 fertilization because weeds have more genetic diversity and therefore are collectively capable of greater physiological plasticity, while crop plants exhibit a smaller range of responses to CO2 fertilization.	16. Northeast		561	4	The text has been revised to incorporate this suggestion.
Garrit	Voggesser	include an in-text citation to Chapter 12	9. Human Health		349	32	We agree with your suggestion and have added an in-text citation to Chapter 12.
Garrit	Voggesser	include an in-text citation to Chapter 12	9. Human Health		351	16	Thank you for your suggestion. The text has been revised to incorporate an in-text citation to Chapter 12.
Garrit	Voggesser	include an in-text citation to Chapter 12	9. Human		352	13	Thank you for your suggestion. The text has been revised to incorporate

			Health				an in-text citation to Chapter 12.
Jenna	Zukswert	It may not be clear to readers why frost and freeze damage might have paradoxically increased. Instead of, or in addition to, referring readers to Chapter 8, it would be helpful to include a short sentence suggesting why this might be.	16. Northeast		560	25	The text has been revised to incorporate this suggestion.
Jenna	Zukswert	Hemlock woolly adelgid is misspelled.	16. Northeast		561	11	The text has been revised to incorporate this suggestion.
Garrit	Voggesser	Include mention of tribal communities in Box on p.349 and in heading on p.351	9. Human Health		349	35	While the comment suggests a good specific example, the authors feel the broad focus across all vulnerable populations for the Box and the existing examples on p. 251 are appropriate and adequate, given the size of the topic and the page limit for the chapter.
Garrit	Voggesser	include "tribal uses" in the list of Columbia River uses	10. Water, Energy, and Land use		405	27	The text has been revised to incorporate this suggestion.
Garrit	Voggesser	"and tribal treaty fishing and hunting rights" after "as well as recreation"	10. Water, Energy, and Land use		405	34	The text has been revised to incorporate this suggestion.
Garrit	Voggesser	: add reference to Voggesser, G., K. Lynn, J. Daigle, F. K. Lake, and D. Ranco. “Cultural Impacts to Tribes from Climate Change Influences on Forests.” Climatic Change. DOI: 10.1007/s10584-013-0733-4	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources		445	37	We have added the suggested citations in our chapter assessment.
Garrit	Voggesser	add reference to Voggesser, G., K. Lynn, J. Daigle, F. K. Lake, and D. Ranco. “Cultural Impacts to Tribes from Climate Change Influences on Forests.” Climatic Change. DOI: 10.1007/s10584-013-0733-4	12. Impacts of Climate Change on Tribal, Indigenous, and		446	6	We have added the suggested citation in the “Forest, Fires, and Food” section of our chapter assessment, along with a reference to NCA Ch. 7: Forest.

			Native Lands and Resources				
Cato	Institute	Many misleading statements and incompletions.Note on sea level rise:Because a significant fraction of America's energy infrastructure is located near the coasts, sea level rise could be a concern. According to the IPCC Fourth Assessment Report, "Global average sea level rose at an average rate of 1.8 [1.3 to 2.3] mm per year over 1961 to 2003. The rate was faster over 1993 to 2003: about 3.1 [2.4 to 3.8] mm per year. Whether the faster rate for 1993 to 2003 reflects decadal variability or an increase in the longer-term trend is unclear." An update to the satellite sea level rise record (Nerem et al., 2010) through 2012 shows that the decadal rate of sea level rise has been slowing. From 2002 to 2012 the rate of sea level rise was 2.7 mm per year (0.09 inches per year). This slowdown in the rate of global sea level rise suggests that the faster rate of rise noted by the IPCC from 1993 to 2003 was influenced in part by short-term natural variability characteristic of the 20th century sea level rise record, rather than a full indication of the increase in the long-term rate of sea level rise.Add a 40% reduction in the estimate of the equilibrium climate sensitivity and rapid sea level rise is really out of the question.The current rate of sea level rise, 2.7 mm per year, is equivalent to approximately 1 inch per decade—a rate which adaptive and protective responses can keep up with. There is no evidence for any effect of sea level rise on the US energy infrastructure.The 6.6 foot reference should therefore be removed.	4. Energy Supply and Use		176	14	It is clear from the most recently available data that the rate of global sea level rise has not slowed since 1992, as shown here: http://sealevel.colorado.edu. The evidence for an acceleration in the rate of global sea level rise during the 20th Century was documented by Church and White (Surveys in Geophysics, 2011, doi:10.1007/s10712-011-9119-1). The upper bound of 6.6 feet by 2100 was chosen because it reflects the recent scientific literature as a feasible, although unlikely, upper bound (see Parris et al., 2012 and Pfeffer et al., 2008). The reference to 6.6 feet has been removed.
Garrit	Voggesser	Add reference to Lynn K, Daigle J, Hoffman J, Lake F, Michelle N, Ranco D, Viles C, Voggesser G, Williams P (2013) The Impacts of Climate Change on Tribal Traditional Foods. Climatic Change. DOI: 10.1007/s10584-013-0736-1	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources		446	20	We have added the suggested citations in our chapter assessment.
Cato	Institute	A note on the resilience of the Gulf Coast energy complex should be added:"The resiliency of the U.S. oil and gas industry has allowed energy production to continue even after large hurricanes. The Gulf Coast is home to a significant portion of the U.S. oil and gas industries, representing nearly 30 percent of the nation's crude oil production and approximately 13 percent of its natural gas production (EIA). One-third of the national refining and processing capacity lies on coastal plains adjacent to the Gulf of Mexico. Several thousand offshore drilling platforms, dozens of refineries, and thousands of miles of pipelines are vulnerable to damage and disruption due to the high winds and storm surge associated with hurricanes and other tropical storms. Powerful hurricanes (such as Katrina and Rita in 2005) temporarily halted all oil and gas production from the Gulf, disrupted nearly 20 percent of the nation's refinery capacity, and closed many oil and gas pipelines. Such low-frequency extreme events will always cause disruptions, but the economic history of the US shows that, in the large scope, they are	4. Energy Supply and Use		176	24	Thank you for your comment. We have added statements on the resiliency-building effects of geographically distributed energy sources to this section (with reference to EIA data on natural gas production). We have also added a statement on oil/gas industry performance to safely shut in and restart operations during Hurricane Issac.

		inconsequential. The diversification of supply points helps to cope with extreme events. As an example, in Katrina, most of the high-volume platforms that operate in deep waters and account for nearly half of the Gulf's offshore oil production escaped significant damage (CBO, 2005)."References:Congressional Budget Office, Testimony of Douglas Holtz-Eakin, Director, Macroeconomic and Budgetary Effects of Hurricanes Katrina and Rita, October 6, 2005, http://www.cbo.gov/ftpdocs/66xx/doc6684/10-06-Hurricanes.pdfEnergy Information Administration, EIA Special Report-Gulf of Mexico Fact Sheet, http://205.254.135.24/special/gulf_of_mexico/					
Garrit	Voggesser	Add reference to Lynn K, Daigle J, Hoffman J, Lake F, Michelle N, Ranco D, Viles C, Voggesser G, Williams P (2013) The Impacts of Climate Change on Tribal Traditional Foods. Climatic Change. DOI: 10.1007/s10584-013-0736-1	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources		446	26	We have added the suggested citations in our chapter assessment.
Garrit	Voggesser	Add reference to Lynn K, Daigle J, Hoffman J, Lake F, Michelle N, Ranco D, Viles C, Voggesser G, Williams P (2013) The Impacts of Climate Change on Tribal Traditional Foods. Climatic Change. DOI: 10.1007/s10584-013-0736-1	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources		446	32	We have added the suggested citations in our chapter assessment.
Cato	Institute	Yay! It's about time that the NCA talks about what will happen, namely that there will be considerable sectoral adaptation. Of course, people in the energy business probably know what to do, so this Table really isn't necessary.	4. Energy Supply and Use	4.2	178		Thank you for the accolade. Inclusion of the table provides awareness for adaptation actions to the general public.
Garrit	Voggesser	Add "and culture" to the end of the sentence	13. Land Use and Land Cover Change		481	21	Made suggested edit.
Cato	Institute	The biofuels industry is a complete waste of taxpayer money. It can't roll without a push from Washington, and it results in more GHG production than simply burning the energy equivalent of	4. Energy Supply		180	9	The charter for this chapter is an assessment of the potential physical

		gasoline. Actually, if yields went down, that would probably force reconsideration of the wisdom of the "Saudi Arabia of corn burning" up 40% of it. But yields are likely to increase given the long lead times for adaptation and genetic engineering. Failing that, sorghum will simply be substituted for corn as it is much more drought tolerant and has roughly the same nutritive value as corn. People adapt to perceived changes and trends. Don't you?	and Use				impacts of climate change to U.S. Energy Systems. An extensive assessment of the advantages and disadvantages of the range of energy sources available in the U.S. to choose preferred energy sources is beyond the scope of this chapter and the National Climate Assessment itself. Note that examples of the potential negative impacts of climate change on biofuels and biomass have been included in the chapter in the "Future Energy Systems" section.
Jenna	Zukswert	The transition from the section reporting effects of climate change on species' ranges and habitats to the section about coastal ecosystems is a bit awkward, particularly in that the first sentence of the paragraph transitioning to the topic of coastal ecosystems begins with "The Northeast's coastal ecosystems are also highly vulnerable to rising seas." It seems as if this sentence would follow a discussion of another type of ecosystem also vulnerable to rising seas, or a discussion of another effect of climate change on coastal ecosystems in particular, not a discussion of the responses of invasive species to climate change. I suggest reconsidering the way in which this is phrased, such as removing "also", or making a clearer connection between this section and the last, conveying that effects of climate change on coastal ecosystems are relevant because they are species' habitats.	16. Northeast		561	25	The text has been revised to incorporate this suggestion.
Garrit	Voggesser	include an in-text citation to Chapter 12: Tribal Lands and Resources	13. Land Use and Land Cover Change		481	25	This comment appears to pertain to text not a graphic as labeled. The suggested edit has been made.
Garrit	Voggesser	The NTAA citation is directly from tribal research; suggest amending this to state "rural communities and tribes", and include an in-text citation for Chapter 12: Tribal Lands and Resources.	14. Rural Communities				Thank you for your comment. The text has been revised to include tribes and an in-text citation to Chapter 12: Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources.
Marjorie	McGuirk	It might be helpful, since you mention the IPCC 4th assessment report, to give a quick capture of the seminal statements from the previous IPCC reports...in a sort of timeline. Better would be to have the National Assessment statements, but, by way of example, here are statements with a time stamp.1960's The great Sahelian drought and famine killed 200,000 people and millions of their animals died. Scientific concern was beginning to mount that human activities could be starting to impact the Earth's climate at global scales. 1985 Villach Conference WMO, UNEP, ICSU	Appendix: The Science of Climate Change				We thank the reviewer for their comment. However, we don't see there being much value in just restating the IPCC findings in a timeline. We do mention several of the other items in our disucssion of the science, especially in the discussion of attribution studies. We also discuss the history of climate science in the Commonly Asked Questions appendix.

		“temperature rises in the first half of the 21st century greater than any in human history” 1990 IPCC 1st Assessment Report “global mean surface air temperature has increased by 0.3 to 0.6°C over the last 100 years...; The size of this warming is broadly consistent with predictions of climate models, but it is also of the same magnitude as natural climate variability” 1992 Rio Conference – The Earth Summit signed the UN Framework Convention on Climate Change for “stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic (man-made) interference with the climate system.” 1995 IPCC 2nd Assessment Report “The balance of evidence suggests a discernible human influence on global climate”. The UN proposes a “no regrets” option. 2001 IPCC 3rd Assessment Report “there is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities”. “Adaptation” in the title of one of the reports for first time. The Great heat wave of 2003 kills thousands of Europeans 2007 IPCC 4th Assessment Report “increases in anthropogenic greenhouse gas concentrations are very likely to have caused most of the increases in global average temperatures since the mid-20th century”.					
Cato	Institute	Reference SectionThe following are pretty much egregious nonstandard references. Using the Union of Concerned Scientists really invites criticism, IMHO:Averyt, K., J. Fisher, A. Huber-Lee, A. Lewis, J. Macknick, N. Madden, J. Rogers, and S. Tellinghuisen, 2011: Freshwater use by US power plants: Electricity’s thirst for a precious resource. A report of the Energy and Water in a Warming World initiative, Union of Concerned Scientists, Cambridge, MA Burkett, V., 2011: Global climate change implications for coastal and offshore oil and gas development. Energy PolicyEntergy Corporation, 2012: Building a Resilient Energy Gulf Coast: Executive Report. [Available online at http://www.entergy.com/gulfcoastadaptation]Rosenzweig, C., W. Solecki, R. Blake, M. Bowman, A. Castaldi, C. Faris, V. Gornitz, K. Jacob, A. LeBlanc, and R. Leichenko, 2009: Climate Risk Information. New York City Panel on Climate ChangeSathaye, J., L. Dale, P. Larsen, G. Fitts, K. Koy, S. Lewis, and A. Lucena, 2011: Estimating Risk to California Energy Infrastructure from Projected Climate ChangeWei, M., 2012: California's Carbon Challenge. Scenarios for Achieving 80% Emissions Reductions in 2050. [Available online at http://censeps.soe.ucsc.edu/sites/default/files/2011- wei.pdf] Wilbanks, T., D. Bilello, D. Schmalzer, and M. Scott, 2012b: Climate Change and Energy Supply and Use Wilbanks, T., G. Backus, S. Fernandez, P. Garcia, K. Jonietz, P. Kirshen, M. Savonis, B. Solecki, and L. Toole, 2012a: Climate Change Infrastructure, Urban Systems, and Vulnerabilities	4. Energy Supply and Use		190	1	The public was invited to submit reference material for this chapter during the NCA development process. The chapter authors reviewed the sources and found that they meet the Guidance on Information Quality Assurance to Chapter Authors of the National Climate Assessment: Question Tools (2/21/2012), which is used by the NCADAC to assure for each source used in the NCA Report: (1) utility, (2) transparency and traceability, (3) objectivity, and (4) integrity and security.
Garrit	Voggesser	Include in-text citation for Ch. 12	14. Rural Commun		496	9	We thank the reviewer for the suggestion. We have added an in-text

			ities				citation to Chapter 12: Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources.
Garrit	Voggesser	Add "tribal governments"	14. Rural Communities		505	18	We agree with your suggestion and have added tribal governments.
Garrit	Voggesser	Add "tribal governments"	14. Rural Communities		506	2	We agree with your suggestion and have added tribal governments.
Garrit	Voggesser	Add "tribal governments"	14. Rural Communities		506	22	We agree with your suggestion and have added tribal.
Cato	Institute	General CommentsThere seems to be an implication in this Chapter that the impacts from anthropogenic climate changes are leading to an overall decline in the U.S. transportation system. This idea is forwarded by statements such as found in Key Message 1 that "[anthropogenic climate changes] are reducing the reliability and capacity of the U.S. transportation system in many ways."The reality of the situation is that the reliability and capacity of the U.S. transportation is increasing and expanding. Clearly improvements are outpacing any impacts from climate change—if such negative impacts even exist at all (they are likely undetectable if other factors are accounted for and the proper normalization procedures are applied).This fact ought to be better highlighted.	5. Transportation				Your point that the U.S. transportation system is continually expanding and, at least in some areas, improving is valid. However, as American Society of Civil Engineers' reports indicate, the nation's transportation infrastructure is badly in need of rehabilitation and replacement. The impact of climate change as reflected in more frequent and severe weather events further exacerbates this problem. The authors believe that it is very clear that climate change will affect the U.S. transportation infrastructure. Key Message 1 has been modified to reflect this concern.
Garrit	Voggesser	Suggest including an in-text citation to Chapter 12: Tribal Lands and Resources and Lynn K, Daigle J, Hoffman J, Lake F, Michelle N, Ranco D, Viles C, Voggesser G, Williams P (2013) The Impacts of Climate Change on Tribal Traditional Foods. Climatic Change. DOI: 10.1007/s10584-013-0736-1; Whyte KP (2013) Justice Forward: Tribes, Climate Adaptation and Responsibility in Indian Country. Climatic Change. DOI: 10.1007/s10584-013-0743-2	17. Southeast and Caribbean				We have added some of the suggested citations in our chapter assessment.
Cato	Institute	Key Message 1As data from the Bureau of Transportation Statistics of the U.S. Department of Transportation (http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/index.html#chapter_1) plainly shows, reliability and capacity of the U.S. transportation system is expanding—contrary to the primary claim made in this Key Message. Examples of this are provided in additional comments.Recommendation: Remove this Key Message.	5. Transportation		195	14	Your point that the U.S. transportation system is continually expanding and, at least in some areas, improving is valid. However, as American Society of Civil Engineers' reports indicate, the nation's transportation infrastructure is badly in need of rehabilitation and replacement. The impact of climate change as reflected in more frequent and severe weather events further exacerbates this problem. The authors believe that it is very clear that climate change will affect the U.S.

							transportation infrastructure. Key Message 1 has been modified to reflect this concern.
Garrit	Voggesser	Include mention of tribal communities	17. Southeast and Caribbean		596	19	While the comment suggests a good specific example, the authors feel the existing examples are appropriate and adequate here.
Garrit	Voggesser	Include mention of tribal communities	17. Southeast and Caribbean		596	30	While the comment suggests a good specific example, the authors feel the existing examples are appropriate and adequate here.
Garrit	Voggesser	include an in-text citation to the tribal chapter Chapter 12: Tribal Lands and Resources	17. Southeast and Caribbean				We have added the suggested citation in our chapter assessment.
Cato	Institute	Key Message 2In discussions of the projections of global sea level rise, it is imperative to discuss the impacts of new evidence that suggests that the equilibrium climate sensitivity is 40% lower than the GCM average used in the NCA projections. Almost certainly, models with a 40% lower equilibrium climate sensitivity will project less sea level rise and thus less impact on the U.S. transportation system.See our Comment Page 31, Lines 15-18 for further details.	5. Transportation		195	18	Thank you for your comment. Sea level rise projections are beyond the scope of this chapter, which focuses on impacts to U.S. transportation systems. Sea level rise projections are addressed in Chapter 2: Our Changing Climate.
Christine	Shearer	Here are some studies to consider for this chapter:pg. 445, line 1-4 Keith Basso, Wisdom Sits in Places (1996) A rich ethnographic narrative of the deep meaning of place in Western Apache tradition, this significant source book speaks directly to the ways that all parts of tribal culture are tied to place and how the creation of places shape the tribe's language, relations, everyday practices, traditions, and ways of living.pg. 444, lines 26-28 Kyle Powys White (2013) Justice Forward: Tribes, Climate Adaptation and Responsibility in Indian. Climatic Change. DOI: 10.1007/s10584-013-0743-2 Whyte's peer-reviewed article provides a clear depiction of the meaning of traditional ecological knowledge, and how this systems of responsibilities relates to climate change adaptation.pg. 453, lines 30-31 White, Kyle Powys (2013) Justice Forward: Tribes, Climate Adaptation and Responsibility in Indian. Climatic Change. DOI: 10.1007/s10584-013-0743-2 This peer-reviewed article is particularly relevant here because it discusses the intrinsic issues of governance and provides a distinct rationale for the use of a justice-based framework for multi-party governance.pg. 442, lines 10-12 Cochran, P, Huntington OH, Pungowiyi C, Tom S, Chapin III FS, Huntington HP, Maynard NG, Trainor, SF (2013) Indigenous Frameworks for Observing and Responding to Climate Change in Alaska. Climatic Change. DOI: 10.1007/s10584-013-0735-2; Lynn K, Daigle J, Hoffman J, Lake FK, Michelle N, Ranco D, Viles C, Voggesser G, and Williams P (2013) The Impacts of Climate Change on Tribal Traditional Foods. Climatic Change. DOI: 10.1007/s10584-013-0736-1; Voggesser G, Lynn K, Daigle J, Lake FK, and Ranco D (2013) Cultural Impacts to Tribes from Climate Change Influences on Forests. Climatic Change. DOI: 10.1007/s10584-013-0733-4 ; Maldonado JK, Shearer C, Bronen R, Peterson K, Lazrus H (2013) The Impact of Climate Change on Tribal Communities in the US: Displacement, Relocation, and Human Rights. Climatic Change. DOI: 10.1007/s10584-013-0746-z These peer-reviewed articles discuss the key vulnerabilities	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources				We have added the suggested citations in our chapter assessment.

		listed and could be included at the end of the list.pg. 449, lines 13-27; pg. 450, lines 13-20; pg. 451, lines 12-16 and 452, lines 1-11 Cochran, P, Huntington OH, Pungowiyi C, Tom S, Chapin III FS, Huntington HP, Maynard NG, Trainor, SF (2013) Indigenous Frameworks for Observing and Responding to Climate Change in Alaska. Climatic Change. DOI: 10.1007/s10584-013-0735-2 Cochran et al.'s peer-reviewed recent article should be cited in the "declining sea ice" and "permafrost thaw" sections, as it provides distinctly relevant and up-to-date information.pg. 444, lines 22-41 and pg. 445, lines 1-27 Cochran, P, Huntington OH, Pungowiyi C, Tom S, Chapin III FS, Huntington HP, Maynard NG, Trainor, SF (2013) Indigenous Frameworks for Observing and Responding to Climate Change in Alaska. Climatic Change. DOI: 10.1007/s10584-013-0735-2 This peer-reviewed article should be cited in this section because it speaks directly to the importance and need for traditional ecological knowledge.pg.453, lines 14-21 Cochran, P, Huntington OH, Pungowiyi C, Tom S, Chapin III FS, Huntington HP, Maynard NG, Trainor, SF (2013) Indigenous Frameworks for Observing and Responding to Climate Change in Alaska. Climatic Change. DOI: 10.1007/s10584-013-0735-2 This peer-reviewed article speaks to the issues of relocation for Alaska Native communities like Newtok.pg. 458-460 Cochran, P, Huntington OH, Pungowiyi C, Tom S, Chapin III FS, Huntington HP, Maynard NG, Trainor, SF (2013) Indigenous Frameworks for Observing and Responding to Climate Change in Alaska. Climatic Change. DOI: 10.1007/s10584-013-0735-2 This peer-reviewed article should be used as a source for key message #4 and #5 pg. 445, lines 35-41 and pg. 446, lines 1-35 Lynn K, Daigle J, Hoffman J, Lake FK, Michelle N, Ranco D, Viles C, Voggesser G, and Williams P (2013) The Impacts of Climate Change on Tribal Traditional Foods. Climatic Change. DOI: 10.1007/s10584-013-0736-1 Lynn et. al's peer-reviewed article should be cited in the "Forests, Fires, and Food" section, as it provides in-depth information on the connection and impacts of climate change, tribal traditional foods, and tribal culturepg. 454-455 Lynn K, Daigle J, Hoffman J, Lake FK, Michelle N, Ranco D, Viles C, Voggesser G, and Williams P (2013) The Impacts of Climate Change on Tribal Traditional Foods. Climatic Change. DOI: 10.1007/s10584-013-0736-1 This peer-reviewed article is relevant to the traceable accounts, key message #1pg. 445, lines 35-41 and pg. 446, lines 1-35 Voggesser G, Lynn K, Daigle J, Lake FK, and Ranco D (2013) Cultural Impacts to Tribes from Climate Change Influences on Forests. Climatic Change. DOI: 10.1007/s10584-013-0733-4 This peer-reviewed article should be cited in the "Forests, Fires, and Food" section, as it provides information on climate impacts on forests and the consequences of these effects on tribal cultures and resources.pg. 454-455 Voggesser G, Lynn K, Daigle J, Lake FK, and Ranco D (2013) Cultural Impacts to Tribes from Climate Change Influences on Forests. Climatic Change. DOI: 10.1007/s10584-013-0733-4 This peer-reviewed article is relevant to the traceable accounts, key message #1 pg. 444, lines 34-39 and pg. 445, lines 18-27 Voggesser G, Lynn K, Daigle J, Lake FK, and Ranco D (2013) Cultural Impacts to Tribes from Climate Change Influences on Forests. Climatic Change. DOI: 10.1007/s10584-013-0733-4 This peer-reviewed article discusses the importance of traditional ecological knowledge when considering the impacts and adaptation strategies to climate change and discusses the need to pair traditional ecological knowledge with Western sciencepg. 446, lines 18-27; pg. 447, lines 16-18 Grah O, Beaulieu J (2013)The Effect of Climate Change on Glacier Ablation and Baseflow Support in the Nooksack River Basin and Implications on Pacific Salmon Species Protection and Recovery. Climatic Change. DOI: 10.1007/s10584-013-0747-y Grah and Beaulieu provide a peer-reviewed case study example of how climate change impacts are impacting the streamflow of the Nooksack River, which effects Pacific salmonids that the Nooksack Indian tribe depends on for ceremonial, subsistence and commercial purposes.pg. 454-455 Grah O, Beaulieu J (2013)The Effect of Climate Change on Glacier Ablation and Baseflow Support in the Nooksack River Basin and Implications on Pacific Salmon Species Protection and Recovery. Climatic Change. DOI: 10.1007/s10584-013-0747-y The case study in this peer-reviewed publication should be cited in the traceable accounts for key message #1pg. 446, lines 18-27; pg. 447, lines 13-15, 25-37 Gautam M, Chief K, Smith Jr. WJ (2013)					

		Climate Change in Arid Lands and Native American Socioeconomic Vulnerability: The Case of the Pyramid Lake Paiute Tribe. Climatic Change. DOI: 10.1007/s10584-013-0737-0 Gautum et al. provide a peer-reviewed case study of how climate change impacts are impacting the subsistence and water resources of the Pyramid Lake Pauite tribe.pg. 454-456 Gautam M, Chief K, Smith Jr. WJ (2013) Climate Change in Arid Lands and Native American Socioeconomic Vulnerability: The Case of the Pyramid Lake Paiute Tribe. Climatic Change. DOI: 10.1007/s10584-013-0737-0 The case study in this peer-reviewed publication should be cited in the traceable accounts for key messages #1 and #2 because it speaks directly to the vulnerability of tribal subsistence and water supplies to climate change impacts pg. 453, lines 1-31 Maldonado JK, Shearer C, Bronen R, Peterson K, Lazrus H (2013) The Impact of Climate Change on Tribal Communities in the US: Displacement, Relocation, and Human Rights. Climatic Change. DOI: 10.1007/s10584-013-0746-z Maldonado et al.'s peer-reviewed article provides three case study examples, as well as discussion around governance issues of climate change and forced displacement and community-led relocationpg. 462 Maldonado JK, Shearer C, Bronen R, Peterson K, Lazrus H (2013) The Impact of Climate Change on Tribal Communities in the US: Displacement, Relocation, and Human Rights. Climatic Change. DOI: 10.1007/s10584-013-0746-z This peer-reviewed publication should be cited in the traceable accounts for key message #5 because it speaks directly to issues of climate change, relocation and governance.pg. 446, lines 18-27; pg. 447, lines 16-18, 25-37 Dittmer, K (2013) Changing Streamflow on Columbia Basin Tribal Lands- Climate Change and Salmon. Climatic Change. DOI: 10.1007/s10584-013-0745-0 Dittmer provides a peer-reviewed case study of how climate change impacts are impacting the subsistence and water resources of the Columbia River basin tribes.pg. 454-456 Dittmer, K (2013) Changing Streamflow on Columbia Basin Tribal Lands- Climate Change and Salmon. Climatic Change. DOI: 10.1007/s10584-013-0745-0 The case study in this peer-reviewed publication should be cited in the traceable accounts for key messages #1 and #2 because it speaks directly to the vulnerability of tribal subsistence and water supplies to climate change impacts					
Cato	Institute	Key Message 3“Extreme weather events currently disrupt transportation networks in all areas of the country; projections indicate that such disruptions will increase.”In most cases in which risks are increasing, actions are taken to mitigate those risks. This includes risks from climate and climate change. In making your “projections” that such “disruptions will increase” how have you factored in modernization of the U.S. transportation system, upgrades, and adaptations that will surely occur? If you did not take them into account, then you should modify your statement to something like:“Under the unrealistic assumption that the U.S. transportation system remains static into the future, projections indicate that disruptions from extreme weather events will increase.”	5. Transportation		195	21	Thank you for your comment. In the introduction of the chapter, we mention that disruptions to our transportation system capacity and reliability can be partially offset by adaptation. The U. S. could adapt to the impacts of climate change either in a reactive mode or as a planned progression in the development of new and rehabilitated transportation infrastructure.
Garrit	Voggesser	Suggest citation to Cozzetto et al. 2013 (Climatic Change)	20. Southwest				We have added the suggested citation in our chapter assessment.
Garrit	Voggesser	1. The discussion of impacts to forests includes reference to traditional tribal uses. Suggest including an in-text citation to Chapter 12: Tribal Lands and Resources and to Voggesser et al. 2013 (Climatic Change). 2. Lines 14-16 mentions affects of ocean acidification on marine food webs. Suggest including an in-text citation to Chapter 12: Tribal Lands and Resources and to Dittmer 2013, Grah and Beaulieu 2013 and Lynn et al. 2013 (climatic change). 3. Consider adding a call-out box or a few sentence to reference impacts to tribes in the Northwest,	21. Northwest				1. None of the other reasons for forests' importance in the opening paragraph of the forest section has a citation, but we have added a citation to this paper farther down in the forest section. 2. There is already a pertinent reference on marine food webs; space precludes additional references.

		and the forthcoming tribal chapter in the Northwest Climate Assessment (published by Island Press in 2013). cite Lynn et al. in Dalton et al. 2013. a. Suggested Text: The Northwest Climate Assessment (Dalton et al. 2013) includes a chapter on the impacts of climate change on tribal communities in the Northwest. There are forty-three federally recognized tribes in Oregon, Washington and Idaho, and the tribal chapter synthesizes information on key climate change vulnerabilities for tribes in the Northwest and potential consequences to a range of tribal cultural and natural resources, traditional foods, and economies.					3. Text and refs added to a new introductory paragraph
Cato	Institute	You throw out carbon dioxide emissions numbers without any perspective whatsoever. In and of themselves, they are meaningless.The U.S. transportation sector produced 1,849 million metric tons of carbon dioxide in 2009, 34% of the total U.S. energy-related emissions of carbon dioxide (EIA, 2011). The U.S. produced 18% of the global total carbon dioxide emissions from the consumption of energy in 2009 (EIA). The U.S. transportation sector was responsible for 6% of the global total. Emissions from the U.S. transportation section have been growing at an average rate of 24 million metric tons of CO2 per year for the past two decades (although since peaking in 2007, they have been in decline). The growth of emissions in China has been at a rate of 253 million metric tons of CO2 per year during the same period, or more than 10 times greater than the growth of emissions from the U.S. transportation sector. In fact, the average rate of emissions growth in China is so great that it adds new emissions equivalent to the total annual emissions from the U.S. transportation sector every 5 weeks. Using the methodology of the United Nations' Intergovernmental Panel on Climate Change, a complete cessation of emissions from U.S. transportation would reduce mean projected global warming approximately 0.11°F per 50 years, an amount too small to reliably measure. Clearly, emissions from the U.S. transportation sector play a minor and rapidly diminishing role in total global greenhouse gas emissions.It is not climate change, but the vagaries of the climate itself that have the greatest impact on U.S. transportation. Climate change, to the degree that it is detectable and identifiable, contributes a mix of impacts, some positive and some negative, and the net impact has never been reliably quantified or monetized. The impacts of climate and climate change are confused and thus used interchangeably, however, such usage is incorrect and misleading.Recommendation: Drop the paragraph in its entirety or put the U.S. transportation emissions and their fractional impact of in the specific weather types that may impact U.S. transportation in its proper perspective.Recommendation: Drop the paragraph in its entirety or put the U.S. transportation emissions and their fractional influence on the specific weather events that impact U.S. transportation in the proper perspective.References:Energy Information Administration, Emissions of Greenhouse Gases in the U. S., March 31, 2011Energy Information Administration, International Energy Statistics, http://www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm?tid=90&pid=44&aid=8	5. Transportation		196	1	Thank you for your comment. We have added information on the percent of emissions from the U.S. transportation system in terms of total global greenhouse gas emissions. Chapter 2: Our Changing Climate provides a discussion on U.S. greenhouse gas emissions in the context of global emissions.
Garrit	Voggesser	Add reference to Cochran P, Huntington OH, Pungowiyi C, Tom S, Chapin FS, Huntington HP, Maynard NG, Trainor SF (2013) Indigenous Frameworks for Observing and Responding to Climate Change in Alaska. Climatic Change. DOI: 10.1007/s10584-013-0735-2	21. Northwest				The reference is not relevant for the Northwest region.
Garrit	Voggesser	Include in-text citation to Chapter 12: Tribal Lands and Resources	23. Hawaii and U.S. Affiliated Pacific Islands				The text has been revised to incorporate this suggestion.
Cato	Institute	You claim that "Transportation systems are already experiencing costly climate change related impacts." Can you quantify the additional cost that human-related climate change caused the transportation system over and above the costs incurred by plain old climate variability? If not, how do	5. Transportation		196	6	The points the comment raises are beyond the scope of this chapter. The charter for this chapter is an

		you know the climate change related impacts were “costly”?You claim that “Many inland states – for example, Vermont, Tennessee, Iowa, and Missouri – have experienced severe precipitation events and flooding during the past three years, damaging roads, bridges, and rail systems.” We assume that you all think that these severe precipitation events were related to human-caused climate change? Otherwise why list them?The Figure below is from Higgis and Kousky (2013) and shows the percent change in the annual number of daily precipitation events (1980-2009 minus 1950-79) for daily events which produced over 25mm of precipitation (their highest category).We note that the number of daily precipitation events greater than 25mm has declined in much of Tennessee and parts of Iowa. So how is it that you suggest that heavy precipitation events there which lead to flooding were from human-caused climate change when the observed climate change is towards fewer heavy events there?And as to the overall changes in heavy precipitation across the U.S., Higgis and Kousky (2013) find that they are strongly related to ENSO variability. So we ask again, what portion of the impact to the US transportation infrastructure from those storms was attributable to human-caused climate change?If you don’t know, then we suggest that you drop these sentences.(Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: The percent change in the annual number of daily precipitation events (1980-2009 minus 1950-79) for daily events which produced over 25mm of precipitation (from Higgis and Koursky, 2013).Reference:Higgis, R.W., and V.E. Kousky, 2013. Changes in observed and daily precipitation over the United States between 1950-79 and 1980-2009. Journal of Hydrometeorology, 114, 105-121, DOI: 10.1175/JHM-D-12-062.1					assessment of the potential impacts of climate change to U.S. transportation systems. Attributions to climate changes are covered in Chapter 2: Our Changing Climate. We refer those interested in learning more about the supporting evidence behind our Key Message #4 and examples on costly climatic impacts to the cited literature in the Traceable Account.
Garrit	Voggesser	1. P.840, Box: mention that shellfish have been a traditionally important food source for tribes for centuries. 2. p.845: mention impacts to coastal tribes in section titled "Impacts of Marine-related Climate Change". 3. p.846: mention tribal initiatives in section titled "Initiatives Serve as a Model". 4. In the Ocean/Marine chapter, it might be useful to note that four tribes (Makah, Quileute, Hoh, Quinault) have ocean treaty rights off the coast of the Olympic Peninsula and, therefore, four voices to join the U.S. voice in discussions of ocean acidification impacts, research and strategies	24. Oceans and Marine Resources				While the comment suggests a good specific examples, the authors feel the existing examples are appropriate and adequate.
Jenna	Zukswert	It is not clear what readers are supposed to learn or realize from this image, particularly since there is no sense of scale presented. This figure could be more effective if the outlines of the six states over which the drainage basin extends were included in the map (similar to in Figure 16.4, where the outlines of the states affected by Hurricane Irene are sketched on the image).	16. Northeast	16.8	562		A completely different image has been selected that communicates better.
Christine	Shearer	Real life cast study of Kivalina, Alaska - a barrier reef community facing permanent displacement - suggests the need to have disaster mgmt policies act as a bridge toward adaptation and to have a relocation policy in the US coordinated under a specified agency. See Shearer C (2012a) The political ecology of adaptation assistance: Alaska Natives, displacement, and relocation. J Pol Ecol 19:174–183	28. Adaptation				Thank you for your comment. The authors agree. Kivalina is called out in our map - which will be figure 28.4 (revision needed).
Jenna	Zukswert	An image would be helpful and interesting in this box. For example, providing an example of one of these culvert maps, if possible, would help readers better perceive the complexity of this issue.	16. Northeast		565	16	We appreciate the suggestion, but space is limited. The author team has deliberated and agreed on the most important information/illustrations to include.
Jenna	Zukswert	This chapter could conclude more strongly with a paragraph that briefly summarizes the entire chapter, maybe highlighting that the Northeast will experience more extreme precipitation and greater than average increases in sea level as a result of climate change, and ending with a future direction for	16. Northeast				A consistent chapter structure did not include incorporating a conclusion since each regional chapter was short.

		planning and adaptation (e.g. this will require more multi-state coordination and action).					
Cato	Institute	"…are reducing the reliability and capacity of the U.S. transportation system"Do you have any data to back this up? Or did you just make this up?The Figures below are from data from the Bureau of Transportation Statistics of the U.S. Department of Transportation (http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/index.html#chapter_1). Since 1990, in the United States, total roadway lane mileage has increased, the total number of airports has increased, the percentage of 'structurally deficient' bridges has decreased, and the percentage of 'unacceptable' roadway surface conditions has decreased. (Figure emailed to comments@usgcrp.gov as per instructions) CAPTION: Estimated U.S. roadway lane mileage (data source: U.S. Bureau of Transportation Statistics).(Figure emailed to comments@usgcrp.gov as per instructions) CAPTION: Number of U.S. airports (data source: U.S. Bureau of Transportation Statistics).(Figure emailed to comments@usgcrp.gov as per instructions) CAPTION: Percentage of "structurally deficient" bridges on U.S. highways (data source: U.S. Bureau of Transportation Statistics).(Figure emailed to comments@usgcrp.gov as per instructions) CAPTION: Percentage of "unacceptable" roadway conditions by functional system (data source: U.S. Bureau of Transportation Statistics).Of the major transportation systems, only the number of Class 1 rail road miles has declined, that is due largely to abandonment of little-used lines and the proliferation of non class-1 (regional) railroads. The total number of freight car miles travelled has been increasing.(Figure emailed to comments@usgcrp.gov as per instructions) CAPTION: Estimated mileage of Class 1 rail. Mileage excludes yard tracks, sidings, and parallel lines. (data source: U.S. Bureau of Transportation Statistics).(Figure emailed to comments@usgcrp.gov as per instructions) CAPTION: Freight car-miles travelled (data source: U.S. Bureau of Transportation Statistics).So clearly your proposition that the reliability and capacity of if the U.S. transportation system is reduced is being reduced by climate change is going to be a tough one for you all to demonstrate.Recommendation: Drop the entire section on Reliability and Capacity Risk (as well as Chapter 5 "Key Point 1") because you do not demonstrate that it is true, in the face of the improving capacity and reliability of the U.S. transportation system.	5. Transportation		197	2	The revised key message is consistent with the author team's thorough assessment of the literature on this topic. We refer to those interested in learning more about the supporting literature to the cited sources included in the Traceable Account.
Jenna	Zukswert	On page 549, line 35, you write that much of the Northeast is dominant by forest, but in this chapter I found little written about effects of climate change on northeastern forests. There seems to be a much larger focus on coastal and riparian ecosystems, and on cities and agriculture, which undeniably are relevant to many people and should have much information presented on them in this chapter. I would suggest adding more information on the effects of climate change on natural ecosystems, in particular forest ecosystems, in addition to the relevant information already presented. This would give readers a wider perspective on the effects of climate change in this region.	16. Northeast				New text has been added to expand the discussion of observed changes in forests.
Cato	Institute	Add a note that your climate models in general have a climate sensitivity that is about 40% higher than recent estimates and thus the future climate change projections from climate models are likely overestimates.See our Comment Page 31, Lines 15-18 for further details.	5. Transportation		197	13	The point the comment raises is beyond the scope of this chapter. The charter for this chapter is an assessment of the potential impacts of climate change to U.S. transportation systems. Information regarding the global climate models and emissions scenarios used is found in Chapter 2: Our Changing Climate.
Cato	Institute	"Climate change is most severe at high northern latitudes."What is the definition that you are using for "severe"? Is a change that exceeds some relative bounds developed for each location? Is it a change that exceeds some absolute bound for each location? Does "severe" mean bad? Can a "severe" change have positive results? On net, over the long term, is a greener Arctic a bad thing? You need to be more precise in your descriptions.	5. Transportation		197	27	We have reworded the text to address this comment.

Jenna	Zukswert	You mention in lines 29 through 31 the relationship between vulnerability and socioeconomic factors. Consider giving this relationship more attention in this section of the chapter, as it is one that affects many people in this region.	16. Northeast		556	12	The text has been revised to incorporate this suggestion.
Garrit	Voggesser	add tribal mitigation efforts to the list of "Voluntary Actions" and include in-text citation to Chapter 12	27. Mitigation		963		A web-site reference to efforts of tribal communities has been added.
Garrit	Voggesser	add "tribal governments"	27. Mitigation		966	36	We have edited the text to incorporate this concern.
Garrit	Voggesser	Table 27.1: add list of sample tribal mitigation efforts.	27. Mitigation		957		A web-site reference to efforts of native peoples has been added.
Garrit	Voggesser	add in-text citation to Chapter 12	28. Adaptation		991	3	We thank the commenter for this suggestion. We have slightly expanded word limit to the chapter and have been allowed to add back some cross references.
Garrit	Voggesser	add "tribes" to list	28. Adaptation		1006	4	Thank you for your comment. This change has been made.
Garrit	Voggesser	include "tribal" in the title of Research Goal 2	29. Research Agenda for Climate Change Science		1037	21	The authors have elected not to call out this group specifically.
Jenna	Zukswert	The first sentence of the "Agriculture and Ecosystems" key message is well supported by the text. However, the second sentence of this key message, "A longer growing season may allow farmers to explore new crop options, but this and other adaptations will not be cost- or risk-free, and inequities exist in the capacity for adaptation", lacks support. I got the impression from the text that the growing season would be shorter due to late planting in the spring as a result of wet springs. I also did not see anything written in this section about exploring new crop options or about the inequities. More evidence and examples and direct statements in the text would better support this key message.	16. Northeast		560	10	The text has been revised to incorporate this suggestion.
Garrit	Voggesser	include tribes in the list	29. Research Agenda for Climate Change Science		1037	34	The text has been amended to address this suggestion.
Garrit	Voggesser	Suggested additional content to address tribes in regards to the sustained assessment. 1. The impacts of climate change are place-based and as such will impact culture, sovereignty, economies and traditional ways of life among American Indians, Alaska Natives, Native Hawaiians and	30. The NCA Long-term				Agree in part. To recognize the unique status of tribes, original line 29 on page 1047 was expanded to read: "…needs of federal agencies, state and

		other indigenous peoples in the United States. a. Perhaps add something describing preferential vulnerability of reservations? ""Many reservations, in particular coastal reservations are preferentially vulnerable to climate change and associated sea-level rise/storm surge and will likely be unable to secure replacement lands of equal or better quality for their cultural needs under the present landscape modified by 150 years of western settlement and urbanization" 2. Tribes are not just vulnerable populations or just another stakeholder; tribes are sovereign nations [and ""co-managers"] and must have a distinct place in the NCA. There are opportunities for tribal leadership, collaboration co-management and engagement in climate research, assessments, and other initiatives. 3. Traditional knowledge can inform understanding of climate impacts and adaptation strategies. The knowledge is culturally-sensitive and should be protected; but tribes can share what they learn to inform broader assessments, federal processes." 4. There is a need for more information on what the National Climate Assessment is and why it is important for and relevant to tribes to engage in. 5. Use NCA findings to evaluation economic impacts of climate change and communicate those costs to tribal (and federal) leaders	Process: Vision and Future Development				local governments, tribes, other decision-makers, and end users…." To go into the detail requested by the commenter, however, would go beyond the scope of this chapter. Other sections of the assessment report are better suited to discuss the unique needs, vulnerabilities, and capacities of the tribes. It should also be noted that the NCADAC Special Report on Sustained Assessments will address the tribal context in more detail.
Garrit	Voggesser	Through a coordinated process by numerous organizations and tribes, comments have been compiled to address tribal issues and perspectives throughout the National Climate Assessment. These comments were intended to assist tribes in reviewing the National Climate Assessment chapters and submitting comments at ncadac.globalchange.gov. Some of the comments submitted may be identical to others submitted by tribes, tribal organizations, or non-tribal entities working with various tribal climate change networks around the country.					Thank you for coordinating review of the report.
Jenna	Zukswert	This figure seems unnecessary. Figure 16.10, which shows the conceptual design for a storm surge barrier, is more effective in that it gives readers an idea of the kinds of adaptation strategies that are currently being considered. Replacing this figure with another figure that conveys an adaptation strategy, either hypothetical or implemented, would better inform readers of planning activities and adaptation strategies that are being considered in the Northeast.	16. Northeast	16.11	565		The text has been revised to incorporate this suggestion.
Cato	Institute	Your description of temperature change in Alaska lacks context and thus implies that the observed changes are the result of human-caused climate changes. They largely are not.Our suggestion would be to discuss the various influences on observed temperatures in Alaska and show the magnitude of the influence of the PDO and include the figures below showing temperatures in Alaska beginning back in 1918, when NCDC begins their data.(Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: The top panel shows the statewide average temperature in Alaska from 1918 through 2011. The bottom panel shows the Pacific Decadal Oscillation (PDO) index over the same period. Notice that temperatures in Alaska largely reflect the PDO.Alaskan climate change has been enigmatic and complex. One clear signal is that, in general (with one or two notable exceptions), the statewide temperature history is characterized by a step-change in 1976-77, which was recognized in hindsight (nearly twenty years later) as a sudden reorganization of pan-Pacific climate known as the Great Pacific Climate Shift (Miller et al., 1994). The ultimate cause of this change, and the reasons for its persistence are currently not known.The Pacific Climate Shift involved 40 physical variables, including the climatic pattern known as the Pacific Multidecadal Oscillation (Miller et al., 1994). As a	5. Transportation		197	28	The description of Alaska is consistent with other chapters of this report, such as Chapter 22: Alaska and the Arctic.

		result, statewide average records tend to show no net warming prior to or subsequent to this change. (Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Annual average temperature history for Alaska since 1949.(source: http://climate.gi.alaska.edu/ClimTrends/Change/TempChange.html)The power of the Pacific Climate Shift is evident in this post-1948 temperature history and shows why reporting the trend since 1949 (as is done in the NCA) is a poor idea. As noted by the Alaska Climate Research Center, at the University of Alaska (Fairbanks), a plot of gross trends is inappropriate because of the step change-nature of the Alaskan climate history.(Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Without the accompanying table (shown below), this map is very misleading about Alaskan climate change.(source: http://climate.gi.alaska.edu/ClimTrends/Change/TempChange.html)It is very apparent that since the Pacific Climate Shift there is very little secular temperature change over all of Alaska with the exception of Barrow. The very large Autumn change there is almost certainly related to the decline of sea ice which has a strong local climate influence.(Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Total change in mean seasonal and annual temperature from stations in Alaska, 1977-2008 (the period since the Great Pacific Climate Shift).(Source: http://climate.gi.alaska.edu/ClimTrends/Change/TempChange.html).The remaining station that shows a significant increase since 1976 is Talkeetna, but there is likely some type of warming bias at the site when compared to other records that are "nearby" (in Alaskan terms), Gulkana and Anchorage International. One interesting aspect of Alaskan temperatures south of the Brooks Range (which divides interior Alaska from the northern coastal plain) is that satellite (microwave)-sensed lower tropospheric temperature show a rise since the Pacific Climate Shift that is not detected by ground-based thermometers. Because both measurements (satellite microwave and thermometer) are presumably accurate, one is left to hypothesize a systematic discontinuity between the lower troposphere (satellite-sensed) and the boundary layer (thermometrically measured) temperature over Alaska.References:Miller, et al., 1994. The 1976-77 climate shift of the Pacific Ocean. Oceanography 7, 21-26. Alaska data: http://climate.gi.alaska.edu/ClimTrends/Change/TempChange.html					
Cato	Institute	While thawing permafrost is a concern from rising temperatures—whether from the natural oscillations of the PDO, anthropogenic global warming, or some combination of these and other factors—the concern should not be overstated, in that the land-based transportation infrastructure of Alaska located in regions where thawing permafrost is sparse. Repairs and improvements can be made on a case by case basis and in association with other planned improvement and expansion projects. In the state of Alaska's long-range transportation policy plan adopted in 2008, concerns about thawing permafrost are rarely mentioned (except in association with planned improvement to the Dalton Highway) and concerns of climate change-related impacts to the state's transportation infrastructure play only a minor role in the overall long-range policy.	5. Transportation		198	1	The chapter documents that the State of Alaska spends $10 million per year dealing with costs associated with thawing permafrost. This figure is neither an understatement nor an overstatement.
Cato	Institute	You seem to be trying to confuse the reader between the impacts of climate and the impacts of climate change in this figure. To help clarify the difference, please include a map of the same region showing only the impact of "a storm surge similar to Hurricane Katrina." That way, through visually differencing the two maps, the reader can better understand the impact of the 30-inch sea level rise. As it is now, a cursory look at the figure leaves you with the impression that all of the inundation is due to climate change-related sea level rise, when, in truth, probably very little of it is due to that factor.	5. Transportation	5.1	199		It would be interesting to show side-by-side maps. Unfortunately, there is not enough space in the chapter. Chapter 2: Our Changing Climate indicates projections of sea level rise, as well as projected increases in hurricane intensity. It is reasonable to show impacts on transportation associated with a major hurricane under a reasonable sea level rise

							scenario.
Cato	Institute	"Thirteen of the nation's largest airports have at least one runway with an elevation within 12 feet of current sea levels (Airnav LLC 2012)."Uh, remind us one more time as to what your sea level rise projections were? We thought they were 1 to 4 feet, but if that is the case, then why did you provide a count of the airports within 12 feet of sea level?	5. Transportation		200	15	In considering vulnerability, one has to take into account sea level rise, but also high tide and storm surge. We have modified the text to address this comment.
Cato	Institute	One of the airports in the list, Louis Armstrong International is listed as being 1.7 feet *below* sea level. Some portions of San Francisco International and Oakland International were actually part of the San Francisco Bay about 50 years ago. Portions of Reagan National Airport were once mudflats of the Potomac River, some runways at LaGuardia and JFK were also reclaimed from the water. Areas that are currently below sea level or that were recently water now support major airports. If that situation didn't deter the current existence of the airports , why should it do so in the future? Recommendation: Remove Figure 5.2 and related discussion in the text.	5. Transportation	5.2	201		In considering vulnerability, one has to take into account sea level rise, but also high tide and storm surge. We have modified the text to address this comment.
Cato	Institute	Replace these lines about inland waterways and flooding with the text below, a far more accurate portrayal of the situation:"Oftentimes, there is confusion when attributing or associating major flood events on major river systems—such as the Mississippi/Missouri river floods of 1993 and 2008—to increases in precipitation extremes. These river systems are highly altered from there natural state by a variety of engineering schemes intended to "control" the rivers to enhance shipping commerce and protect riverfront communities from flooding. While the collection of levies, dykes, channel alterations, etc., have largely achieved this goal on a day to day basis, they oftentimes exacerbate conditions of extremely high flow. The increases in impervious surfaces and the channelization of the river flow (which keeps the rivers from overflowing into their natural flood plains) leads to confined flow and increasing flow speeds which can result in extremely high, erosive water levels and catastrophic flooding and concomitant disruption of transportation services and damages to transportation infrastructure, when the river level tops or breaks through existing protection structures. Certainly heavy and persistent rainfall is the instigator of major flooding events, but human alterations to the waterways and management decisions can exacerbate the magnitude and destructive potential of the flood events."	5. Transportation		202	11	Increases in flood risk reflect both changing precipitation and changing land use patterns. We have modified the text to incorporate this information.
Cato	Institute	There is a body of scientific literature that projects that AGW will alter the storm track of Atlantic hurricanes such that it is shifted eastward resulting in a decrease in the number of U.S. landfalls. That literature seems not to have been taken into account in your description.Instead of your few lines on hurricanes, we suggest the following, more thorough treatment:"Projections of future changes in tropical cyclone (tropical storms and hurricanes) characteristics are neither overly large nor unambiguous. Globally, the frequency of tropical cyclones is expected to be decline slightly with increasing atmospheric greenhouse gas concentration increases. Tropical cyclone intensity is expected to increase slightly. However, at the regional level, changes may depart from the global tendency. In the Atlantic basin, new research suggests that although there may be a tendency for a slight increase in both storm number and storm intensity, the preferred storm track may be shifted towards more storms out to sea in the central Atlantic and away from the continental U.S. (Wang et al., 2011). As the greatest hurricane-related impact to coastal transportation infrastructure occurs when hurricanes make a direct strike to the U.S., a future tendency for land-falling hurricanes (of any strength) to become less frequent would mitigate hurricane-related damages.However, the projected changes to Atlantic tropical cyclone characteristics are neither certain nor large enough to warrant directed measures modifying the nation's transportation infrastructure. Instead, it should be recognized that there are large natural variations in hurricane characteristics that occur over timescales from years to decades. Tropical cyclones have been and will continue to be threats to coastal development. Periods characterized by lulls in Atlantic hurricane activity—such as the late 1970s, 1980s and early 1990s—	5. Transportation		202	20	The text is consistent with the current state of science on hurricanes described in more detail in Chapter 2: Our Changing Climate, which is referenced in our text.

		underrepresent the true nature of the threat and encourage booms in coastal development and the accompanying transportation infrastructure. Active periods of Atlantic tropical cyclones, such as the 1940s and 1950s and again in the period since the mid-1990s serve as reminders of existing vulnerabilities.A collection of some of the world's leading hurricane researchers issued the following statement that reflects the current thinking on hurricanes and their potential impact (Emanuel et al., 2006):'…the possible influence of climate change on hurricane activity is receiving renewed attention. While the debate on this issue is of considerable scientific and societal interest and concern, it should in no event detract from the main hurricane problem facing the United States: the ever-growing concentration of population and wealth in vulnerable coastal regions. These demographic trends are setting us up for rapidly increasing human and economic losses from hurricane disasters, especially in this era of heightened activity. Scores of scientists and engineers had warned of the threat to New Orleans long before climate change was seriously considered, and a Katrina-like storm or worse was (and is) inevitable even in a stable climate. Rapidly escalating hurricane damage in recent decades owes much to government policies that serve to subsidize risk. State regulation of insurance is captive to political pressures that hold down premiums in risky coastal areas at the expense of higher premiums in less risky places. Federal flood insurance programs likewise undercharge property owners in vulnerable areas. Federal disaster policies, while providing obvious humanitarian benefits, also serve to promote risky behavior in the long run. We are optimistic that continued research will eventually resolve much of the current controversy over the effect of climate change on hurricanes. But the more urgent problem of our lemming-like march to the sea requires immediate and sustained attention. We call upon leaders of government and industry to undertake a comprehensive evaluation of building practices, and insurance, land use, and disaster relief policies that currently serve to promote an ever-increasing vulnerability to hurricanes.'It is not climate change that demands our attention, but the vulnerability of existing and planned transportation infrastructure to the existing climate. The damage potential from on-going demographic changes in coastal locations far exceeds that from even the worst projections of climate change induced alterations to the characteristics of the storms themselves (Pielke Jr., 2007)."References:Emanuel, K., et al., 2006. Statement on the U.S. hurricane problem, http://wind.mit.edu/~emanuel/Hurricane_threat.htmPielke, Jr., R. A., 2007. Future economic damage from tropical cyclones: sensitivities to societal and climate changes. Philosophical Transactions of the Royal Society A, doi:10.1098/rsta.2007.2086Wang, C., L. Hailong, S-K. Lee, and R. Atlas, 2011. Impact of the Atlantic warm pool on United States landfalling hurricanes. Geophysical Research Letters, 38, L19702, doi:10.1029/2011GL049265.					
Cato	Institute	Along with the current Figure 5.3 "Gulf Coast Transportation Hubs at Risk" add the figure (and caption) below to show the reader what the non-AGW rates of sea level rise are in the region.(Figure emailed to comments@usgcrp.gov as per instructions)	5. Transportation	5.3	203		The caption is consistent with Chapter 2: Our Changing Climate, which discusses the current state of science on sea level rise.
Cato	Institute	Box on Hurricane SandyWhat exactly is the point of this Box? There is no definitive science that links the path or intensity of Sandy to AGW. The only robust impact of AGW in the region was a sea level rise of about 6 inches. So, please recast your Box 2 in terms of what damage the extra 6 inches of sea level caused—everything else is chalked up to a natural occurrence independent from AGW and need not be included in the NCA as it gives the reader a false sense of reality.	5. Transportation		203	9	Though not attributable to climate change, the results of the storm were much in line with vulnerability assessments conducted over the past four years. We have modified the text to incorporate this information.
Cato	Institute	"Climate change…will also alter the stability of food supplies and create new food security challenges"Food supply is a function of production minus consumption. This statement is supported in the text by Lobell (2011), a paper (mis)titled "Climate Trends and Global Crop Production since 1980." The paper is actually about yield, which is the amount per planted or harvested acre. (Production is the product of yield multiplied by acreage.) So, while it is obvious that changes in temperature and	6. Agriculture		228	5	This statement reflects a general summary of the overall issues and is a synthesis of several papers and not attributed to any one single author. The main message is the stability of

		precipitation have detectable effects on yield, what really matters is how much is produced, which is reproduced below.(Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Global annual total production from maize, rice, soybeans, and wheat. Data source: Food and Agriculture Organization, United Nations, available at http://faostat.fao.org/site/567/DesktopDefault.aspx?PageID=567An exponential fit (Y = 2283.3 -2.32 (year) + .00059(year)2) to the global crop production is significantly better than a linear one, which demonstrates how insignificant the climatic component of global food production is. What's missing here? There's simply little, if any, effect of year-to-year global climate variability. That's because the world food system is highly diverse, in terms of varieties grown and the climates in which they grow. Further, there is a tremendous amount of reserve built into food supply because of the (stupid) diversion towards biofuels. In fact, the amount we divert to ethanol dwarfs the amount that is lost to climate. Lobell (2011) reported that, after allowing for the growth enhancement from atmospheric carbon dioxide, global average crop yields were reduced by a bit less than 1% (which is small compared to the amount that they increased because of technological advances) during the period 1980-2008.But consider this. The U.S. produces about 36 percent of the world's corn. And about 40 percent of U.S. corn is used to produce ethanol for use as a gasoline substitute instead of being consumed by humans or animals. Globally, corn makes up 30 percent of total worldwide production of the four crops studied by Lobell's group.And even this less than 1 percent impact was described by Lobell et al. as perhaps being "overly pessimistic" because it did not fully incorporate long-term adaptive farming responses to changing climate conditions (i.e., farmers are not as dumb as statistical models make them out to be).What this means is that even under overly pessimistic scenarios, we still currently burn more than 4 times as much grain as climate change has taken away. Thinking about this in future terms, if we observe twice as much climate change from 2010 through 2038 as we did from 1980 to 2008 (Lobell's study period), all we would have to do is stop burning half as much ethanol as we do now to make up for the entire global climate-related crop reduction. Therefore, climate is an irrelevant overlay on world food supply for the foreseeable future. If we really need the food, just stop the stupid conversion to ethanol.Obviously there is a lot of wastage in the world food supply from this stupid policy and any statement about the "stability of food supply" and "food security" challenges, is a result of the farm lobby and not climate. Why is this missing from the NCA?Reference:Lobell, D.B., W. Schlenker, and J. Costa-Roberts, 2011. Climate trends and global crop production since 1980. Science, 333, 616-620.					the food supply.
Cato	Institute	Internal inconsistency.The first sentence is correct. Supply affects price. The second sentence is misleading. Price is the way markets allocate production, and the global production data shown above clearly demonstrate that global weather can't conspire to drastically lower production.	6. Agriculture		228	31	We deleted the last sentence to make the statement more direct.
Cato	Institute	Nationwide, policy has become more important than climate in determining our food supply. This needs to be noted. Here's an example from Illinois:(Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Annual acres planted of corn and soybeans in Illinois. (Data from the National Agricultural Statitics Service, USDA)Corn and soybean acreage was roughly equal around 2000. The upward trend in corn acreage is a result of George Bush's ethanol mandate, not climate. As the mandate will continue to increase, the effect will be even larger in the future, as long as the ag lobby has its way.	6. Agriculture		231	8	Policy always has had an influence on food supply. The chapter makes no statement about the relative importance of policy and climate change on food supply. The chapter (and in fact the entire assessment) discusses policy only in citing that policy is one possible tool to mitigate and adapt to climate change.
Cato	Institute	This is highly misleading. No serious student believes that yields flat-lined in 2000. Instead, what these projections are, are detrended yields. The fact of the matter is that, even Lobell (2011) shows that the technological component of ag yields dwarfs the interannual weather (or climate) component. This caption should clearly indicate this. Why doesn't it?	6. Agriculture	6.4	232		There is no indication of a flat-lined yield in 2000, the caption clearly states that 2000 is the reference year. In this model the technology parameter was maintained as a constant.

Cato	Institute	If you really mean “perennial” crops, that’s a very tiny portion of the world’s supply. If you mean annual crops, this sentence is sooo 1970s. Genetic engineering speeds up varietal adoption by 20 years, and gives a much more predictable result than “selective breeding for both plants and animals.”	6. Agriculture		235	21	We have added a statement on genetic engineering.
Cato	Institute	Why is kudzu a concern?Yes it will take over open areas where it is not removed, but is there any demonstrable effect on southern crop yields as a result of it? That needs to be documented if this sentence is to stand.	6. Agriculture		238	15	This was used as an illustration of the changing demographics of weeds.
Cato	Institute	Um…wasn’t the switch to no-till (which conserves soil and water) responsible for a massive jump in glyphosphate use—an order of magnitude, at least, compared to maybe a doubling from enhanced carbon dioxide levels that we aren’t likely to see for 100 years (at least—thanks to shale gas)? Which is more important to agriculture, climate and weather or technology? (The answer is obvious).	6. Agriculture		238	21	Thanks for the comment. No change was made in the text. The current text is consistent with our assessment of the literature on this topic.
Cato	Institute	Absurd.Of course “a warmer world brings higher humidity in wet years.” Sounds like good weather for sugar cane to us. Seriously, we haven’t seen a demonstration that high dew points inhibit production—see Brazil, for example?	6. Agriculture		238	23	The text “a warmer world brings higher humidity in wet years” is no longer in the chapter.
Cato	Institute	You have to be kidding!This is what gives your opponents big shotguns against a large barn. It is simply nonscience to take one point (Des Moines) and display a graph with an obvious variance of at least two days, with a trend of slightly over one in 117 years, as if that means something.Remember that a “trend” that is not significant cannot be differentiated from a line with a slope of zero. In those cases, lines should never be drawn through data. This trend needs to be tested for significance. Normally we would do that but in this case it’s your job.	6. Agriculture	6.9	240		Recent frequent occurrences of such events at individual stations are consistent with the statistically significant upward trend of heavy precipitation events documented in the upper midwestern U.S (USGCRP SAP 3.3, 2008). We have modified the sentence to clarify this point.
Cato	Institute	The section on Food Security (and Key Point #5 of the Chapter) is terribly misleading.Food supply is a function of production minus consumption. This statement is supported in the text by Lobell (2011), a paper (mis)titled “Climate Trends and Global Crop Production since 1980.” The paper is actually about yield, which is the amount per planted or harvested acre. (Production is the product of yield multiplied by acreage.) So, while it is obvious that changes in temperature and precipitation have detectable effects on yield, what really matters is how much is produced, which is reproduced below:(Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Global annual total production from maize, rice, soybeans, and wheat. Data source: Food and Agriculture Organization, United Nations, available at http://faostat.fao.org/site/567/DesktopDefault.aspx?PageID=567An exponential fit (Y = 2283.3 -2.32 (year) + .00059(year)2) is significantly better than a linear one, which demonstrates how insignificant the climatic component of global food production is. Where’s the change in the “stability of food supplies”? As the climate has apparently become worse, negatively affecting yields (Lobell, 2011), productivity continues to increase exponentially.What’s missing here? There’s simply little, if any, effect of year-to-year global climate variability. That’s because the world food system is highly diverse, in terms of varieties grown and the climates in which they grow. Further, there is a tremendous amount of reserve built into food supply because of the (stupid) diversion towards biofuels. In fact, the amount we divert to ethanol dwarfs the amount that is lost to climate. Lobell (2011) reported that, after allowing for the growth enhancement from atmospheric carbon dioxide, global average crop yields were reduced by a bit less than 1% (which is small compared to the amount that they increased because of technological advances) during the period 1980-2008.But consider this. The U.S. produces about 36 percent of the world’s corn. And about 40 percent of U.S. corn is used to produce ethanol for use as a gasoline substitute instead of being consumed by humans or animals. Globally, corn makes up 30 percent of total worldwide production of the four crops studied by Lobell’s group.And even this less than 1 percent impact was described by Lobell et al. as perhaps being “overly pessimistic” because it did not fully incorporate long-term adaptive farming responses to changing	6. Agriculture		243	12	Thanks for the comments. After consideration of these points, we have decided to leave the Key Message as is. The section is consistent with the authors' assessment of the literature on this topic.

		climate conditions (i.e., farmers are not as dumb as statistical models make them out to be).What this means is that even under overly pessimistic scenarios, we still currently burn more than 4 times as much grain as climate change has taken away. Thinking about this in future terms, if we observe twice as much climate change from 2010 through 2038 as we did from 1980 to 2008 (Lobell's study period), all we would have to do is stop burning half as much ethanol as we do now to make up for the entire global climate-related crop reduction. Therefore, climate is an irrelevant overlay on world food supply for the foreseeable future. If we really need the food, just stop the stupid conversion to ethanol.Obviously there is a lot of wastage in the world food supply from this stupid policy and any statement about the "stability of food supply" and "food security" challenges, is a result of the farm lobby and not climate. Why is this missing from the Assessment?Reference:Lobell, D.B., W. Schlenker, and J. Costa-Roberts, 2011. Climate trends and global crop production since 1980. Science, 333, 616-620.					
Cato	Institute	Congratulations for rescuing this misleading chestnut from the 2009 report! It's only missing one thing: a crop. I suggest you substitute this one showing two perennial crops, Sherwood Idso and Eldarica Pine, under conditions of enhanced carbon dioxide.(Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Eldarica pines grown in increasing concentration of carbon dioxide clearly show growth enhancement.	6. Agriculture	6.10	244		The figure, "Herbicide Loses Effectiveness at Higher CO2" is no longer in the chapter.
Cato	Institute	Description of evidence baseInaccurate citation.The Assessment says: "Evidence that climate change will have impacts on crops and livestock is based on numerous studies and is incontrovertible (….Lobell et al., 2011)"Here's what Lobell et al., actually say: "However, we do not directly estimate the full set of adaptation possibilities that might occur in the long term under climate change (8). For this reason, we prefer to view these not as predictions of actual impacts, but rather as a useful measure of the pace of climate change in the context of agriculture."Note that the Assessment is in the future tense and Lobell et al., say that they do not view their findings as predictions, but "rather as a useful measure of the pace of climate change in the context of agriculture." Text should be changed to reflect what Lobell et al. actually said.	6. Agriculture		245		We added information to show this statement was based on the past responses of agriculture to climate change.
Cato	Institute	General CommentThis is a remarkably thin chapter, with little reference to a voluminous literature on growth enhancement that in general is in evidence from NDVI data. While the chapter is correct that this does not apply to many places in the western US (and southern Alaska), there is little doubt that there is a substantial greening of the eastern 2/3's of the lower 48 states. Why is so little attention paid to the possible causation of this salutary change? Does that alter the narrative?	7. Forestry				We have added another reference on satellite based forest growth trends.
Cato	Institute	Here is a typical paragraph that simply ignores a voluminous literature that can at least in part explain why at least the eastern 2/3 of the lower 48 states is greening so rapidly.Everything else being equal, rising temperatures and declining moisture availability, i.e., heat and drought, will lead to decreased tree growth (Karl et al., 2009). However, the increase in the atmosphere's CO2 concentration ameliorates and can compensate for these two phenomena by simultaneously increasing the optimal temperature for photosynthesis (Jurik et al., 1984; Long, 1991; McMurtrie and Wang, 1993) and the efficiency with which trees use water (Leal et al., 2008; Wyckoff et al., 2011; Brienen et al., 2011). The beneficial impacts of the rise in the air's CO2 content is demonstrated by the results of several studies of temperate trees (Tognetti et al., 1998; Paoletti et al., 2007; Wyckoff and Bowers, 2010) and boreal trees (Peltola et al., 2002; Bergh et al., 2003; Kostiainen et al., 2004). And this CO2-induced productivity stimulation is experienced by trees that are also experiencing water insufficiency (Knapp et al., 2001; Tognetti et al., 2002; Soule and Knapp, 2006) and very old age (Phillips et al., 2008; Laurance et al., 2009; Lewis et al., 2009).Very little attention is paid to the importance of management with regard to insect outbreaks, particularly Western Pine Beetle. Pine bark beetles are endemic over most of the continental US, and this endemicity results in sporadic (and sometimes severe and widespread) outbreaks. These create a patchy forest distribution that favors ecosystem diversity. The overlay of	7. Forestry		266	6	In response to the first comment. After consideration of this point, we still feel the existing text is clear and accurate. This section focuses on forest disturbances. Forest productivity is discussed in a later section and changes in forest growth are noted. Due to the size of the forest sector, and the page limit for the chapter, we focuses on broad trends rather than deleving too deeply or providing such a level of specificity. And because of this aspect, we have not chosen to include these citations. In response to the second comment on management with regard to insect

		more favorable climate conditions (warmer winters) increases the likelihood of severe outbreaks, such as those currently occurring in the Northwest.Severe outbreaks simply cannot be stopped in a heavily infested forest. However, management of non-infested areas greatly reduces the likelihood of a severe outbreak (Leatherman et al., 2011). The severe dieback of extensive stands of Northwest forest has a counterintuitive effect on severe crown fires. While it is a “rural legend” that these large areas of dead trees provide more fuel in an already fire-prone environment (a myth that the 2009 iteration of this report also uncritically propagated), in fact, modern research shows that pine beetle-killed forests result in less fuel to burn and actually suppress severe fires (Simard et al., 2011). References:Karl, T.R., Melillo, J.M. and Peterson, T.C. 2009. Global Climate Change Impacts in the United States. 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Geophysical Research Letters 28: 2657-2660.Tognetti, R., Raschi, A. and Jones M.B. 2002. Seasonal changes in tissue elasticity and water transport efficiency in three co-occurring Mediterranean shrubs under natural long-term CO2 enrichment. Functional Plant Biology 29: 1097-1106.Soule, P.T. and Knapp, P.A. 2006. Radial growth rate increases in naturally occurring ponderosa pine trees: a late-20th century CO2 fertilization effect? New Phytologist 171: 379-390.Phillips, N.G., Buckley, T.N. and Tissue, D.T. 2008. Capacity of old trees to respond to environmental change. Journal of Integrative Plant Biology 50: 1355-1364.Laurance, S.G.W., Laurance, W.F., Nascimento, H.E.M., Andrade, A., Fearnside, P.M., Rebello, E.R.G. and Condit, R. 2009. Long-term variation in Amazon forest dynamics. Journal of Vegetation Science 20: 323-333.Lewis, S.L., Lopez-Gonzalez, G., Sonke, B., Affum-Baffoe, K., Baker, T.R., Ojo, L.O., Phillips, O.L., Reitsma, J.M., White, L., Comiskey, J.A., Djuikouo K., M.-N., Ewango, C.E.N., Feldpausch, T.R., Hamilton, A.C., Gloor, M., Hart, T., Hladik, A., Lloyd, J., Lovett, J.C.,				outbreaks, particularly the western pine beetle. Due to the size of this topic, and the page limit for the chapter, we focused on broad trends with respect to management rather than delving too deeply. In later text, we noted that these disturbance events pose major challenges to forest managers and the implications to the forest sector.

		Makana, J.-R., Malhi, Y., Mbago, F.M., Ndangalasi, H.J., Peacock, J., Peh, K. S.-H., Sheil, D., Sunderland, T., Swaine, M.D., Taplin, J., Taylor, D., Thomas, S.C., Votere, R. and Woll, H. 2009. Increasing carbon storage in intact African tropical forests. Nature 457: 1003-1006.Leatherman, D.A., et al., 2011. Mountain Pine Beetle, Colorado State University Extension, http://www.ext.colostate.edu/pubs/insect/05528.htmlSimard, M., et al., 2011. Do mountain pine beetle outbreaks change the probability of active crown fire in lodgepole pine forests? Ecological Monographs, 81(1), 3-24					
Cato	Institute	No mention of important changes in tree demographics that are in an opposite sense to what is being reported in this paragraph.Johnson and Abrams (2009) explored growth rate (basal area increment, BAI) relationships across age classes (from young to old) for eight tree species commonly found throughout the eastern United States. They note, "a remarkable finding of this study is that even the oldest trees of several species had slow but increasing BAI values, which continued throughout the life of most trees…[which] contradicts the sigmoidal growth model that predicts growth rate should plateau and then decline, as middle age trees approach old age,"and"over the last 50-100 years, younger trees within a species grew faster than did the older trees when they were of the same respective age."Knapp and Soule (2011) also found this to be the case with ponderosa pine trees in the USA's northern Rocky Mountains.Johnson and Abrams (2009) wrote that their finding "may be due to a stimulatory effect of anthropogenic global change defined in the broadest sense," including "increased CO2 levels, warming temperatures, increased precipitation, and changes in precipitation chemistry," while noting that "yearly average temperatures, atmospheric CO2 and nitrogen levels have increased in the eastern US." Knapp and Soule went further, stating that "old-growth ponderosa pine forests of the northern Rockies have likely benefited from the effects of increased atmospheric CO2 since the mid-20th century," additionally noting that "the benefits increase with tree age."How could this paragraph ignore this?There is an extensive literature to resolve the speculation here, as well as an integrative measure of forest health/growth, namely the NDVI data published in various sources mainly by Mynini and Nemani at BU. Here's a blowup of the most recent (de Jong et al., 2012) version we could find. While this paper notes that there is a tendency for a decline in the greening and an increase in the "browning" over time on a global scale, the draft is about climate change impacts in the United States. (Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Global greening and browning in terms of normalized difference vegetation index changes between 1982 and 2008 (adapted from deJong et al., 2012)This section indicates a general tendency towards declining forest health/growth in the western US from climate change, and similar effects in the eastern US from pollution. Obviously, whatever is being forced in the eastern 2/3's of the US is associated with greening, not browning. This paragraph needs at least to note this. References:Johnson, S.E. and Abrams, M.D. 2009. Age class, longevity and growth rate relationships: protracted growth increases in old trees in the eastern United States. Tree Physiology 29: 1317-1328.Knapp, P.A. and Soule, P.T. 2011. Increasing water-use efficiency and age-specific growth responses of old-growth ponderosa pine trees in the Northern Rockies. Global Change Biology 17: 631-641.De Jong, R., et al., 2012. Trend changes in global greening and browning: contribution of short-term trends to longer-term change. Global Change Biology, 18, 642-655.	7. Forestry		266	14	The text has been revised to incorporate this perspective. The potential for increase forest productivity is noted. As stated, additional impacts of changing climate in absence of extremes is covered in the section on "Changing Carbon Uptake". We appreciate the suggested additional references, but feel the current references are appropriate and adequate given the chapter's space limitations.
Cato	Institute	Reiterate comment from Page 266, lines 6-12.	7. Forestry		267	10	In response to the first comment. After consideration of this point, we still feel the existing text is clear and accurate. This section focuses on forest disturbances. Forest productivity is discussed in later text and we noted here that forest growth

							is slowly accelerating. Due to the size of the forest sector, and the page limit for the chapter, we focused on broad trends rather than delving too deeply or providing such a level of specificity. And because of this aspect, we have not chosen to include these citations. In response to the second comment on management with regard to insect outbreaks, particularly the western pine beetle. Due to the size of this topic, and the page limit for the chapter, we focused on broad trends with respect to management rather than delving too deeply. In this section, we noted that these disturbance events pose major challenges to forest managers and the implications to the forest sector.
Cato	Institute	Bioenergy sectionWow. Deforestation doesn't contribute to an increase in atmospheric carbon dioxide? That seems to be the sense here. Whether wood is burned (oxidized) or decomposed (oxidized, slower) the result is largely the same. This section might as well be extolling the (nonexistent) virtues of ethanol; it's about that logical. We guess there are similarities between the two: both are subsidized buy-offs of large numbers of nominally republican landowners, both contribute atmospheric carbon dioxide, both will only supply a small amount of energy, and both cost much more than the alternatives.	7. Forestry		274	1	After consideration of this point, we still feel the existing text is clear and accurate. Deforestation contributes to atmospheric CO2 concentration, and that contribution has been declining over time. Worldwide the estimate for that contribution in 2008 was about 12% (9.9 Pg C yr -1) (La Quere etal. 2009). The bioenergy contribution question is largely one of incentives for appropriate management. When forest have no value, they are burned or used inappropriately. Bioenergy can be produced in a way that provides more benefits than costs or vice versa. We have added text with this clarification in the traceable account for this key message.
Luisa	Cristini	Please add degrees centigrades	2. Our Changing Climate		25	34	The National Climate Assessment uses units customarily used in the U.S. so that it will be readily understood by readers in the U.S.
Luisa	Cristini	Please add cm or mm. Although the report is mostly directed to US nationals, the use of the International System is always recommended. This facilitate the comparison with other international studies and reports (e.g., the IPCC AR5).	2. Our Changing Climate		26	30	The National Climate Assessment uses units customarily used in the U.S. so that it will be readily understood by readers in the U.S.
Luisa	Cristini	In this paragraph I would mention the World Meteorological Organization's recommendation to make climate statistics over a minimum of 30 years.	2. Our Changing		28	36	The section has been revised to incorporate this perspective.

			Climate				Additional information has been added to clarify the definition of climate. The WMO's recommendation of a 30-year period for climate statistics is noted in the Box in the Introduction.
Luisa	Cristini	Please add horizontal resolution in km!	2. Our Changing Climate		29	10	The National Climate Assessment uses units customarily used in the U.S. so that it will be readily understood by readers in the U.S.
Luisa	Cristini	Please add degrees centigrades	2. Our Changing Climate		31	20	The National Climate Assessment uses units customarily used in the U.S. so that it will be readily understood by readers in the U.S.
Janet	Van De Winkle	Constructive Critique of the NCA Midwest ChapterOverall, the Midwest chapter brings to light many important facets of the effects that climate change will have upon the Midwest. I believe the key messages largely are concise yet impactful. There are a few figures and points however, that merit further clarification and elaboration. First off, toward the end of the Introduction on page 619 lines 6 and 7, it reads "In 2011, 11 of the 14 U.S. weather-related disasters with damages of more than $1 billion affected the Midwest." Perhaps it would be useful to understand how much in damages directly affected the Midwest. Stating that 11 disasters with damages of more that $1 billion can sound misleading if say only a small fraction of the damages affected the Midwest. Additionally, having more specific numbers on damage in the Midwest is important in making decisions based on return on investment such as upgrading infrastructure. In Figure 18.2: "Temperature Details Show a Range of Changes", the titles and keys can be difficult to understand. For instance, the first graph "Annual Average Temperature" is clear because the time frame is stated. However on the other three graphs, it does not specify if the difference in number of days is on an annual basis. This could be misleading if a reader assumes this portrays over the next decade or even century. Additionally, the "Cooling Degree Days" graph has a key that ranges from 0-750 for "Difference in Number of Days". With no information on the time scale, it's very difficult to comprehend. Under the section on Energy-Intensive Economy, on page 626, it reads that there is an expected shift as a result of longer summers and more frequent heat waves to an increase in the number of cooling degree days. This increased demand for cooling by the middle of this century is projected to exceed ten gigawatts. Not addressed however, was the chance of experiencing less heating days, and if this would in part or totally offset the energy used for increased cooling days. In regards to the possibility of decreased lake levels as mentioned on page 632 on lines 12-19, there was no mention of thermal expansion that the Great Lakes would experience with rising temperatures. Though understandably, there is a level of uncertainty as to how the lake levels will respond to the effects of climate change, there are projections for water temperature to increase considerably in the next century as explained on pages 630 (lines 39-42) and 631 (lines 1-4). This information should be factored in or at least addressed to develop a more integrated model to reflect lake levels.	18. Midwest				1. Due to the size of the topic, and the page limit for the chapter, we focused on broad trends rather than delving too deeply or providing such a level of specificity. 2. The figure has been clarified. 3. Revisions have clarified the offsets of winter & summer energy demand shifts. 4. This basic fact is already included in all literature projections.

		These critiques can be addressed in a manner that will further the legitimacy of the effects climate change will have upon the Midwest. The emphasis on agriculture, grid capacity, and the energy intensiveness of the economy is well warranted as decision makers have the ability to create sweeping changes if fully informed of the vulnerabilities. Lastly, this chapter's emphasis on how the Midwest population is, and will be affected by its aging infrastructure, is a strength that should not be compromised in any revisions or editing.					
Luisa	Cristini	Excellent figure	10. Water, Energy, and Land use	10.3	396		Thank you for the comment.
John	Spielberg	I did not see anything in the report that included desertification as one cause of climate change. It may even be a major cause, as much as greenhouse gases, according to Allan Savory. His recent 2013 TED presentation (see http://www.youtube.com/watch?v=vpTHi7O66pI) suggests that desertification is a primary cause of climate change, and that slowing or reversing desertification by controlled grazing can help reverse climate change. He may be a bit overly optimistic that his method is the "only" way to slow or reverse climate change. However, if his method is effective in slowing climate change, then I don't see why it should not be included in a portfolio of solutions. Most solutions to difficult problems require attacking the problem from multiple fronts. Even the Food and Agriculture Organization of the U.N. seems to support grassland management as one means of dealing with climate change (see Conant, R. T., & Food and Agriculture Organization of the United Nations. (2010). Challenges and opportunities for carbon sequestration in grassland systems : a technical report on grassland management and climate mitigation. Rome: Food and Agriculture Organization of the United Nations.).					This comment about desertification is inconsistent with the author team's thorough assessment of the science. The physical and chemical drivers of climate change are very well understood, as described in the Commonly Asked Questions appendix.
John	Spielberg	Another thing I noticed has to do with citing references to support the various conclusions of the committee. None of the reference citations that I checked included page numbers. Page numbers associated with cited references may not be that necessary for small references, say 5 to 10 pages. But, for someone to check a 500-page document to see where it supports one of your conclusions would be very difficult. Adding page numbers would certainly entail another layer of effort, but not including page numbers could suggest to a reader that you are trying to hide something. Certainly, for a reviewer like me, the lack of page numbers associated with cited references makes it harder for me to check the rigor of your conclusions based on evidence.					Thank you for the suggestion. The references in the final document will adhere to the standard NCA format.
Jane	Heinze-Fry	Thank you for the tremendous amount of work dedicated to creating the National Climate Assessment. The report has made extraordinary progress since the 2009 report. As a science and environmental educator for 3 decades now, I look forward to continuing efforts to use web-based and social media to further the continuing education of the American public about Climate Change.While the NCA offers documentation that advances the first 3 strategic goals of the USGCRP, I see a missed opportunity to further Goal 4: "Communicate and Educate: Advance communications and education to broaden public understanding of global change and develop the scientific workforce of the future." One of the six objectives of the NCA itself is "Supporting climate-literacy and skilled use of NCA findings."In my view, then, the NCA is an opportunity to not only provide updated understandings of "state of climate change," but also to provide a status report of the National Climate Understanding and Skills by the American people. An educated people, according to D. Bob Gowin and other educational theorists, integrate their thinking, attitudes, and behaviors. Is there a way to both facilitate and document the education of the American public in regard to climate change? Can the NCA track a systemic educational response to climate change?Science Education Research. Some science education research about climate change is emerging. It would be helpful to have the NCCP portal give clear access to this research. CIRES, for instance, has published some common misconceptions about climate change.	1. Executive Summary				Thank you for your comments and your interest in climate literacy. There is a limit to the number of topics that could be adequately covered in this report, but a sustained assessment process provides adequate opportunities to address these topics in the future. This report will be available electronically, which provides plenty of opportunity for engagement through applications.

http://cires.colorado.edu/education/outreach/climateCommunication/CC%20Misconceptions%20Handout.pdf

Some of this information is available linked to the "Research on Student Learning" tabs of the National Digital Science Library Science Literacy Maps.

Further, as people communicate about climate change, they need to "know their audience." With the "Six Americas Report" and other publications, Leiserowitz et al at Yale University are making substantial progress in this regard. I would suggest that the North American Association for Environmental Education, the National Science Teacher's Association, the American Association for the Advancement of Science, the National Research Council and others are well-positioned to provide those insights and to develop that data.Standards: We are fortunate to have multi-agency documents on the Principles of Climate Literacy and the Principles of Energy Literacy to guide educators. "Communicating and Learning about Global Climate Change," An Abbreviated Guide for Teaching Climate Change from Project 2061 at AAAS is an excellent resource, linking firmly to the National Digital Science Library. The Next Generation Science Standards, which are rich in climate standards, were just released on April 9. It remains to be seen how many states will adopt these standards, but it would be useful to have continuing progress charted by the NCA about how many states have education standards that address the Climate Literacy Principles. It is the implementation of these standards that will require a systemic plan.For Teachers: Teachers need to be updated in their knowledge about climate change themselves and they need access to High-Quality Instructional Activities and Investigations to create their own courses.

Various sources are offering online climate change education. "MOOCs" offer an opportunity to reach larger audiences.

Carleton College provides resources that support "Designing an Effective Climate Change Course." The Climate Literacy and Energy Awareness Network is one superhighway to K-12 climate change activities and investigations vetted by both scientists and educators.

Can you create pathways to various resources that enable visualization of climate change based on different actions that are taken, such as John Sterman (MIT's) app for the iPad iPhone: "Climate Pathways." Can you create "superhighways" to innovative TED talks and Teachers Domain resources to teach/learn about climate change?For Learners: Can your portal enable American citizens to educate themselves and to move forward with responsible actions? It would help us as citizens if pathways for responsible choices and actions were made visible. Is there a way to design a website that citizens can put in their zipcode and access not only the "state of the climate" in their town, state, region, but also that they can access groups of neighbors, town committees, state committees, regional committees that are working on climate change issues. Can you highlight success stories in different regions to spread innovative ideas? Assessment. We need a sense of progress, that these innovations are making a difference and that our education and communication technologies can facilitate societal change at a rate that will make a difference to Earth's physical and biological changes being reported in the NCA. We need data-driven decision-making. Can you track jobs that address climate change and their rate of filling? If we don't have a measurement or baseline, how will we know that we are making progress?Please add a chapter that updates us on new climate change standards, science education research about climate change, vetted educational resources, and status of Americans' knowledge and skills regarding climate change. There are lots of bits and pieces of climate change education "out

		there." We need a portal to bring together quality resources we can build with. Please make these components part of the USGCRP portal.Thank you for advancing our understanding of Climate Change.					
Stella	Protopapas	Be specific in regards to what "devastated" means: number of deaths, loss in diversity. Some concrete data could assist in adding specificity.	8. Ecosystems, Biodiversity, and Ecosystem Services		300	22	"Devastated" has been replaced with "damaged". We do not have room to provide details.
Allie	Goldstein	Overall, the chapter conveys a clear picture of the likely consequences of climate change for agriculture in the United States. In general, the scope and order of the six key messages is logical: The first key message makes the important point that climate change has already disrupted agriculture in the United States and its consequences will be mostly negative over the next 25 years and beyond. Key messages two through four build on this premise by going through some of the specifics of what I assume are the most devastating impacts of climate change on agriculture: increased weeds, diseases, pests, and other stresses; extreme precipitation; and drought and heat. Key message five loops back to the beginning, making the point that agriculture has been able to adapt to the climate changes that are already occurring but that it will be challenging to keep up with the pace and scale of future change. Finally, key message six concludes the chapter with an outlook for food security—probably the closest-to-home potential consequence of climate change on agriculture for many Americans.Though the overall messages are strong, the structure of the chapter was confusing at times. As I detail in the section-specific comments, there were a few paragraphs and figures that seemed like they would fit better in a different section. For instance, the section on “Animal Response to Temperature Extremes” under key message one seems like it would fit better under key message four, which focuses on heat and drought. Similarly, Figure 6.10 on weeds and herbicide losses should go under either key point two on weeds or under key point five on ability to adapt. This slight rearranging may also reveal redundancies among sections, freeing up a little space. The wording of key message four should also perhaps be revised to reflect the focus on heat and drought specifically—not all weather extremes, since increased precipitation is actually discussed under the previous key message. There were a few instances (noted in the line-by-line comments) where the “Traceable Accounts” evidence included essential information that was not stated as clearly or succinctly in the body of the chapter; I would suggest moving these sentences up.The chapter is strongest when it first outlines the science and then uses specific examples to explain a general trend. For example, on p. 233, the authors write that, “corn yields were affected by high nighttime temperatures in 2010 and 2012 across the Corn Belt.” This specificity in time and place helps to make potential impacts real for readers. In other places, though, the evidence was less specific. The authors offer no substantiation, for instance, for their claim in key message six that climate affects food processing, storage, transportation, and retailing. This is a fascinating point and one that could be aptly illustrated with a specific example. Also ccontributing to a sense of vagueness is the fact that the word “increase” is used liberally throughout the chapter, often several times in a single sentence. If it is possible to alter or refine this language without overstating the message, this would help give readers a better sense of the magnitude and speed of the change—and would also just improve readability.There was one (implicit) premise of the chapter that I don’t necessarily agree with, and that is the assumption that our future food system will look very similar to our current food system in terms of (1) Americans’ diets and (2) food miles travelled. By avoiding these issues, the chapter authors seem to assume that the types of agricultural products produced in the United States (as represented in Figure 6.1) are immutable and that the trend of increasing imports and exports (as	6. Agriculture				Thanks for the comments. The revisions made in the process of addressing the comments address these concerns.

		represented in Figure 6.3) will continue on an exponential path. And yet climate change may nudge or force Americans to eat differently, either by shifting their diets from land- and water-intensive crops and livestock to less impactful ones, or by changing distribution routes for food. Perhaps a climate-changed world cannot support the scale of international shipping of produce that we have today, and food systems will become more localized over the next fifty years. Though it is not the goal or role of this chapter to "envision" any particular future food system, the key message on adaptation might allude to the idea that the future may not look like the present and that American diets and food distribution systems are already being affected by climate change. As a small example, I ate almost no apples last fall because of a March heat wave followed by a frost killed 90 percent of the buds in Michigan—perhaps a fluke, but perhaps an indicator that regional diets will need to change.					
James	Tolbert	Chapter 4 on Energy completely avoids any discussion of the largest effect of global change on energy production in the United States. Currently, energy production in the United States is dominated by burning fossil fuel and discharging the carbon dioxide into the atmosphere with no limitations on the amount of carbon dioxide that can be discharged and also no cost for the discharge of the carbon dioxide into the atmosphere. To stabilize global climate change, this will necessarily change over the next 25 to 100 years. Therefore, Chapter 4 is incomplete without some discussion that the largest change to our energy production over the next 25 to 100 years will most likely be related to our attempts to manage our carbon dioxide emissions. The Global Change Research Act, incorporated in the United States Code, Title 15, Chapter 56A - Global Change Research, includes the following two requirements for the National Assessment Report: • Analyzes the effects of global change on the natural environment, agriculture, energy production and use, land and water resources, transportation, human health and welfare, human social systems, and biological diversity • Analyzes current trends in global change, both human- induced and natural, and projects major trends for the subsequent 25 to 100 years. Changes to the refining capacity in the United States, or limitations on hydroelectric production are very minor compared to the actions that are contemplated in Chapter 27. Mitigation. Please revise Chapter 4 to include an analysis of the largest effect of global change on energy production in the United States over the next 25 and 100 years: our necessary movement away from the unrestricted discharge of carbon dioxide into the earth's atmosphere. Note: The only currrent reference to this issue appears to be on page 183, Lines 1 to 3.	4. Energy Supply and Use				We agree that future carbon emission constraints could have a significant influence on U.S. energy supply in the future. We have re-emphasized this point by the addition of a sentence at the end of the Introduction. We direct the reader to the discussion in the "Future Energy Systems" where the range of factors that influence energy system selection is addressed. Finally, while future regulatory constraints on carbon could have a major impact on energy system selection, this is not an established outcome. Innovations in technology and lower costs of production, such as in solar and hydraulic fracturing, may have a larger impact on energy production than carbon regulation.
Chris	Heuer	Responding to some of the comments may be beyond the scope of remaining work. If so, the comments should be considered suggestions for future work.	Appendix: The Science of Climate Change				We thank the reviewer for their comment. However, this chapter is an assessment of the current state of the science and is not intended to provide an analysis of future research needs. however, these comments will be taken into consideration when planning future assessments.
Chris	Heuer	On page 1144, climate sensitivity (i.e., doubling carbon dioxide from 280 to 560 ppm) is estimated to be 5.4°F. However, as discussed on pages 1121 and 1124, without 170 to 300 ppm of carbon dioxide, the greenhouse effect would not function, and the Earth would be 60°F colder. It appears much better to	Appendix: The Science		1120	20	The 60 degrees colder statement applies to a blackbody calculation of the temperature of the Earth with no

		err on too much rather than too little carbon dioxide.	of Climate Change				greenhouse gases in the atmosphere, including water vapor -- it is not just about CO2. We believe the reviewer did not understand the concept, so have clarified the text accordingly.
Chris	Heuer	In this sentence, "heat-trapping gases" specifically includes water vapor.	Appendix: The Science of Climate Change		1120	17	The sentence has been rewritten for clarity.
Chris	Heuer	In this sentence, "heat-trapping gases" appears to exclude water vapor.	Appendix: The Science of Climate Change		1121	10	The sentence has been revised for clarity.
Chris	Heuer	In this sentence, does "heat-trapping gases" include or exclude water vapor?	Appendix: The Science of Climate Change		1121	15	The sentence has been revised for clarity.
Chris	Heuer	(There are no line numbers for this figure.) Comment on how the atmospheric concentration of carbon dioxide is calculated based on the emissions in the figure. What assumptions are made by the GCM's about the distribution of carbon dioxide around the globe and with altitude.	Appendix: The Science of Climate Change	Figure 2	1122		In general, the concentrations of CO2 are calculated by carbon cycle models which take emissions as input, and calculate uptake by the ocean and biosphere. However, some Earth System Models do contain the full carbon cycle model processes internally and are calculating the CO2 changes directly. Carbon cycle models are carefully evaluated using tracers such as 14C to ensure they are able to simulate the observed flow of carbon through the Earth's climate system. GCMs typically begin with CO2 concentrations directly from observed concentrations and then use concentrations from carbon cycle models for future projections.
Chris	Heuer	Information about the global carbon balance would be useful? What are the natural sources and sinks? How do the natural and anthropogenic sources and sinks compare? How does calculated concentration compare to measured concentration? Could there be any unknown natural sources and sinks?	Appendix: The Science of Climate	Figure 2	1122		The figure caption has been expanded and overall more discussion on the carbon cycle added to the text, but there were limitations on what we could put in this report.

			Change				
Chris	Heuer	Over the last 50 years, warming due to carbon dioxide may only be about half of the total warming. The other half may be natural variability due to the AMO. See Tung and Zhou 2013 ("Using Data to Attribute Episodes of Warming and Cooling in Instrumental Records", PNAS,110, 2058-2063).	Appendix: The Science of Climate Change		1122	5	First, it is not just CO2 -- other heat trapping gases and black carbon particles are all important. Secondly, analyses with models accounting for all forcings, including the cooling effects of some particles, compare well with the observed temperature record (e.g., . several studies indicate that heat has heavily gone into the deep oceans over the last decade, which could be related to AMO or other ocean cycles, but that connection remains highly uncertain. The problem with the Tung and Zhou paper though is the lack of mechanism for their claim of the AMO accounting for effects on the trend is basically based on a curve fit without a recognized science basis. Finally, with many attribution studies citing human emissions as accounting for as much as 100%+ of observed warming and a single (non-mechanistic) analysis on the other suggesting they are only responsible for ~50% of the warming, we believe our discussion reflects the balance of the science on this issue to date.
Chris	Heuer	Over the past 800 k years, minimums in carbon dioxide occurred during glacial periods, while maximums occurred during interglacials. What caused the glacial periods - changes in total solar irradiance or changes in carbon dioxide? Did carbon dioxide lead or lag the change in temperature? Include a figure that shows the change in temperature from the same ice cores. Expand the time scale for a single glacial/interglacial cycle to illustrate leading or lagging.	Appendix: The Science of Climate Change	Figure 4	1124		Both. The relationship of Earth to the Sun caused about one third to half of the forcing to initiate the ice ages while the resulting changes to the carbon cycle then did the rest of the climate change.Since temperature is not shown on this figure, there is no leading or lagging to be shown, nor would it tell one anything really useful as just explained in the first sentence. This point is clearly explained in the CAQs.
Chris	Heuer	The figure shows that a change of about 1 W/m2 is important. Total solar irradiance is about 1,360 W/m2. Therefore, the system is very sensitive to small changes, which means small unknowns could be important. Do GCM's calculate total heat loss from the Earth to space? How do the results compare to satellite measurements?	Appendix: The Science of Climate Change	Figure 5	1127		After consideration of this point, we still feel the existing figure and caption are clear and accurate, given space limitations. The GCMs do calculate total heat transfers in the Earth-atmosphere system and the resulting

							spectra agree well with satellite data.
Chris	Heuer	If data is available from 1850, why does Figure 7 start at 1900? Mention the Hadley Centre Central England Temperature dataset that goes back to the 1700's. Figure 9 does go back to 1850.	Appendix: The Science of Climate Change		1128	8	This figure has been modified and now starts in 1850. Mention of a short European series seems superfluous to a US assessment or an assessment of global climate.
Chris	Heuer	Although, different research groups get similar results, it would be good to give the reader some sense of the complexity involved in calculating global average temperature. How does the number of stations vary with time and location, especially ocean versus land? How does the number of stations compare to paleoclimate reconstructions?	Appendix: The Science of Climate Change	Figure 7	1129		Too much detail for the current assessment given the charge we were given which was to produce a high level synthesis -- that material is readily found on the NCDC and other websites as well as numerous other assessments and peer reviewed papers, many of which are referenced in the assessment text.
Chris	Heuer	Explain why an anomaly (temperature difference) is used rather than just temperature. Why do different investigators use so many different references for their anomaly? That complicates comparing the results.	Appendix: The Science of Climate Change	Figure 7	1129		Since the mean annual average temperature varies by many tens of degrees across the globe, the use of a global mean temperature has very little connection to any particular place. However, changes in temperature relative to some base period ("anomalie") can be compared across regions and compared to a gobal mean value. The choice of a base period is somewhat arbitraary, often with a historical basis. We have no control on what others have chosen. The base periods for this report have been standardized so that all line plots use one reference period, and all maps another, across the entire report.
Chris	Heuer	There appears to have been some smoothing. If so, comment on the method used.	Appendix: The Science of Climate Change	Figure 7	1129		We have revised the figure. It just shows the annual averages for each of the datasets.
Chris	Heuer	What is the gray shading for land surface air temperature? Is sea surface temperature or marine air temperature used to calculate global average temperature? Is there a standard depth for sea surface temperature?	Appendix: The Science of Climate Change	Figure 9	1131		The grey shading has been removed with changes to this figure. It represented the ensemble spread of the CRUTEM4 product. SST is used to create the global surface temperature datasets for reasons discussed in the

							cited literature. There are numerous papers discussing the issue of sea surface temperatures - some of which are referenced in the assessment. The level of detail requested by the reviewer is inconsistent with the scope of the current assessment.
Chris	Heuer	Why not use all these datasets to validate the accuracy of GCM's?	Appendix: The Science of Climate Change	Figure 9	1131		The authors have considered this suggestion and still think it should be very clear from the figure on human influences apparent in many climate variables, and the associated Key Message that it is indeed the case that all of these variables and datasets - as well as others - have been used to assess the veracity of GCMs.
Chris	Heuer	It would be useful to include a temperature versus time chart for paleoclimate. Showing just the global average can mask important regional events such as the Medieval Warming Period and the Little Ice Age. See the differences for 90S to 30S versus 30S to 30N versus 30N to 90N in Marcott et al. 2013 ("A Reconstruction of Regional and Global Temperature for the Past 11.300 Years", Science, 339, 1198-1201).	Appendix: The Science of Climate Change		1133	1	We have heavily revised the paragraph relating to paleo analyses and added additional information to address reviewer questions and concerns.
Chris	Heuer	Why use 2 k years for the reference period? Figure 4 shows carbon dioxide data for 800 k years. The continents have been close to their current positions for millions of years. Over geologic history, the Earth has generally been warmer. For assessing the potential impacts of climate change, focusing on the last 2 k years is reasonable. However, for understanding climate mechanisms such as the effect of carbon dioxide, a much longer time is probably useful to consider. Are the causes of the last glacial/interglacial cycle (20 k years) well understood?	Appendix: The Science of Climate Change		1133	1	We have heavily revised the paragraph relating to paleo analyses and added additional information to address reviewer questions and concerns.
Chris	Heuer	The report states that "the warming of the last 100 years is unusual". Here "warming" must refer to warming rate rather than current global average temperature. Higher warming rates may have occurred over a longer time period. As time before present increases, the resolution of climate proxies decreases. Therefore, rates become more uncertain.	Appendix: The Science of Climate Change		1133	1	We have heavily revised the paragraph relating to paleo analyses and added additional information to address reviewer questions and concerns.
Chris	Heuer	Modes of natural variability (e.g., AO, AMO, ENSO, NAO, NP, PDO, PNA) depend on ocean circulation. How well do GCM's model ocean circulation? Is adequate data being collected for ocean circulation. Add a figure similar to Figure 6 for observing oceans.	Appendix: The Science of Climate Change		1134	18	We inserted a summary statement from Stoner et al. (2009) on climate models' ability to capture the major modes; also added a reference to Deser et al. (2012). An additional figure on ocean observing systems would deviate from the main thread of this discussion, and space is limited.
Chris	Heuer	Natural variability is "difficult to predict", but natural variability can have an important effect on temperature over decades. Therefore, 100 years of data may be needed for the effects of natural variability to "sum to zero". See Tung and Zhou 2013.	Appendix: The Science of		1135	6	Reference to Tung and Zhou (2013) and a statement about natural variability impacts on trends have been added to Key Message 3.

			Climate Change				
Chris	Heuer	Tung and Zhou 2013 argue that 1970 to 2010 is too short to determine the warming rate due to carbon dioxide.	Appendix: The Science of Climate Change	Figure 13	1137		Reference to Tung and Zhou (2013) and a statement about natural variability impacts on trends have been added to Key Message 3.
Chris	Heuer	Are we currently in a "warming hole"? There as been little warming of the global average temperature since 1998.	Appendix: The Science of Climate Change		1137	13	A sentence about this period has been added to the caption of the figure on long-term warming and short-term variation.
Chris	Heuer	Averaging different GCM results to average out errors in each model is not a good way to build confidence in the results.	Appendix: The Science of Climate Change		1138	7	The averaging removes natural variations, which are not errors. Each GCM simulation represents a different possible reality within the constraints of external forcing. The removal of randomly occurring natural variations facilitates identification of the externally forced signal.
Chris	Heuer	The observations do not appear to be 10-year averages as stated in the caption.	Appendix: The Science of Climate Change	Figure 16	1141		Agreed. The caption has been revised to incorporate this suggestion.
Chris	Heuer	All the charts show an increase in the warming rate in the 1970's. That aligns nicely with an increase in the slope of carbon dioxide concentration versus time. Temperature lags slightly in time, which is reasonable. However, since about 1998, measurements have shown little warming in global average temperature, while predictions continue to increase. Predictions are now diverging from measurements. The next few years of data will be very interesting.	Appendix: The Science of Climate Change	Figure 16	1141		The issue of the temperature increase hiatus is discussed in Chapter 2 through added text. We thank the reviewer for the observation.
Chris	Heuer	There are significant differences between the continents. Therefore, comparing measured versus predicted temperature by continent is a much stronger test than just using global average temperature. Comparisons should also be performed for different regions of the Atlantic and Pacific and using downscaled results, some specific locations with long historical records.	Appendix: The Science of Climate Change	Figure 16	1141		The entire ocean has been evaluated in this way, but not the individual areas of the oceans. Dynamically-downscaled model results are not available for the entire late 19th/20th Centuries and for all of the global area; even if they were, the surface temperature in such simulations is heavily constrained by the driving global models and would not provide an independent test. Likewise, comparisons for individual stations

							have not been done.
Chris	Heuer	Since it would be easy, why not report temperature versus carbon dioxide assuming no feedback mechanisms? Would that be a lower bound on future warming?	Appendix: The Science of Climate Change		1144	3	We have added additional information on warming without feedbacks, but do not view that number as a lower bound as the literature is clear that the net feedback effects are positive.
Chris	Heuer	Clouds, albedo, and uptake of carbon dioxide are listed as important feedback mechanisms. What data collection programs are underway for these mechanisms? When will adequate data be available to check the accuracy of GCM's.	Appendix: The Science of Climate Change		1144	9	This is a broad topic that is the subject of current investigation; text has been added that mentions this.
Chris	Heuer	If it is appropriate to average future projections over 20 to 30 years, then historical comparisons of measured and predicted temperatures should also use such averages. Thirty-year averages would be consistent with climate normals.	Appendix: The Science of Climate Change		1145	2	The authors refer the reviewer to the emissions, concentrations, and temperatures projections figure (in Key Message 5), in which changes corresponding to each scenario are clearly delineated. From this figure, it is clear that RCP6.0 is closest at 2100 to SRESA1B. RCP4.5 is closest to SRESB and RCP8.5 is indeed close to SRESA1FI. This information has been added to the caption for the figure. For the figure on projected wintertime precipitation changes, the most accurate statement is that RCP8.5 is on a higher trajectory than SRESA2 (which is adequately sampled, as compared to SRES A1FI, which is not); this information has been added to the caption for the figure.
Chris	Heuer	The reason for "averaging many models" is not discussed.	Appendix: The Science of Climate Change		1152	2	Point taken. Added text about reasons for model averaging.
Chris	Heuer	It should be possible to use a simple model with a uniform Earth, a uniform atmosphere, and constant solar forcing to illustrate the sensitivity of equilibrium temperature to carbon dioxide concentration.	Appendix: The Science of Climate Change		1152	5	This comment is inconsistent with the current state of the science on this topic. The climate system is far too complicated to gain policy relevant scientific information in this manner. Climate sensitivity is discussed in the revised Chapter 2.
Chris	Heuer	How are the initial conditions for a GCM established?	Appendix		1152	9	Today's climate models are carefully

			: The Science of Climate Change				initialized using techniques to ensure correct interactions among the atmosphere, oceans, and land surfaces (e.g., see IPCC AR4 or Stouffer et al., 2004). Most of the models do not use flux corrections between the atmosphere and oceans used in earlier models. In general, climate change projections are a boundary value problem. Analyses are done both numerically and theoretically to ensure that initial conditions do not affect the projections. Space limitations preclude our discussing and addressing this question in the text.
Chris	Heuer	There must be important unknowns. Although GCM's model ocean currents, they cannot predict natural variability that depends on ocean circulation.	Appendix : The Science of Climate Change		1152	25	Models do capture most of the known modes of natural variability but the capabilities do vary from model to model. The latest high resolution global ocean models, when suitably forced at the surface, reproduce observed modes of natural variability. See previous reference to Stoner et al 2009 and Deser et al 2012.
Chris	Heuer	Give a few examples of "abrupt changes". On page 1133 it was stated that the recent warming rate is "unusual" relative to the last 2,000 years.	Appendix : The Science of Climate Change		1152	25	Have added a reference to a National Research Council report entitled "Abrupt Climate Change: Inevitable Surprises" and to the CAQ that discusses abrupt climate change.
Chris	Heuer	How important are the cloud-related parameterizations? Were they tuned to improve the match between measured and predicted temperature? The recent CLOUD experiment at CERN indicted that cosmic rays can affect cloud formation. How might that change the existing parameterizations?	Appendix : The Science of Climate Change		1152	34	The CERN/CLOUD results (e.g., Kirkby et al., 2011, Nature) are part of the much broader research enterprise to improve parameterizations of clouds in climate models. While we considered citing it, the effect of cosmic rays on cloud parameterizations are relatively small in comparison to the effects of other research (e.g., Randall's work with cloud-resolving models) that we feel this goes beyond the scope of the present key message.
Chris	Heuer	If there are 35 different GCM's, there must be many different ideas on how to model climate change. Does that indicate uncertainty in the science?	Appendix : The Science of		1153	13	In the sense that different parameterizations are used in different models, the answer is yes. However, some models (subsets of the

			Climate Change				35 models) use the same or very similar parameterizations of particular processes, so the uncertainty is not as large as if there were 35 completely different models. Space limitations preclude our discussing and addressing this issue in the text Please see also the response to comment 33306.
Chris	Heuer	Mention what parameters other than global average temperature were considered by Randall for historical comparisons. Considering only global average temperature is a relatively weak test. It also does not address accuracy of predictions for state and local actions.	Appendix: The Science of Climate Change		1153	18	Added a statement that model evaluations are dependent on the variable or metric, and cited the relevant paper of Reichler and Kim (2008).
Chris	Heuer	Three categories are used to describe agreement between GCM's. Category 3 is the strongest agreement but only requires 67% of the models to agree on the sign of the change. That is not consistent with the statement that all simulations of the future predict warming.	Appendix: The Science of Climate Change		1153	19	The cited section of text does not mention Category 3. We say simply that all models predict warming over the course of the coming century -- and all models do project higher global and regional temperatures by the end of the century.
Chris	Heuer	If there are a number of databases with downscaled results, why not present some comparisons of measured and predicted temperatures for several specific locations. Provide references for the databases.	Appendix: The Science of Climate Change		1154	9	The point of statistical downscaling is to train a model to match observed climate at a given location. Any mismatch between modeled and observed temperature, precipitation, or other downscaled variable is primarily due to shortcomings in the model's statistical algorithm, and only secondarily (for a very poor quality GCM such as BCCR-BCM2) due to GCM inability to simulate reasonable climate. Text has been added to make this point. Additional references have been added.
Chris	Heuer	Explain "ensemble with at least three experiments". Indicate the timing of CMIP3 and CMIP5 GCM's.	Appendix: The Science of Climate Change	Figure 23	1157		Deleted the mention of the ensemble; added statement about timeframes of CMIP3 and CMIP5.
Chris	Heuer	Comment on how the different components were validated as they were added. How did the predictions change as components were added?	Appendix: The Science of	Figure 23	1157		These topics would be interesting to include, but they go beyond the scope of the Key Message and would require extensive space that we do not have

			Climate Change				available in this section.
Allie	Goldstein	Key message 1: Increasing Impacts on AgricultureThis is the longest section, and it's a bit unwieldy. Overall, I thought this key message might have done more to dispel the two common arguments as to why climate change will be positive for agriculture: (1) the idea of CO2 fertilization and (2) the idea of longer growing seasons. For instance, on p. 237, it might be helpful to specify in what ways the experiments on elevated CO2 concentrations have yielded mixed results for plant growth; the authors only write that the magnitude of CO2 growth stimulation for crop and tress species is "relatively well understood." What is the range of results from the various studies cited? Also, while the section on decreased cooling days does help to add nuance to the incorrect assumption that growing seasons will be longer for all crops, the points about growing season are scattered over several paragraphs. The point that only some crops in some regions will benefit from a longer growing season could be made more clearly. Both of these clarifications would help to communicate the key message that climate change means mostly negative consequences for agriculture.A few specific suggestions to help narrow/clarify the scope of this key message: • Overall, it would have been helpful to break the section up into subheads (Impacts on Crop Yield, Impacts on Livestock, etc.). • The point on p. 235 that temperatures of 1.8 to 7.2 degrees Fahrenheit moderately reduces vegetable yields while temperatures above that lead to die-off should also perhaps be made earlier or more prominently—this adds some specificity to the claims made throughout. • There is a very long section on chilling days (p. 235 – 236) that could probably be condensed unless this is really one of the most important consequences of climate change on agriculture. • The section on "Animal Response to Temperature Extremes" could actually fit well within the Heat and Drought section. This section should include much of the paragraph above the subhead as well. • Should Figure 6.3 on exports and imports be moved to the food security section? That is the section that deals more with trade.	6. Agriculture		228	18	We appreciate the constructive comments. We added section headers.
Allie	Goldstein	Key message 2: Weeds, Diseases, and PestsThis section makes the key point—that weeds might benefit more from CO2 fertilization than crops—upfront, which is helpful. The price tag of $11 billion/year already spent on weed control is also quite convincing that this could be a very costly problem. The second paragraph on the potential increase in diseases is also well laid out. Might there also be something to say about these diseases migrating north, beyond their typical range? I thought the points in the "Traceable Accounts" section about pests having "increased overwinter survival" and fitting "more generations into a single year" should have also made it into the text of this section.	6. Agriculture		238	10	Thanks for the comment.
Allie	Goldstein	Key message 3: Extreme PrecipitationThis is an interesting section, and I think the examples used help to illustrate why, even if annual mean rainfall doesn't change under climate change conditions, the frequency and intensity of precipitation events is extremely important. (Though the subheading should probably include "Soil Loss" as well as "Extreme Precipitation" to reflect the scope of the section.) In terms of structure, it seems that the third paragraph in this section about how increased precipitation increases erosion and soil loss might actually go first—talk about the mechanism of change first and then the impacts in terms of ecosystem services affected. The clarification in the "Traceable Accounts" section that soil erosion impacts are well-known whereas where and to what extent increased precipitation will actually occur is more uncertain seems to be a key point—could this be moved up	6. Agriculture		238	34	We have modified the section heading and moved the paragraph.

		into the chapter text?					
James	Tolbert	Lines 1 to 3 on Page 183 appear to be the only reference to the largest effect of global change on energy production in the United States. Currently, energy production in the United States is dominated by burning fossil fuel and discharging the carbon dioxide into the atmosphere with no limitations on the amount of carbon dioxide that can be discharged and also no cost for the discharge of the carbon dioxide into the atmosphere. To stabilize global climate change, this will necessarily change over the next 25 to 100 years. This one sentence appears to deserve an entire section within Chapter 4 to discuss the largest expected change to our energy production over the next 25 to 100 years which will most likely be related to our attempts to manage our carbon dioxide emissions. The Global Change Research Act, incorporated in the United States Code, Title 15, Chapter 56A - Global Change Research, includes the following two requirements for the National Assessment Report: • Analyzes the effects of global change on the natural environment, agriculture, energy production and use, land and water resources, transportation, human health and welfare, human social systems, and biological diversity • Analyzes current trends in global change, both human- induced and natural, and projects major trends for the subsequent 25 to 100 years. Please revise Chapter 4 to include an analysis of the largest effect of global change on energy production in the United States over the next 25 and 100 years: our necessary movement away from the unrestricted discharge of carbon dioxide into the earth's atmosphere.	4. Energy Supply and Use		183	1	We agree that future carbon emission constraints could have a significant influence on U.S. energy supply in the future. We have re-emphasized this point by the addition of a sentence at the end of the Introduction.
Allie	Goldstein	Key message 4: Heat and DroughtPerhaps "weather extremes" in this key message should be narrowed to just "heat and drought" since extreme precipitation is discussed in the previous section. Overall, though, this section did a good job of illustrating the critical issue of timing: extreme heat or drought can be disastrous for food production if it occurs at an essential stage in the life cycle of a plant or animal, such as during pollination. Since the paragraphs on p. 237-238 are mostly about animal response to extreme heat, I thought that those paragraphs should perhaps be moved down under this key point.	6. Agriculture		241	20	Thank you for the comment.
Allie	Goldstein	Key message 5: Rate of adaptationI thought this section did a good job of mentioning some of the "hopeful" sustainable agriculture practices currently being adopted while highlighting the potential constraints to adaptation: the magnitude and speed of some changes may simply be too great for our agro-ecosystems to overcome. The statement about how "climate risk" compounds with all of the other risks—financial, regulatory, etc.—that producers already deal with is an important one. Another example or two in this section would have been helpful. For instance, is there a physiological limit of corn that we may hit up against in the future, even though we have been able to adapt the species to climate conditions up until now? Right now, the points made are a bit abstract. Also, on p. 241, it seems remiss to talk about the continual adaptation of U.S. agriculture and "steadily increased productivity" over the past century without mentioning increased pesticide and fertilizer use after World Ward II. These chemical inputs were a huge factor in increasing food production, and our food system was transformed because of them.Again, a pair of sentences in the "Traceable Accounts" section was clearer and more succinct than any statement made in the actual text. I would move these sentences up, perhaps right to the beginning of the section: "Much of the economic literature suggests that in the short-term producers will continue to adapt to weather changes and shocks as they always have, with changes in the timing of field operations, shifts in crops grown, and changing tillage or irrigation practices, for the case of crop production. In the longer term, however, existing adaptive	6. Agriculture		242	3	We modified this section by revising the opening paragraph to discuss additional examples of adaptation limitations that were mentioned in the traceable account. An extensive assessment of the need for and timing of a transformation of the agricultural system is beyond the scope of the chapter given space limitations.

		technologies will likely not be sufficient to buffer the impacts of climate change without significant impacts to domestic producers, consumers, or both.”					
Allie	Goldstein	Key message 6: Food SecurityThis is an interesting key message and one that I imagine many readers care a lot about. The section does a decent job of capturing some of the nuance of food security in a short space and making the point that climate change will exacerbate socioeconomic problems that already exist. The authors bring up the interesting dynamic that the globalization of the food system may both buffer against impacts and transmit shocks globally. However, there was not actually much discussion of climate change effects on food processing, storage, transportation, and retailing except in the bolded statement—it would be interesting to add an example or two to the text. I was also wondering whether Figure 6.3 on U.S. Agricultural Trade would make more sense in this section?	6. Agriculture		243	12	Thanks for the comments. Given chapter space limitations, an in-depth discussion on impacts to food processing, storage and transportation is outside the scope of this chapter assessment. Chapter 5 of this report however covers impacts to transportation.
James	Tolbert	Williams et al. 2012 appears to be one of the only references regarding mitigation instead of adaptation. This appears to be a very un-even balance within all of Chapter 4 where the dominant discussion is on possible disruptions that will require adaptation; whereas the dominant change over the next 25 to 100 years for Energy in the United States is clearly a shift to adjust to mitigation strategies discussed in Chapter 27 of the Draft NCA as the unregulated, unpriced discharge of carbon dioxide into the atmosphere is eliminated. I suggest that the authors provide a more balanced set of references relating to the most likely changes to Energy in the United States over the next 25 to 100 years.	4. Energy Supply and Use		192	15	The charter for this chapter is an assessment of the potential physical impacts of climate change to U.S. Energy Systems. Carbon emission reduction (mitigation) opportunities are primarily addressed in Chapter 27 - Mitigation. Improvements in efficiencies (which will result in reduced carbon emissions) in energy, cooling, manufacturing, irrigation and water distribution/reuse are identified in Table 4.2 of this chapter as Adaptation Actions in the Energy Sector.
Allie	Goldstein	This sentence makes it seem as if the increased production in U.S. agriculture over the last century was due to adaptations such as crop rotations, genetic selection, and water management, when in fact increased chemical inputs (fertilizers and pesticides) played a very large role.	6. Agriculture		228	1	We have added fertilizer management and pest management to the sentence for clarification.
Allie	Goldstein	The word “profitability” is strange here—the ultimate goal is to “feed the world,” not necessarily increase profitability. Maybe “ensure food security.”	6. Agriculture		228	17	We have reworded the text in response to this and Comment ID # 8931 to add more clarification.
Allie	Goldstein	After “for the next 25 years,” maybe add a short phrase about expected temperature increase in the United States within this time period. By the middle of the paragraph we learn that temperatures are expected to increase 1.8 to 5.4 degrees Fahrenheit by mid-century, but it would be nice to know the 25-year projection upfront.	6. Agriculture		228	23	The opening sentence of the paragraph has a reference to Chapter 2: Our Changing Climate where these are discussed. No change is needed.
James	Tolbert	Under the "summer precipitation" columns there are numbers with no units. I assume these are inches but the text does not define them. All other units appear to be defined. The table presents weather and sea level related challenges and opportunities but misses a major point - challenges and opportunities related to the emissions from energy generation. The table appears to completely sidestep the need to change our energy production away from CO2 emitting sources. I categorize this as a major flaw in the presentation in Table 4.3.	4. Energy Supply and Use	4.3	181		The percentage sign refers to a seasonal increase without specific units. Carbon emission reduction (mitigation) opportunities are addressed in Chapter 27 - Mitigation.
Allie	Goldstein	The color scheme could more clearly convey that about half of the value is attributed to crops and the other half to livestock. As is, the reader would not understand this from the figure without reading the caption. Also it is not clear what “value” means—perhaps each slice of the pie should include a label with the dollar value?	6. Agriculture	6.1	229		Thank you. We have changed the figure to incorporate your suggestion.

Allie	Goldstein	This figure is too small to read and not very informative. Perhaps the map in the top right corner (the market value of agricultural products sold in 2007) could be made larger and combined with Figure 6.1, which is also about the value of agricultural products. The other 11 maps that show the distribution of different crops and livestock across the United States could conceivably be combined into one, with different colored dots for each item and a master key explaining what the dots represent. Such a map would be much more readable and visually interesting. Also: it is not clear to me why these 11 items in particular were selected since they do not match up with the categories presented in Figure 6.1. The title of Figure 6.2 or its caption should explain this (why apples, alfalfa, etc.?).	6. Agriculture	6.2	230		Thank you for your comment. The purpose of the figure is to indicate the geographic distribution in commodity production. The suggestion of an overlay for a map produces a nearly incomprehensible graphic, thus no change was made.
Chris	Heuer	How many different models and how many different simulations were used to generate the CMIP3 and CMIP5 historical curves. The curves are much smoother than the mean calculated curve report in AR4 2007, Figure 1, page 600, chapter 8, Climate Models and Their Evaluation.	2. Our Changing Climate	Figure 2.3	33		The 13 point IPCC AR4 filter was applied to these curves. Surprisingly it is not used on that particular AR4 figure. The motivation is to highlight the human contribution of the temperature change. The noise in the AR4 figure mentioned has no interpretable meaning.
Chris	Heuer	This is the only figure that compares measured and predicted temperatures. More such comparisons are needed. How do individual models compare to measured data? What are the comparisons for different regions and specific locations? One good specific location would be the Hadley Centre Central England Temperature dataset that goes back to the late 1700's. What about comparisons for longer periods using paleoclimate data? What about comparisons of parameters other than temperature?	2. Our Changing Climate	Figure 2.3	33		We appreciate the suggestion, but space is limited. The author team has deliberated and agreed on the most important information/illustrations to include. We refer those interested in a deeper treatment of the topic to the provided citations, including IPCC AR4/5.
Chris	Heuer	The calculation of average global temperature from measurements is quite complicated. As shown in Figure 2 of Appendix 2, different research groups get similar results, which is positive. Nevertheless, it would be good to give the reader some sense of the complexity involved.	2. Our Changing Climate	Figure 2.3	33		We appreciate the suggestion, but space is limited. The author team has deliberated and agreed on the most important information/illustrations to include. We refer those interested in a deeper treatment of the topic to the provided citations, including IPCC AR4/5.
Chris	Heuer	It would also be useful to provide statistics based on individual stations. For example, calculate warming rate from 1900 and 1950 and from 1950 to 2012 for each station with an adequately long record. What are the distributions of warming rate? How does warming rate change with time? Any temperature adjustments should be the same as for calculating the global average temperature.	2. Our Changing Climate	Figure 2.3	33		We appreciate the suggestion, but space is limited. The author team has deliberated and agreed on the most important information/illustrations to include. We refer those interested in a deeper treatment of the topic to the provided citations, including IPCC AR4/5.
Chris	Heuer	The historical curve should be updated through 2012. Comment on way recently the predictions show more warming than the data.	2. Our Changing Climate	Figure 2.3	33		We appreciate the suggestion, but the figure effectively illustrates natural and human contributions to climate change without adding data for 2012. The authors have deliberated and agreed on the most important

							information to include. The figure has been removed from Our Changing Climate but remains in the Appendix of FAQs.
Allie	Goldstein	Were these dollar values converted back to a common equivalent, such as 2010 dollars? This needs to be specified in the caption, otherwise the figure is unhelpful.	6. Agriculture	6.3	231		These are adjusted dollar values. We have modified the caption to indicate this.
Allie	Goldstein	Add “and” between “soil water.”	6. Agriculture		231	17	After consideration of your point, we feel that the current wording is adequate and appropriate.
Allie	Goldstein	It is unclear whether “upper and lower boundaries for growth” refers to boundaries as to when the plant will/will not grow or boundaries that dictate how large the plant will grow.	6. Agriculture		231	12	We have reworded the text to incorporate this suggestion.
Allie	Goldstein	I’m not sure if this is the best figure to include here given that (a) it is specific to California crops and (b) it deals only with temperature, and the previous sentence indicated that production is affected by soil and water changes more than it is changes in temperature. If kept, the figure caption needs to explain what the A2 and B1 emissions scenarios are in terms of actual CO2 projections; the current description is too vague.	6. Agriculture	6.4	232		This example is meant to be an illustration of the potential impacts on different crops within the same geographic region. We have added this clarification in the caption.
Allie	Goldstein	Though I understand that this is the only divergent scale, it looks a little strange to have the “change in number of dry days” map in a different color scheme than all the rest.	6. Agriculture	6.5	243		Thank you for your comment, however we would like to preserve the original color scheme for this map to be consistent with similar maps found in other chapters of this report.
Allie	Goldstein	Why is solar radiation decreasing in agricultural areas?	6. Agriculture		235	12	Reduction in solar radiation in agricultural areas is due to increased clouds and humidity. We have modified the text to indicate this.
Allie	Goldstein	Perhaps the section on the limitations of selective breeding could be moved under key point 5, on the limits of adaptation.	6. Agriculture		235	16	Thank you for your comment. After consideration of your suggestion, we still feel the current text on selective breeding fits appropriately under Key Message 1 regarding impacts on livestock and crops.
Allie	Goldstein	What is the temperature definition of “chilling” for the particular fruits implied in this figure? The figure seems a bit abstract without this information.	6. Agriculture	6.6	236		We have added the exact temperature value to the text.
Allie	Goldstein	Remove comma after “gases”	6. Agriculture		236	13	Thank you. We have incorporated this editorial change.
Allie	Goldstein	This paragraph is very important but is written mostly in passive voice and it is difficult to follow the logic of the sentences. I would suggest reordering and rephrasing the sentences. What about: “The impacts of elevated CO2 on grain and fruit yield and quality are mixed. Some experiments have documented that elevated CO2 concentrations can increase plant growth while increasing water use efficiency. The magnitude of CO2 growth stimulation for crop and tree species in the absence of other stressors has been extensively analyzed and is relatively well understood; however, the interaction	6. Agriculture		237	1	This section was rewritten for better clarity in response to this and other comments.

		among increased CO2, changing temperature, and water and nutrient constraints creates uncertainty in the magnitude of these responses. In plants such as soybeans and alfalfa, elevated CO2 conditions have been associated with reduced nitrogen and protein content, causing a reduction in grain and forage quality, and reducing the ability of pasture and rangeland to support grazing livestock. Because the growth stimulation effect of CO2 has a disproportionately positive impact on several weed species, this effect will contribute increased risk of crop los due to weed pressure."					
Allie	Goldstein	This heading should probably go above the previous paragraph (between lines 18 and 19). The information in these first two paragraphs about animal response is somewhat repetitive and could be condensed. Alternatively, these paragraphs on animal response to heat could simply be moved under key point 4.	6. Agriculture		237	34	We have added a subheading in a different paragraph.
Allie	Goldstein	Maybe add, "Since warm air holds more water," before this sentence just to bring the point home.	6. Agriculture		238	23	The text on higher humidity in wet years is no longer in the chapter.
Allie	Goldstein	Would it be important to mention here that erosion also depends on the slope of the land, not only rainfall?	6. Agriculture		239	16	After consideration of this point, we have decided to keep the text as is. Erosion is a function of a number of factors; however, changing rainfall intensity is the one primarily related to climate change.
Allie	Goldstein	Though it is important to state that changes in production practices actually have a larger-in-magnitude effect on soil erosion than climate change, this paragraph could have done more to make the point that climate change will only exacerbate the problems that are already occurring.	6. Agriculture		241	7	We have revised the text in response to this comment and added more detail on the erosion processes.
Allie	Goldstein	Awkward phrasing here. Maybe begin with, "By the end of this century…" Also, why is this sentence a new paragraph?	6. Agriculture		241	32	We moved and modified the sentence to address this comment, and added more detail to this section.
Allie	Goldstein	I'm not sure why biofuel production is an "adaptation" to climate change. This statement is controversial at best.	6. Agriculture		242	15	Thanks for the comment. After consideration of this point, we have decided to leave the statement as is but did add a phrase on land use change. The statement reflects the literature cited, discussed in more detail in Chapter 10: Water, Energy and Land Use.
Allie	Goldstein	Change "changes" to "changing" or "altering" (the gerund form makes more sense here).	6. Agriculture		243	25	We have reworded the text to address this comment.
Allie	Goldstein	When did the doubling of the FAO price index occur?	6. Agriculture		244	3	We added the year to the sentence.
Allie	Goldstein	This figure should probably go under key point 2 (Weeds, Diseases, and Pests). Also, the person in the red shirt on the left-hand picture is a bit distracting—could the photos be cropped to eliminate this?	6. Agriculture	6.10	244		The figure, "Herbicide Loses Effectiveness at Higher CO2" is no longer in the chapter.
James	Tolbert	P 621 line 12-13 references Michigan's tart cherry crop in 2012. This can also add additional flowering fruit crops in Michigan. I encourage the authors to cite the actual production of fruits in Michigan. The list below was queried from http://quickstats.nass.usda.gov/results/. National Agricultural Statistics	18. Midwest		621	12	We appreciate the suggestion, but space is limited. The author team has deliberated and agreed on the most

		Services, USDA. Queried March 25, 2013. Michigan Agricultural Actual Production by Year Tart Cherries (1,000,000 pounds) 2012: 11.6 2011: 157.5 2010: 135 2009: 266 Sweet Cherries (tons) 2012: 4,250 2011: 18,600 2010: 15,100 2009: 28,700 Apples (1,000,000 pounds) 2012: 115 2011: 980 2010: 570 2009: 1,150 Peaches (tons) 2012: 1,980 2011: 16,650 2010: 14,000 2009: 17,200 Pears (tons) 2012: 40					important information/illustrations to include.

		2011: 4,400 2010: 900 2009: 4,200					
James	Tolbert	The y-axis shows the ratio of the number of record highs to the number of record lows. The scale is straight arithmetic with a low of 0, a mid-point of 1, and a high of 2. I request that the authors consider using a log scale to provide a more meaningful visual comparison. For a meaningful visual comparison, 2 and 0.5 should be the same distance from 1. If you are trying to avoid using log scales for a public document then I suggest the graphic must be edited to present the data in a way where the visual comparisons of "distance from 1" has meaning. In the current graphic, showing 0 on the low end would be equivalent to showing infinity on the upper end.	2. Our Changing Climate	2.18	53		The figure has been removed due to space limitations. The revised supporting text for the Key Message discusses the numbers of record high and low temperatures, rather than the ratio.
James	Tolbert	The caption indicates that the y-axis is in percentage. The y-axis is not labeled in the graph and appears to be in a fraction, not in percent. Please check to see if the y-axis is in percent or a straight fraction and label appropriately and consistently with the caption. (e.g. 0.1 is either 10% or 0.1% - the graphic currently does not differentiate these two interpretations.)	2. Our Changing Climate	2.21	57		Note that this figure using PDSI has been moved the appendix. This axis will be labeled in new figure
James	Tolbert	I am concerned that the report would show ice coverage in March of 2012 as the example. March 2012 was an extreme event breaking all records for warmth in the Midwest. This is not "ice maximum" for the 2011-2012 season. It appears to be an arbitrary pick to "cherry pick" the data that shows the greatest contrast. I am constantly battling the anti-global warming bloggers who "cherry pick" their earth surface temperatures to state that the earth surface temperature has been stable over some specified period of years (around the last 15 years), and I would like the NCA to be a neutral document that does not "cherry pick" data to make points in either direction. I think the graph above the pictures is solid, showing reductions in ice coverage in the Great Lakes, otherwise, maybe use photos from "maximum ice coverage" or some other justifiable method of selecting your dates for the photographs.	2. Our Changing Climate	2.27	66		As recommended, we removed the two photos from the figure. We have also added to the discussion of the trends by citing Bai et al. (2010) and noting that the inclusion of earlier years in the record results in a smaller trend (cf. first paragraph of revised KM 11).
James	Tolbert	I do not see a numeric scale on the y-axix for pCO2 (uatm). It is unclear to me if the ppm scale for CO2 is also intended to be used for uatm.	2. Our Changing Climate	2.30	70		The figure has been redrawn and updated.
Kathy	Lynn	(1) Change line 21 to: "severe enough that some communities - including Alaska Native communities - are already facing relocation." (2) In paragraph 5 (lines 32-40), add reference to tribal communities or to NCA Ch. 12	Introduction: Letter to the American People		1	21	The authors appreciate the suggestion, but still feel the text is clear and accurate. Changes experienced by Native Americans are mentioned elsewhere in the Letter. A new Report Finding on Native Peoples has been added to the Executive Summary.
Kathy	Lynn	Add in-text citation to NCA Chapter 12 to the following statements: p.4, lines 13, 34, and 41 p.5, line 7 p.6, lines 16 and 42 p.7, line 8 p.9, line 14	1. Executive Summary		4	13	This has been done, Ch 12 is now referenced in numerous places.

		p.10, line 18					
Cato	Institute	General CommentsThis chapter is significantly better than most of those reviewed here, and stands in sharp contrast to the atrocious and politically-driven polemic that is the Human Health section (Chapter 9). Perhaps this might be due to the fact that CLA Peter Groffman received his BA at UVa which at the time provided appropriate intellectual diversity. The intro section, before expansion of the first Key Message, is significantly better than most others in the overall assessment, being quite straightforward about the limitations of our understanding at this point in time (and the potential continued limitations).	8. Ecosystems, Biodiversity, and Ecosystem Services				Thanks for the nice comment!
Kathy	Lynn	Suggest including an in-text citation to NCA Chapter 12 at p.118, line 14-15 p. 126, line 22.	3. Water Resources		118	14	We have added the suggested citation in our chapter assessment.
Cato	Institute	Usage of 40% of input in 25% of our watersheds, compared to 76% in the Colorado River basin, suggests that considerable additional capacity exists around the country. This is particularly true in the Southeast, where an average annual rainfall in excess of four feet per year means that any chronic and increasing supply limitations are driven by politics and NIMBY, and not the climate. Groffman's old haunts in Charlottesville are an archetypical example of this process.	8. Ecosystems, Biodiversity, and Ecosystem Services		292	21	No change suggested. Just an interesting comment.
Cato	Institute	"…lower spring precipitation".Actually no change, according to NCDC. Also, the spring average of slightly under three inches is by far the lowest seasonal average in the region, and not a particularly important contributor to the annual flow. There is no significant overall trend in both spring precipitation and the PDSI histories (precipitation history according to NCDC shown below).(Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: March-May precipitation in the "Southwest" region (data source: NCDC Climate at a Glance).	8. Ecosystems, Biodiversity, and Ecosystem Services		292	25	The text is changed to reflect the challenge of detecting trends -- variability is large, and the "answer" depends on what months are used, the time window for analysis, and the spatial scale of analysis. See climatewizard.org for plots of precipitation history by season and state.
Cato	Institute	Implications not noted.A severe 1994 outbreak of cryptosporidium is thought to have been responsible for at least 54 deaths in Milwaukee, but this was due to abnormally high concentrations that remained in the water after treatment. As cryptosporidium is present in 17% of sampled U.S. drinking water supplies (Rose et al., 1991), and the lack of any evidence for large scale endemicity indicates outbreaks are more a result of treatment error rather than climatic change. Text should be changed to reflect this. Reference:Rose, J.B., C.P. Gerba, and W. Jakubowski, 1991: Survey of Potable Water-Supplies for Cryptosporidium and Giardia. Environment Science & Technology, 25, 1393-1400,	8. Ecosystems, Biodiversity, and Ecosystem Services		293	23	No change. The text is pointing out that cryptosporidium is inactivated by UV light and that this inactivation is inhibited by high levels of DOC. It is an indirect effect of climate change.
Kathy	Lynn	Suggest including an in-text citation to NCA Chapter 12: Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources to p.291, line 35-36.	3. Water Resources		291		This comment does not apply to our chapter but there are several references to Ch. 12 in our chapter.
Cato	Institute	What is the purpose of this? If it is to say that estuaries like Pamlico sound are more subject to algae blooms because of increasing hurricane activity, that's a false conflation, as hurricane activity is not increasing, and shows no relationship whatsoever to global temperature.(Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Accumulated Cyclone Energy (ACE) index for the Atlantic Basin from 1851 through 2010. There is obviously no relationship to global temperature. Data	8. Ecosystems, Biodiversity, and	8.2	295		No change. The caption says nothing about "increasing hurricane activity."

		available at http://www.aoml.noaa.gov/hrd/tcfaq/E11.html. If it is meant to say that hurricane activity will increase in the future in this region, the literature is very conflicted on that. The consensus is still evolving as to how anthropogenic climate change will alter the characteristics of Atlantic basin tropical cyclones. There is growing evidence that the frequency of Atlantic basin tropical cyclones will be little changed, but that some storms may become more intense, although the preferred tracks of storms may be altered in such a way as to reduce the threat of a U.S. landfall (e.g., Wang et al., 2011). However, such changes are not anticipated to emerge above the level of natural noise until very late in this century (Michaels et al., 2005).References:Wang, C., L. Hailong, S-K. Lee, and R. Atlas, 2011. Impact of the Atlantic warm pool on United States landfalling hurricanes. Geophysical Research Letters, 38, L19702, doi:10.1029/2011GL049265.Michaels, P. J., P. C. Knappenberger, and C. W. Landsea, 2005. Comments on "Impacts of CO2-Induced Warming on Simulated Hurricane Intensity and Precipitation: Sensitivity to the Choice of Climate Model and Convective Scheme". Journal of Climate, 18, 5179-5182.	Ecosystem Services				
Kathy	Lynn	Suggest including an in-text citation to Chapter 12: Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources at p.334, line 14-15	9. Human Health		334	14	We agree with your suggestion and have added a reference to Chapter 12: Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources in our chapter assessment.
Kathy	Lynn	Suggest including an in-text citation to Chapter 12: Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources at p.348, line 25	9. Human Health		348	25	We agree with your suggestion and have added an in-text citation to Chapter 12.
Kathy	Lynn	Suggest including an in-text citation to Chapter 12: Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources at p.349, line 32-34	9. Human Health		349	32	We agree with your suggestion and have added an in-text citation to Chapter 12.
Kathy	Lynn	Suggest including an in-text citation to Chapter 12: Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources at p.351, line 16-21; p.352, line 13.	9. Human Health		351	16	Thank you for your suggestion. The text has been revised to incorporate in-text citations to Chapter 12.
Cato	Institute	Nothing unprecedented in Alaska.Kaufmann et al. (2004) noted that for 10-12kyr ybp that Alaskan temperatures were 1.6 +/- 0.8°C higher than the 20th century average, which makes the current era no more than similar at best. Worth noting here.Reference:Kaufmann, D.S., et al., 2004. Holocene thermal maximum in the western Arctic (0–180°W). Quaternary Science Reviews, 23(5–6), 529-560.	8. Ecosystems, Biodiversity, and Ecosystem Services		297	9	No change. This reference doesn't add anything new to the example and is not contradictory as both the old and new changes were driven by temperature.
Kathy	Lynn	Include mention of tribal communities in Box on p.349	9. Human Health		349	35	We appreciate the suggestion, but feel the current focus on broad trends across all vulnerable populations for this Box is appropriate and adequate given the chapter's space limitations.
Cato	Institute	This makes it sound like climate is the driver of the massive Canadian bark beetle epidemic according to Raffa et al., 2008. This neglects the importance of irrational fire suppression. As Raffa et al., 2008 note:"Management practices in some regions have also increased the abundance of susceptible hosts. Lodgepole pine–dominated forests cover much of the interior regions of western Canada, and most originated from stand-replacing wildfires. Because of aggressive fire suppression, the annual burned area declined from about 100,000 ha to less than 1000 ha over the last five decades (Taylor and Carroll 2004). This reduced rate of disturbance yielded forests in which nearly 70% of lodgepole pine was more	8. Ecosystems, Biodiversity, and Ecosystem		297	40	No change. The paragraph is quite clear that climate change is not the only driver of this epidemic. Discussing all these other factors is beyond the scope of this section.

		than 80 years old, significantly greater than would be expected under a natural wildfire regime, and an overall threefold increase in the amount of susceptible pine, from 1910 to 1990…"The text should be revised to note this.	Services				
Kathy	Lynn	Include mention of tribal communities in discussion of Most vulnerable at risk; also include in-text citation to Chapter 12: Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources.	9. Human Health		351		Thank you for your suggestion. We have added an in-text citation to Chapter 12. Due to the size of the topic, and the page limit for the chapter, we focused on broad trends across all vulnerable populations for this section rather than delving too deeply or discussing specific examples. Thus, we are only adding the in-text citation but not expanding the discussion.
Cato	Institute	The section on Ecosystem-based management is very good, especially compared to much of the content of many of the other chapters in this report.	8. Ecosystems, Biodiversity, and Ecosystem Services		299	5	Thanks for the nice comment!
Cato	Institute	Box 2There should be some indicators of whether changes are salutary, negative, or neutral.For example, with regard to biological response 2 (page 302, lines 10-11), Wiebe and Gerstmar (2010) write, “This suggests that there is no ecological mismatch linked to prey availability for Northern Flickers and that individuals could benefit by laying earlier if spring temperatures allow”, i.e., that this warming may be salutary.Biological response 12 has nothing to do with observed or projected climate change and merely states if rain is above normal in the late summer, bison gain weight, and above normal midsummer precipitation decreased weight. That’s like saying if there’s little food that herbivores will lose weight, or that tree seedling survival is lower in dry years (biological response 21) Shocking! Remove them.A problem is that no one (except fools like me) are going to look up your citations. So people (like The President) will hold forth about all these changes, not knowing they are really nugatory. For example, biological response 19 hardly merits a mention. From Kascher et al., 2011:“Although the absolute loss in optimal habitat for native species might regionally affect as many as 11 species, this is predicted only in relatively small areas (Fig. 5A).”Suggestion: Remove.	8. Ecosystems, Biodiversity, and Ecosystem Services		302	1	Many studies document trends on species' responses to climate change and their (in)ability to respond to changing environmental conditions. In many cases, the full range of impacts on a population due to climate change are not known. Even if a species or population can adjust their phenology, food resources many not change at a similar rate; there may also be unknown trophic interactions with competitors or predators that could effect population success. We have added text to examples in box where studies were able to show a postiive, negative, or neutral trend, but this was not always possible. Studies such as Kascher et al., 2011 show or predict how species or groups of species are or are predicted to respond to climate change across different regions. We have left this study in but added more detail to make the full breadth of the results more impactful. Same with Ibáñez et al. (2008) example.

Kathy	Lynn	UNABLE TO ENTER COMMENTS IN TEXT REGION:(1) p.405, line 27-28: include "tribal uses" in the list of Columbia River uses. (2) p.405, line 34: add "and tribal treaty fishing and hunting rights" after "as well as recreation".	9. Human Health		405		Thank you for the suggestion. The text in the Energy, Water, Land chapter has been revised to incorporate this suggestion.
Kathy	Lynn	UNABLE TO ENTER COMMENTS INTO TEXT REGION: (1) p.405, line 27-28: include "tribal uses" in the list of Columbia River uses. (2) p.405, line 34: add "and tribal treaty fishing and hunting rights" after "as well as recreation".	9. Human Health		405		Thank you for the suggestion. The text in the Energy, Water, Land chapter has been revised to incorporate this suggestion.
Kathy	Lynn	p.481, line 21: Add "and culture" to the end of the sentence. p.481, line 25: including an in-text citation to Chapter 12: Tribal Lands and Resources.	13. Land Use and Land Cover Change		481	21	Made suggested edits.
Kathy	Lynn	Suggest changing sentence to "rural communities and tribes", and include an in-text citation for Chapter 12: Tribal Lands and Resources.	14. Rural Communities		498	8	Thank you for your comment. The text has been revised to include mention of impacts on tribes and an in-text citation to Chapter 12: Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources.
Kathy	Lynn	Include in-text citation for Ch. 12 at p.496, line 9 or 12.	14. Rural Communities		496	9	We thank the reviewer for the suggestion. We have added an in-text citation to Chapter 12: Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources.
Kathy	Lynn	Add "tribal governments"	14. Rural Communities		505	18	We agree with your suggestion and have added tribal governments.
Kathy	Lynn	Add "tribal governments".	14. Rural Communities		506	2	We agree with your suggestion and have added tribal.
Kenneth	Johnson	1. Pg. 195, Line 37-the bullet does not match the other bullets. 2. Pg. 195, the national transportation system is composed of four main components, one of which concerns people. Should the chapter include more data about the potential loss of jobs in the transportation sector as a result of climate change? The transportation sector is a significant source for jobs in the U.S.3. Adaptation has been labeled as one of the mechanisms that must be emplaced in order to offset the direct affects of climate change. In Key message #4/4, Assessment of confidence based on evidence, costs may be significantly reduced by adaptation action; however, the magnitude would be difficult to determine. I believe an estimated number in this section that talks about this $4.1 trillion transportation sector is very important. Simply stating that it would be difficult to determine the cost may not satisfy decision makers who will use this chapter to make changes to their state and local transportation infrastructure. 4. It is clear that Alaska is and will face substantial changes as a result of climate change; however, there is no talk about how Hawaii will be affected. I think analysis there is equally important. 5. Figure 5.1: Impact of Sea Level Rise and Storm Surge on Mobile, Alabama provides an illustrative dimension that is needed to show the reader. However, the analysis of the potential sea level rise has not been correlated with potential losses in revenue, which would further develop the adaptation argument. Why has this not been included in the analysis? 6. In the Coastal Impacts section, channel disruption is	5. Transportation				1) We changed the bullet so it has the same formatting as the rest. 2) This is beyond the scope of our chapter and there is paucity in the literature on potential job loss or gain. 3) At this point in time, this estimate is not available. We agree this is a research need. 4) There is paucity in the literature on this topic, thus no change was made to the text. 5, 6 and 10) We appreciate your comments, however we are limited in the amount of space we have to discuss climate change impacts on U.S. transportation. The author team has

		discussed, but dredging and the environmental impacts are not discussed. It would be valuable to specifically address the two major waterways in the interior of the United States—Saint Lawrence Seaway and the Mississippi River. Climate change will have a significant impact on these systems and they must be addressed. 7. Over one page is dedicated to Hurricane Sandy; however, this one single event cannot be tied to climate change. Katrina was given much less space in this assessment. Why?8. Table 5.1: Illustrative Risks of Climate-related Impacts. Risk is defined as the chance of loss or the perils to the subject matter of an insurance contract; also: the degree of probability of such loss according to Merriam-Webster Dictionary. I think the addition of the Positive (beneficial)-Magnitude of Consequences diminishes the efficacy of the table. Risk has an implicit negative connotation; therefore, putting (beneficial) consequences creates dissonance. 9. Figure 5.2: Airport Runways Near Sea Level. What is the purpose of the photo in the center of the United States? I'm not sure why it's there and what value it adds?10. The only discussion of insurance is The National Flood Insurance Program; however, insurance is a major component of reducing consequences of climate change impacts on transportation. I believe more discussion about insurance must be added in order to strengthen the adaptive strategies to reduce consequences. (Figure 5.5) 11. Pg 208. Many projected climate change impacts and resulting consequences on transportation systems can be reduced through a combination of infrastructure modifications, improved information systems, and policy changes. The part that I am concerned about is policy changes. According to Figure 5.5, the only policy change would be land-use regulations relating to development in vulnerable areas. Do these policy changes only relate to adaptive strategies to reduce consequences?12. The majority of the chapter discusses adaptation mechanisms; however, there is very little about mitigation. In Key message #1/4: New information and remaining uncertainties, there is discussion about how "adaptation can significantly ameliorate impacts on the transportation sector, but there is no talk about mitigation. "The NCA will help evaluate the effectiveness of our mitigation and adaptation activities and identify economic opportunities that arise as the climate changes." A more encompassing discussion about both mitigation and adaptation would certainly strengthen the chapter. 13. There are four key messages, yet none specifically address mitigation. One of the key messages has to address mitigation (e.g., PHEV, EV, Hybrids, Biofuels, FCEV, etc.). Furthermore, intelligent transportation systems and self-driving vehicles work on the mitigation front as well. 14. There are several real world examples of what extreme weather direct effects to transportation. Yet, the indirect effects are not described in detail. Why aren't indirect effects described when real world examples (Katrina and Irene for example) are described?15. Pg 197, paragraph starting on line 13. I believe an actual graph would add value in supporting this paragraph. By stating, "climate models project that extreme heat and heat waves will become more intense, longer, and more frequent," it does not fully build the argument. What climate model projects this? Who is the source of the analysis? Skeptics are attempting to tear apart the climate change argument. Making this claim with no source allows that to happen. 16. I think it would be valuable to show the current growth rates in the transportation sector (e.g., passenger vehicle ownership and airline travel). I think an addition of this statistic would show the definite need for adaptation to the sector.						deliberated and agreed on the most important information to include. 7) Hurricane Katrina was dealt in the last NCA. We chose to focus on Sandy because it is timely and pertinent to the issues raised by the chapter. 8) While we recognize that a risk matrix implies negative consequences we felt it important to show there are positive consequences as a result of climate-related impacts. 9) We have deleted the inset. 11) We appreciate the comment and fully recognize that policy decisions are critical to adaptation strategies. The figure is intended to be illustrative, not all-inclusive. We also recognize that many of the strategies mentioned reflect basic policy decisions, such as improved air traffic management, shift to alternative modes, and relocation of facilities. 12 and 13) We appreciate your comment, but space is limited. The author team has deliberated and agreed on the most important information to include. We refer those interested in a deeper treatment of mitigation and adaptation to Chapters 27 and 28. 14) The comment has validity. There are many indirect effects on society and economy including impacts on different social economic groups, but limitations in this chapter did not permit discussion of indirect impacts, nor are we aware of sufficient peer reviewed literature on this topic. 15) We appreciate the comment. Extreme events are covered in detail in Chapter 2: Our Changing Climate. We have added a direct link. 16) We have added text to address this comment.Thank you for your comments.
Kathy	Lynn	Suggested additional content to address tribes in regards to the sustained assessment. 1. The impacts of climate change are place-based and as such will impact culture, sovereignty,	30. The NCA Long-				Duplicate comment. See response to comment 33661.

		economies and traditional ways of life among American Indians, Alaska Natives, Native Hawaiians and other indigenous peoples in the United States. a. Perhaps add something describing preferential vulnerability of reservations? ""Many reservations, in particular coastal reservations are preferentially vulnerable to climate change and associated sea-level rise/storm surge and will likely be unable to secure replacement lands of equal or better quality for their cultural needs under the present landscape modified by 150 years of western settlement and urbanization" 2. Tribes are not just vulnerable populations or just another stakeholder; tribes are sovereign nations [and ""co-managers”] and must have a distinct place in the NCA. There are opportunities for tribal leadership, collaboration co-management and engagement in climate research, assessments, and other initiatives. 3. Traditional knowledge can inform understanding of climate impacts and adaptation strategies. The knowledge is culturally-sensitive and should be protected; but tribes can share what they learn to inform broader assessments, federal processes." 4. There is a need for more information on what the National Climate Assessment is and why it is important for and relevant to tribes to engage in. 5. Use NCA findings to evaluation economic impacts of climate change and communicate those costs to tribal (and federal) leaders	term Process: Vision and Future Development				
Stella	Protopapas	How does this earlier arrival date adversely effect the birds (i.e. lack of food resources)? Also “increasing” winter temperatures would be clearer if replaced with “higher” winter temperatures.	8. Ecosystems, Biodiversity, and Ecosystem Services		303	30	The study did not measure how the shifts in arrival time affected bird populations, only the timing and trend of migration shifts. It is unclear whether bird (and other shifting) populations will be affected as there are other factors that are either still unresolved or have not yet been fully realized; these include how their food resources also respond to changing climate (through early emergence or declines), as well as changing and potentially novel trophic interations with competitors and predators. I have added some language to the box text to expand a little and clarify. Also, I think "increasing" is appropriate here since the study was documenting a trend.
Stella	Protopapas	The chosen quotation indicates that we need to help people adapt to the adverse effects of climate change -- which we caused. There should be mention of other life forms, which we have harmed, as well as indications that our goal should be to mitigate climate change. This would indicate a greater goal than just 'getting used to' a rapidly deteriorating environment.	8. Ecosystems, Biodiversity, and		299	21	No change. The suggested additions are outside the scope of this section and chapter.

			Ecosystem Services				
Ron	Brunner	Draft Chapter 28 (v. 11 Jan. 2013) of the National Climate Assessment provides an excellent overview of work on climate adaptation in the United States. There are, however, some missed opportunities to help citizens and other policy makers clarify their interests and guide their efforts in climate adaptation, especially in connection with the sixth key message:“6. The effectiveness of climate change adaptation has seldom been evaluated, because actions have only recently been initiated, and comprehensive evaluation metrics do not yet exist.” [983:37-39]This key message apparently overlooks evaluations of local and regional initiatives that went beyond planning and approaches to the implementation of actions that actually reduced losses and vulnerability to climate change. These initiatives were often undertaken “to fulfill other societal goals” including “disaster risk reduction” as mentioned in the draft’s fourth key message [983:30-32]. Nevertheless, they qualify as “adaptation” actions that increased “resilience” and reduced “vulnerability” to climate change by the definition of those terms in the draft [985:4-5, 17-18, 21-24]. The evaluations include, for example:Becker, William S. (1983). Come Rain, Come Shine: A Case Study of a Floodplain Relocation Project at Soldiers Grove, Wisconsin. Madison, WI: Bureau of Water Regulation and Zoning, Wisconsin Department of Natural Resources.Bullock, Jane A., George D. Haddow, and Kim S. Haddow, eds. (2009). Global Warming, Natural Hazards, and Emergency Management. Boca Raton, FL: CRC Press.Climate Leadership Academy (2010). Promising Practices in Adaptation and Resilience: A Resource Guide for Local Leaders (Version 1.0). Institute for Sustainable Local Communities in partnership with the Center for Clean Air Policy.Dickson, Dave (2009). “Living River: The Napa Valley Flood Management Plan,” 126-149. In Bullock et al. (2009).Ganderton, Philip T., et al. (2006). “Mitigation Generates Savings of Four to One and Enhances Community Resilience.” Natural Hazards Observer XXX (March), 1-3.Hewes, Will and Kristen Pitts (2009). Natural Security: How Sustainable Water Strategies Are Preparing Communities for a Changing Climate. Washington, DC: American Rivers.Holdeman, Eric and Ann Patton (2008). “Project Impact Initiative to Create Disaster-Resistant Communities Demonstrates Worth in Kansas Years Later,” Emergency Management (December 12), http://www.emergencymgmt.com/disaster/Project-Impact-Initiative-to.html.Patton, Ann (2009). “A Tulsa Story: Learning to Live in Harmony with Nature,” 84-113. In Bullock, et al. (2009).Judging from these and similar sources, it is clear that Americans have been adapting all along to extreme weather events like those that will increase in frequency and severity as climate change continues. For example, successful initiatives to reduce losses and vulnerability to repetitive flooding events began in the Charles River basin in MA in 1955 (Hewes and Pitts, 2009, 40-46), in Tulsa, OK in 1974 (Patton, 2009), in Soldiers Grove, WI in 1975 (Becker, 1983), and in the Napa Valley in 1995 (Dickson, 2009). In short, there is a vast amount of long-term experience, some of it now evaluated as successful by the communities involved. This experience can inform the adaptation efforts of citizens and other policy makers in current and future initiatives. Only in recent initiatives have local and regional efforts begun to take projected climate change explicitly into account. That tends to divert attention from outcomes (actual reductions in losses and vulnerability) to approaches. For example, in Table 28.6 [1002] the draft reports that “Tulsa, OK, has a three-pronged approach to reducing flooding and managing stormwater” and describes that approach briefly. This overlooks the fact that “By the end of the [1980s], Tulsa had cleared more than 1,000 of its most dangerous buildings from its floodplains, using the open lands for parks, trails, open space storage, and flood control works” (Patton, 2009, 92). Policy makers might learn from evaluations of Tulsa’s on-going initiative, which only a few years ago began to take climate change explicitly into account. The lack of comprehensive evaluation metrics did not preclude successes in reducing losses and vulnerability in the sources cited above. My inquiry into them – especially Becker (1983), Patton (2009), Dickson (2009), and Holdeman and Patton (2008) -- indicates that while practitioners on the ground make use of relevant piecemeal	28. Adaptation		983		This chapter is only focused on adaptation done for climate change. We are not addressing the effectiveness of all natural resource management on climate change. We added a clarifying sentence in the introduction. New text is: "The effectiveness of climate change adaptation, per se, has seldom been evaluated" Did add a sentence "In many cases, lessons learned from initial pilot programs help inform future adaptation strategies."

		metrics readily available, they do not rely primarily on metrics. Like the literature on evaluation, they recognize that many important considerations in their initiatives are observable but not reducible to metrics in practice. The latter includes stakeholder engagement, what is elsewhere called “the politics of finding common ground,” often a prerequisite for the implementation of climate adaptation plans and approaches. For details on this, see the sources cited in two papers:Brunner, Ronald D. (2011). “Evaluating Progress in Adapting to Climate Change.” Revision of a paper presented at Practical Solutions for a Warming World: AMS Conference on Climate Adaptation, 18-20 July 2011, Asheville, NC.Brunner, Ron and John Nordgren (2012). “Climate Adaptation as an Evolutionary Process.” A white paper based on the Kresge Grantees and Practitioners Workshop on Climate Change Adaptation, 7-9 February 2012, Portland, OR. In addition, the lack of metrics did not preclude claims of success in the approaches taken in illustrative case studies in Sec. VI. of the draft [1008:8-9; 1013:36-37]. Moreover, its key messages [983:20-39] suggest the magnitude and ultimate futility of a quest for comprehensive evaluation metrics: There is “no ‘one-size fits all’ adaptation.” Evaluation in each and every case entails consideration of “other societal goals” in addition to climate adaptation. And the success or failure of actions taken – including “[s]haring best practices, learning by doing, and iterative and collaborative processes” – must be interpreted in light of many “[b]arriers to implementation” and “other stresses.” The diversity and complexity of climate adaptation means that any metric (like any qualitative observation) can be reliably understood and effectively communicated only as part of a comprehensive case study. In conclusion, long-term adaptation initiatives have been evaluated in terms of their effectiveness in reducing their losses and vulnerability to extreme weather events and climate change; metrics were not a prerequisite. The sixth key message should be revised accordingly, to buttress the empirical foundations of adaptation and make it self-correcting on the basis of experience. Ronald D. Brunner Professor Emeritus, University of Colorado, Boulder					
Kevin	Trenberth	It was puzzling to me that I did not find in the NCA any discussion of the hiatus in warming globally or the role of the oceans in taking up energy. More generally the cause of the warming planet is not addressed well. The issue is highlighted by this article in the Economist: http://www.economist.com/news/science-and-technology/21574461-climate-may-be-heating-up-less-response-greenhouse-gas-emissions?zid=313&ah=fe2aac0b11adef572d67aed9273b6e55With increasing greenhouse gases in the atmosphere, there is an imbalance in energy flows in and out of the top-of-atmosphere (TOA): the greenhouse gases increasingly trap more radiation and hence create warming. "Warming" really means heating, and so it can be manifested in many ways. Rising surface temperatures are just one manifestation. Melting Arctic sea ice is another. And increasing the water cycle and invigorating storms is yet another that can play a role in the energy imbalance by changing clouds and albedo. However, most (over 90%) of the energy imbalance goes into the ocean, and several analyses have now shown this. I want to draw attention to a new analysis that is now published that brings this out in several new ways. It shows that increasingly in the past decade, more of that heat has been dumped at levels below 700m, where most previous analyses stop. About 30% has gone below 700m in depth. Balmaseda, M. A., K. E. Trenberth and E. Källén, 2013: Distinctive climate signals in reanalysis of global ocean heat content, Geophys. Res Lett.. doi:10.1002/grl.50382.This is fairly new, only in the past decade and the cause of the change is a particular change in winds, especially in the Pacific Ocean where the subtropical trade winds have become noticeably stronger, thereby increasing the subtropical overturning in the ocean (among other things) and providing a mechanism for heat to	2. Our Changing Climate				We do discuss the recent slowdown in temperature increase in the appendix. We have written a special subsection in the revised text to incorporate additional explanation of why the recent warming slowdown is consistent with the author team's thorough assessment of the science.

		be carried down into the ocean. This is associated with the Pacific Decadal Oscillation negative phase which is in turn related to the La Niña phase of ENSO. Note that we have found, really for the first time, strong volcanic signals that punctuate the record with short term periods of cooling that quantitatively match up with actual estimates of that cooling effect) (so-called radiative forcing). Previous OHC records have at best hinted at this and it was missing in Levitus' work which could not resolve interannual variations well. The warming then is not uniform in time, and the peak warming was the early 2000s; while perhaps the quiet sun led to somewhat less cooling in recent years.Some of the penetration of heat into depths of the ocean may be reversible, as it comes back in the next El Niño. However, one suspects that a lot is not: instead it contributes to the overall warming of the deep ocean that has to occur for the climate system to equilibrate. It speeds that process up faster than assumed almost everywhere in climate research, and it invalidates simple energy balance climate models. It means less short term warming at the surface but at the expense of a greater earlier long-term warming, and faster sea level rise. It also means that the current hiatus in surface warming is a transient and global warming has not gone away: there is a radiative imbalance at the top of atmosphere bigger than some have estimated.					
Joseph	Zajac	2 Climate change is already affecting the American people. Certain types of weather events have 3 become more frequent and/or intense, including heat waves, heavy downpours, and, in some 4 regions, floods and droughts. Sea level is rising, oceans are becoming more acidic, and glaciers 5 and arctic sea ice are melting. These changes are part of the pattern of global climate change, 6 which is primarily driven by human activity.The Earth has not warmed in over 15 years according to Hansen and the IPCC. Use of NON-EXISTENT terminology. Phrases do not exist in any weather or in meteorological dictionaries: heat waves, heavy downpoursSea levels rising due to human activity is not proven. Report does not factor in tectonic plate movement. 21 U.S. average temperature has increased by about 1.5°F since 1895; more than 80% of thisOnly 45 states back in 1895, data set is not uniform, insufficient amount of data collected in every location. 26 U.S. temperatures will continue to rise, with the next few decades projected to see another 2°F 27 to 4°F of warming in most areas. The amount of warming by the end of the century is projected 28 to correspond closely to the cumulative global emissions of greenhouse gases up to that time: 29 roughly 3°F to 5°F under a lower emissions scenario involving substantial reductions in 30 emissions after 2050 (referred to as the "B1 scenario"), and 5°F to 10°F for a higher emissions 31 scenario assuming continued increases in emissions (referred to as the "A2 scenario") (Ch. 2).2 - 4 100% variance; 3-5 66 2/3% variance; 5-10 100% variance Variances (margin of error) are too large if the confidence in the models are high.	1. Executive Summary				Thank you for your comments. The climate science chapter addresses many of your individual observations. Changes have been made to the Context and Background section to emphasize the distinctions between climate variability and climate change.
Colleen	Reid	Page 5, lines 8-21 tries to summarize the public health chapter. However, it does not get into the sections on public health action and co-benefits (Key messages 3 & 4 of the public health chapter). These are important aspects of the public health chapters findings that should be in the executive summary.	1. Executive Summary		5	8	Language has been modified in response to this comment.

Colleen	Reid	In line 19, not just “maintaining” but also “improving” the public health infrastructure will be critical to managing the public health impacts of climate change.	1. Executive Summary		5	19	A change in this language has been made.
Colleen	Reid	This report lacks urgency in general. Climate change is not just something off in the future, the effects are now. It is impacting us already and the projections for the future are dire. We can act now to lessen the future impacts, but we also need to act quickly and urgently to make our communities more adaptable and more resilient. Children born today are going to be living in a much different world than we live in and many of these children are expected to live into the 22nd century. This urgency needs to be conveyed in these reports for both policy-makers and the public. While there are still uncertainties in global climate model forecasts, those uncertainties are decreasing, but there is great uncertainty when trying to spatially and temporally downscale the models. However, we already know where the vulnerable populations are for most of the health treats that will be exacerbated by climate change. Actions can be taken now, without waiting for better models, to make communities more resilient. Efforts to decrease public health disparities in general will decrease the risks of climate change on public health. The section in the public health chapter on vulnerabilities is a start and identifies these disparities, but it could be said in a more urgent and compelling way that local public health departments, particularly in poor, non-white, neighborhoods with high levels of obesity and asthma need additional funding to decrease these underlying health disparities and that will lead to better resiliency for climate change.	9. Human Health				This comment does not seem to raise any question or suggest any revision.
Elizabeth	Marino	This chapter expresses vulnerability to Alaska Native communities explicitly as a product of changing climates. While understandably this document is intended to outline climatic changes in Alaska and the Arctic in particular - the authors should acknowledge the interplay of social and natural or human/ecological systems. This is consistent with the latest theories of vulnerability. See Adger 2006, Cutter 2006, Wisner et al. 1994, Marino and Ribot 2012 and specifically for Alaska Native communities, Marino 2012.	22. Alaska and the Arctic				We appreciate the suggestion, but feel the current references are appropriate and adequate given the chapter’s space limitations. The last paragraph of the introduction addresses these interactions explicitly. The chapter on adaptation addresses the interaction with other stresses in depth.
Elizabeth	Marino	Lines 17/18: Change: Communities must rely not only on improved knowledge of changes that are occurring, but also on strength from within in order to face an uncertain future. To: Communities must rely not only on improved knowledge of changes that are occurring, but also on support from larger social and development institutions, traditional institutions and knowledge systems, and on strength from within in order to face an uncertain future.	22. Alaska and the Arctic		775		The text has been revised to incorporate this suggestion.
Colleen	Reid	Overall, a lot of information is being put into captions that is not just a description of what is occurring in the Figure. Some people may skip over reading the caption and miss this important information. For example, Figure 9.6 has a lot of information about how fine particles penetrate indoors, the number of acres burned during the 2012 wildfire season and the estimated global deaths from landscape fire smoke. Only the first two sentences of this caption (page 341) are related to the image.	9. Human Health	9.6	341		Authors appreciate this observation, yet are aware that some readers will concentrate on the figures and captions rather than read the text. We will let the caption text stand to provide context for both audiences.
Colleen	Reid	Figure 9.3 is a good figure, but it is older than the previous national assessment. It is also not stated in the paragraph on allergens that increased CO2 leads to higher allergens. This information needs to be in the report, but it is not sufficiently discussed in the text as well as in the figure.	9. Human Health	9.3	337		We have added text in the report that indicates that increased CO2 can contribute to increased production of plant-based allergens.
Colleen	Reid	This figure is not needed.	9.	9.4	338		We agree and have removed this

			Human Health				figure.
Colleen	Reid	This figure is not needed.	9. Human Health	9.5	339		We agree and have removed this figure.
Colleen	Reid	Because vulnerability is important, the latest paper by Rappold et al.(Rappold et al. 2012) should be cited because it looks at effect modification of cardio-respiratory health outcomes from the North Carolina peat fires by community characteristics.Rappold AG, Cascio WE, Kilaru VJ, Stone SL, Neas LM, Devlin RB, et al. 2012. Cardio-respiratory outcomes associated with exposure to wildfire smoke are modified by measures of community health. Environ Health 11.	9. Human Health		340	1	We have revised the text to incorporate the suggested citation.
Lauren	Baum	The NCA should take note of the Marcott et al. study that concludes that current temperatures are warmer than 75% of the Holocene temperature history. Surface temperature reconstructions of the past 1500 years suggest that recent warming is unprecedented in that time. Here we provide a broader perspective by reconstructing regional and global temperature anomalies for the past 11,300 years from 73 globally distributed records. Early Holocene (10,000 to 5000 years ago) warmth is followed by ~0.7°C cooling through the middle to late Holocene (<5000 years ago), culminating in the coolest temperatures of the Holocene during the Little Ice Age, about 200 years ago. This cooling is largely associated with ~2°C change in the North Atlantic. Current global temperatures of the past decade have not yet exceeded peak interglacial values but are warmer than during ~75% of the Holocene temperature history. Intergovernmental Panel on Climate Change model projections for 2100 exceed the full distribution of Holocene temperature under all plausible greenhouse gas emission scenarios.Citation: Marcott et al. (2013). A reconstruction of regional and global temperature for the past 11,300 years. Science. Retrieved from: http://www.sciencemag.org/content/339/6124/1198.abstract	2. Our Changing Climate				A discussion of past climates, including additional references, has been added to the chapter.
Colleen	Reid	A new paper from British Columbia cites the effects of wildfire on asthma medication dispensations (Elliott et al. 2013). This should be cited as another health endpoint related to exposure to air pollution from wildfires in lines 7-12 on page. 340. Elliott CT, Henderson SB, Wan V. 2013. Time series analysis of fine particulate matter and asthma reliever dispensations in populations affected by forest fires. Environ Health 12:11.	9. Human Health		340	7	Thank you for your comment. We have added the suggested new citation and the phrase "and medication dispensations."
Joseph	Zajac	1 M. What about the global cooling predictions in the 1970? 2 An enduring myth about climate science is that in the 1970s the climate science community was 3 predicting “global cooling” and an “imminent” ice age. A review of the scientific literature 4 suggests that this was not the case. On the contrary, even then, discussions of human-related 5 warming dominated scientific publications on climate and human influences. Page. 10873 Caption: The number of papers classified as predicting, implying, or providing 4 supporting evidence for future global cooling, warming, and neutral categories. For the 5 period 1965 through 1979, the literature survey found seven papers suggesting further 6 cooling, 20 neutral, and 44 warming. Based on Peterson et al. (2008).	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z				CAQ M deals directly with this question. The point is that the theoretical understanding of climate change was just developing in the 1960s and 1970s. Even at that time,when there was so little data, there were scientists telling the President and Congress that a warming climate could become an extremely important issue. That there were 44 papers during this period raising concerns about a warming climate while only 6 discussed the slight cooling during that period actually demonstrated the insight of the science community in grasping the key science outcomes from the

		Page. 1088To claim from a small sample size of just 71 papers that the literature supports global warming is pure hubris, misleading and an embarrassment to any thinking person.ONLY 44 papers written over 15 years supporting global warming!! 1965 through 1979, 15 years, 44/15 = 2.933333 papers. Let's say an average of 3 PAPERS PER YEAR! Peterson et al. (2008) should all be sent back to school to take a logic class for their bogus claim that the literature supported global warming. No mention is made of the 1974 CIA climate study. CIA commissioned THE best climate experts at the time conduct research with the consensus another ice age was coming. The original prediction by CIA paid weather researchers back in the 1970's was for another ice age. That group represented the most brilliant minds at the time on climate. CIA August 1974: A Study of Climatological Research as it Pertains to Intelligence Problems. CIA pulled in the groups of "climate scientists" to conduct research pretty much representing the biggest brain trust on climate change at the time. Some excerpts just from the first few pages: Early in the 1970's a series of adverse climatic anomalies occurred. - The world's snow and ice cover had increased by at least 10 to 15 percent. - In the eastern Canadian area of the Arctic Greenland, below normal temperatures were recorded for 19 consecutive months. Nothing like this had happened in the last 100 yearsBecause of the global cooling trend, the lower circumpolar vortex has in recent years stayed further south during the summer.Scientists are confident that unless man is able to effectively modify the climate, the northern regions, such as Canada, the European part of the Soviet Union, and major areas of northern China, will again be covered with 100 to 200 feet of ice and snow. Leaders in climatology and economics are in agreement that climate change is taking place and that is has already caused major economic problems throughout the world.					collective data. This comment has no effect on the validity of the text in the associated CAQ, but a sentence has been added to further explain the time period this CAQ relates to. The 1974 CIA report has been the point of recent discussion on a numbe rof blogs but otherwise had no relevance during the 1970s (as a CIA report it was not publically available at that time). It was likely developed by their office and not by any of the leading scientists of the day. It also does not appear to be peer-reviewed. It doesn't even cite the well known 1970 SCEP report that was written by leading scientists that concluded that a warming climate was likely to be of much more concern than a coolngn climate, but also discussed the major lack of information on the climatesystem at that time. It is also worth noting that, if humans were not exerting a dominant effect on climate at this time, the evidence does suggest that Earth would be heading very slowly into another ice age - see for example Tzedakis et al. 2012 Nature Geoscience
Colleen	Reid	May be good to separate what deaths have been attributed to wildfire smoke compared to the Johnston paper. All of the other papers cited are epidemiology papers. The Johnston et al. 2012 paper is an estimate of the global burden of disease from landscape fire smoke which uses risk assessment methods.	9. Human Health		340	7	We agree with the comment and have modified the text and citations to incorporate this suggestion.
Colleen	Reid	The McDonald et al. 2009 and Shea et al. 2008 papers are about allergens and not about wildfire. These should be removed from line 13 of Page 340. This is an error.	9. Human Health		340	13	Thank you for your comment. We have deleted the McDonald et al. 2009 citation, but have kept the Shea et al. 2008 citation as it has a section on wildfire smoke.
Colleen	Reid	should be “affect” not “effect”.	9. Human Health		341	7	Thank you for your comment. We have corrected the sentence, changing "effect" to "affect."
Colleen	Reid	“physiology” should be “physiological”	9. Human Health		351	6	Thank you. The text has been revised to "physiological."
Colleen	Reid	This section on vulnerability is incredibly important. However, there is much more that should be included here. However, there is a lot more that should be touched on after the introductory	9. Human		351	1	The text in the next section on "Prevention Provides Protection" has

		paragraph. For example, the Reid et al. 2009 paper is a study that mapped vulnerability to heat in metropolitan areas throughout the country. This has been followed by many other studies of mapping vulnerability to heat including (Buscail et al. 2012; Harlan et al. 2012; Johnson et al. 2012; Sister et al. 2009; Uejio et al. 2011; Wilhelmi and Hayden 2010) as well as many outside of the US (Buscail et al. 2012; Kershaw and Millward 2012; Loughnan et al. 2009; Rinner et al. 2009). Additionally, there needs to be validation of these maps, which was done in (Reid et al. 2012). Buscail C, Upegui E, Viel JF. 2012. Mapping heatwave health risk at the community level for public health action. Int J Health Geogr 11:38. Harlan SL, Declet-Barreto JH, Stefanov WL, Petitti DB. 2012. Neighborhood effects on heat deaths: Social and environmental predictors of vulnerability in maricopa county, arizona. Environ Health Perspect. Johnson DP, Stanforth A, Lulla V, Luber G. 2012. Developing an applied extreme heat vulnerability index utilizing socioeconomic and environmental data. Applied Geography 35:23-31. Kershaw SE, Millward AA. 2012. A spatio-temporal index for heat vulnerability assessment. Environ Monit Assess. Loughnan ME, Nicholls N, Tapper NJ. 2009. A spatial vulnerability analysis of urban populations to extreme heat events in melbourne australia. . Melbourne, Australia:Victorian Department of Health. Reid CE, Mann JK, Alfasso R, English PB, King GC, Lincoln RA, et al. 2012. Evaluation of a heat vulnerability index on abnormally hot days: An environmental public health tracking study. Environ Health Perspect 120:715-720. Rinner C, Patychuk D, Jakubek D, Nasr S, Bassil KL, Campbell M, et al. 2009. Developmetn of a toronto-specific, spatially explicit heat vulnerability assessment: Phase i. Toronto, Canada:Toronto Public Health. Sister CE, Boone CG, Golden JS, Hartz D, Chuang WC. Mapping social vulnerability to heat wave in chicago. In: Proceedings of the Fourth Symposium on Policy and Socio—Economic Research at The 89th American Meteorological Society Annual Meeting, 2009. Phoenix, AZ. Uejio CK, Wilhelmi OV, Golden JS, Mills DM, Gulino SP, Samenow JP. 2011. Intra-urban societal vulnerability to extreme heat: The role of heat exposure and the built environment, socioeconomics, and neighborhood stability. Health Place 17:498-507. Wilhelmi O, Hayden M. 2010. Connecting people and place: A new framework for reducing urban vulnerability to extreme heat. Environmental Research Letters 5:014021.	Health				been revised to incorporate this suggestion and to add several of the suggested references.
Lauren	Baum	The NCA should take note of a report that projects an ice-free Arctic in September within 30 years. According to the report: September 2008 followed 2007 as the second sequential year with an extreme summer Arctic sea ice extent minimum. Although such a sea ice loss was not indicated until much later in the century in the Intergovernmental Panel on Climate Change 4th Assessment Report, many models show an accelerating decline in the summer minimum sea ice extent during the 21st century. Using the observed 2007/2008 September sea ice extents as a starting point, we predict an expected value for a nearly sea ice free Arctic in September by the year 2037. The first quartile of the distribution for the timing of September sea ice loss will be reached by 2028. Our analysis is based on projections from six IPCC models, selected subject to an observational constraints. Uncertainty in the timing of a sea ice	22. Alaska and the Arctic				While the comment suggests a good specific example, the authors feel the existing examples are appropriate and adequate. The work of Wang and Overland is already cited and in the traceable accounts we make the points that the reviewer stresses. There is considerable uncertainty in the rate of future sea-ice retreat, so

		free Arctic in September is determined based on both within-model contributions from natural variability and between-model differences.Citation: Wang, M. and Overland, J.E. (2013). A sea ice free summer arctic within 30 years? Geophys. Res. Lett. Link: http://www.pmel.noaa.gov/pubs/outstand/wang3261/wang3261.shtml					we provide a median model estimate rather than rely solely on one published paper.
Colleen	Reid	This paragraph is incredibly important and should have its own title: Environmental Justice and Climate Change or something similar to that.	9. Human Health		352	10	Thank you for your suggestion. After consideration of this point, we still feel the existing text in question, given its small length, fits appropriately under the main title, "Most Vulnerable at Most Risk," and does not require a separate subtitle.
Colleen	Reid	While air conditioning can decrease exposure to extreme heat, any mention of it in a report on climate change must include the caveat that air conditioning not only uses energy, so any increase in AC use will increase energy use and thus fossil fuel use for the majority of users since most energy use in the US is fossil fuel based, but also the fact that AC use exhausts heat to the local environment, so AC use can exacerbate the urban heat island effect. Notably, the urban heat island effect is currently not sufficiently analyzed in the section on heat and health.	9. Human Health		351	26	A discussion of the exhaust heat and form of the urban heat island effect is perhaps more appropriate to the "Urban Systems, Infrastructure, and Vulnerability" chapter (Ch.11) of the NCA draft report. Urban heat island effect is mentioned on lines 3-4 of page 343, but owing to space constraints we cannot provide more detail. We have revised text in the 'Temperature Extremes' section (on p. 343 line 6), to incorporate a reference to Chapter 11.
Cato	Institute	General CommentWhen I reviewed the 2009 draft Assessment, I stated that in my long career, of the many such documents I had reviewed, it was “by far the worst.” That was then, this is now. The Human Health chapter is the worst single chapter I have ever read on climate change. It is littered with statements of “fact” that are easily challenged by the simplest observations. Here is an example from page 349:"…some patients with mental illness are especially susceptible to heat (ref). Suicide varies seasonally (ref), suggesting potential climate impacts on depression. "OK. Are people more depressed in the South? Silly me, I was under the impression that Seasonal Affective Disorder is related to cold temperatures and short days. I stand corrected. It goes on:"Dementia is a risk factor for hospitalization and death during heat waves (ref). Patients with severe mental illness such as schizophrenia are at risk during hot weather related both to their illness (ref) and their medications (ref)."More schizophrenia is expressed in the south and in Arizona? Further, "Additional potential mental health impacts, less well understood [!!!-eds], include distress associated with environmental degradation (refs), and the anxiety and despair that knowledge of climate change might elicit in some people (ref)."You might add, “caused by scientists pushing insane hypotheses as facts.” How depressing!	9. Human Health				This comment is inconsistent with the author team’s thorough assessment of the science.
Lauren	Baum	The NCA should take note of Dr. Wieslaw Maslowski's study, The Future of Arctic Sea Ice. Abstract: Arctic sea ice is a key indicator of the state of global climate because of both its sensitivity to warming and its role in amplifying climate change. Accelerated melting of the perennial sea ice cover has occurred since the late 1990s, which is important to the pan-Arctic region, through effects on atmospheric and oceanic circulations, the Greenland ice sheet, snow cover, permafrost, and vegetation. Such changes could have significant ramifications for global sea level, the ocean thermohaline circulation, native coastal communities, and commercial activities, as well as effects on the global surface energy and moisture budgets, atmospheric and oceanic circulations, and geosphere-biosphere feedbacks. However, a system-level understanding of critical Arctic processes and feedbacks	22. Alaska and the Arctic				We have added the suggested citations in our chapter assessment.

		is still lacking. To better understand the past and present states and estimate future trajectories of Arctic sea ice and climate, we argue that it is critical to advance hierarchical regional climate modeling and coordinate it with the design of an integrated Arctic observing system to constrain models.Citation: Maslowski, W., Kinney, J.C., Higgins, M., and Roberts, A. (2012). The future of Arctic sea ice. The Annual Review of Earth and Planetary Sciences, 40: 625-54. Doi: 10.1146/annurev-earth-042711-105345. Link: http://www.oc.nps.edu/NAME/Maslowski%20et%20al.%202012%20EPS%20Future%20of%20Arctic%20Sea%20Ice.pdf					
Cato	Institute	This sentence is completely meaningless. Delete.	9. Human Health		334	1	The authors disagree and believe the sentence does have meaning, most specifically making the point that not all health impacts of climate change can be prevented or eliminated by adaptation.
Joseph	Zajac	1. Overall impression is this paper is poorly written, unprofessional, and designed to invoke fear and panic. Written very much like a sensationalized news story instead of a balanced and serious paper.2. Written as if there is no doubt, however much doubt exists, the paper just refuses to admit many scientists and people doubt global warming. 3. Fails to establish minimum requirements for paper inclusions such as: no data sets smaller than 500 readings/samples; no paper older than 5 years; no margin of error larger than 10%; no use of non-accepted/non-standardized/non quantified terminology (use of extreme (fill in a word) for example) etc. Worst data offender: (1 M. What about the global cooling predictions in the 1970? Page 1087, caption 1088)Analysis of just 71 papers over a 15 year period (3 per year!) concluding because 44 papers supported global warming, the literature at the time supported global warming. Study ignored a major report by the CIA in 1974 and all the participating scientists concluding global cooling!4. Not one dissenting or opposing opinions are included in the paper. Each chapter must include opposing opinions for balance.5. No biographies, education, list of relevant qualifications, list of relevant papers written, salaries, or funding sources; for the 60-person Federal Advisory Committee.6. No biographies, education, list of relevant qualifications, list of relevant papers written, salaries, or funding sources; for the scientists whose papers are referenced in the report.7. No conflict of interest disclosure by any person. 8. No disclosure on how much funding has each contributor received and from whom?9. Not one mention of “margin of error” on the data or conclusions in the paper; however “confidence” is used without explaining that increasing the margin of error also increases the level of confidence a value falls within a projected range. Just one mention of “margins of error” without a quantified explanation. 10. Paper makes excessive use of shocking and highly subjective words such as: a. "extreme" b. “massive” and c. “heavy”;Without quantifying the exact meaning in the context of the sentence. Chapter 1: p 13, 19-20. “ Terms like “weather-extremes,” “climate extremes,” “heat waves,” and “heavy downpours” need to be defined when used in a scientific context.”Proper reporting requires SPECIFIC definition of terminology. You CANNOT use undefined, unaccepted and non-standardized terms in a scientific report! This pure	Introduction: Letter to the American People				The authors intend to provide a balanced summary based on the weight of evidence. All of the findings in this report are compliant with the Information Quality Act. The draft has now been reviewed multiple times by the FACA Committee that is responsible for this document, as well as the National Research Council, the public, and 13 federal agencies. The FACA Committee membership was reviewed when they were nominated for potential conflict of interest and none of the members were found to have any conflicts. All of their work and the work of the 240 authors on this report was pro bono. The authors believe that the language that has been used in the report is understandable.

		fear mongering. EVERY reference using the words below MUST be removed. 11. Use of NON-EXISTENT terminology. Phrases do not exist in any weather or in meteorological dictionaries as: a. "extreme events" b. "extreme heat" c. "extreme weather" d. “extreme extremes” e. “extreme heat events” f. “extreme precipitation” g. “extreme weather events” h. “heat waves” i. “heavy downpours” j. “heavy flood events” k. “heavy precipitation” l. “heavy precipitation events” m. “heavy rains” n. “heavy rain events” o. “heavy rainfall events” p. “heavy snows” q. “heavy snowstorms” r. “high temperature extremes” s. “intense extreme heat” t. “massive flooding” u. “moderate extremes” v. “rare precipitation event” w. “strong hurricanes”					

		x. “urban heat extremes” y. “very heavy precipitation” z. “weather extremes”12. There is an overall lack of factoring in CO2 consumption by plant life in the climate models incorporated in the report.					
Cato	Institute	You continue to miss the positive externalities associated with climate change, like the fact that we have doubled our life spans in societies that were largely powered by fossil fuels that have slightly raised mean global temperature.Doubling the lifespan of, say, two billion people, is equivalent to saving one billion lives. This dwarfs any negative effects of climate change. Me, I’ll take 85 quality years versus 43 with a price of one degree Celsius, which I can counter simply by moving from the city into the 'burbs.	9. Human Health		334	3	The authors disagree with the assertion that the doubling of life span is a result of climate change that has occurred to this point. The commenter's point is well taken that there have been remarkable improvements in health associated with the industrial revolution and the use of fossil fuels as an energy source.
Cato	Institute	Multiple system failure here with regard to extreme events! Please correct in light of the following:With regard to the effects of “increasingly frequent and intense extreme heat,” mortality from heat waves declines as heat wave frequency increases. The NCA claim to the contrary is not borne out in the empirical data. From the 1970s to the 1990s, population-standardized heat-related deaths declined across the U.S. (despite the great Chicago heat wave of 1995) (e.g., Davis et al., 2003). Between 1979–1992 to 1993–2006, the average annual death rates for excessive cold and excessive heat declined by 31% and 17%, respectively (Goklany, 2009).Based on data from 1895 onward, heat waves in the U.S. peaked in the 1930s, according to the U.S. Climate Change Science Program (USCCSP, 2008). However, the latter notes that, “In contrast to the 1930s, the recent period of increasing heat wave index is distinguished by the dominant contribution of a rise in extremely high nighttime temperatures.” (Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Annual value of a U.S. national average “heat wave” index. Heat waves are defined as warm spells of 4 days in duration with mean temperature exceeding the threshold for a 1 in 10 year event (US EPA, 2010).Several studies find that heat waves for the most part have become less deadly in urban areas. Davis et al. (2003) found that from 1964 to 1998, heat-related deaths declined significantly for 19 of 28 U.S. metropolitan areas, as well as for the 28-city average. Kalkstein et al. found a reduction in mortality attributable to excessive heat events from 1996 to 2004 for 40 major U.S. metropolitan areas.(Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Average heat-related mortality in U.S. urban areas has declined nationwide (Davis et al., 2003); subsequent research shows this trend continues into the 21st century (Kalkstein et al., 2011).The Davis et al. (2003) study also shows that base heat wave mortality is much lower in urban areas where they are more frequent. Notably, the two cities with the lowest mortality, Tampa and Phoenix, have some of the oldest age-distributions in the world. Thus the subsequent (Page 350, lines 4-5) statement that “the elderly are more vulnerable to heat stress,” while physiologically correct, is profoundly misleading. Not only it is quite clear that in affluent societies that adaptation to heat more than compensates for the relative inability of the elderly to tolerate very high temperatures, but also increasing vulnerability as the elderly population increases has little to do with climate change.Further, greenhouse warming will warm the extreme cold of winter more than it will raise the high temperatures of summer. Greenhouse physics demonstrates that the cold, dry air of the winter must warm more than the hot, moist air of the U.S. summer. This is because the atmosphere’s two main greenhouse gases, water and carbon dioxide, absorb some of the same infrared wavelengths emitted by the earth’s surface. When both gases are in	9. Human Health		334	9	Thank you for your comment, but the authors disagree that a text correction is required. The cited section of the chapter refers to key drivers of health impacts, which include extreme heat. As described in Chapter 2 of the NCA draft report (Our Changing Climate), in the past 3 to 4 decades in the U.S. the ratio of record daily high temperatures to record daily low temperatures has steadily increased. This trend toward increasingly frequent and intense extreme heat is an important health driver to include, especially since extreme heat remains associated with increased mortality and morbidity. Not all people have access to air conditioning at times of increased heat vulnerability, as witnessed in recent power outages during heat waves (see Anderson and Bell 2012). With climate change, rising temperatures will create an even greater place demand for energy, adding strain to aging power grids. In order to provide some more insights into the question of net effects of extreme cold and heat on mortality, section on Temperature Extremes (p. 343, line 12) has been updated to include a citation to Li et al. (2013) study, which found a net

		short supply (as they were in the necessarily dry winter air prior to the major emissions of carbon dioxide) an increment of either of them creates much more warming than a similar change in the moist warm air of summer. This logarithmic response of temperature to greenhouse gases at similar wavelengths has been known for over a hundred years.The reality of this can be demonstrated by comparing January and July temperatures over the US that are concurrent with the global warming that began in the mid-1970s. These are the two months that see the most extreme cold and warm excursions of the calendar year. (Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: January and July climatologically have the year's most extreme temperatures. These plots are coterminous US average temperature beginning in 1976, which is the beginning year for the second ("global") warming of the 20th century. It is very clear from this data that the extreme cold of winter has warmed approximately three times more than the extreme heat of summer (data source: NCDC).As the relative warming of extreme cold must be greater than the increase in extreme heat, and weather-related deaths from cold far exceed those from heat, greenhouse warming should therefore result in an overall decrease in temperature-related mortality.(Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Estimated effect of cold and hot temperature exposure on daily female all-cause mortality rates for 30 days following exposure (Deschenes and Moretti, 2009). Note that the number of abnormal deaths from extreme winter cold persists to day 15, while the death rate actually drops below normal three days after extreme heat, and the average anomaly remains negative through 30 days. References:Davis RE, Knappenberger PC, Michaels PJ, Novicoff WM, 2003. Changing Heat-Related Mortality in the United States. Environmental Health Perspectives 111: 1712–18.Goklany, I., 2009. Deaths and death rates from extreme weather events: 1900-2008. Journal of the American Physicians and Surgeons, 14(4), 102-109.U.S. Climate Change Science Program, 2008. Weather and Climate Extremes in a Changing Climate Final Report, Synthesis and Assessment Product 3.3.U.S. Environmental Protection Agency, 2010. Climate Change Indicators in the United States, www.epa.gov/climatechange/indicators.html, updated from U.S. Climate Change Science Program's 2008 report: Synthesis and Assessment Product 3.3: Weather and climate extremes in a changing climate.Kalkstein, L.S., Greene, S., Mills, D.M., and Samenow, J., 2011. An evaluation of the progress in reducing heat-related human mortality in major U.S. cities. Natural Hazards 56 (1): 113-129. Deschenes, O., and E. Moretti, 2009. Extreme weather events, mortality and migration. Review of Economics and Statistics, 91, 659-681.					annual increase in temperature-related deaths across 16 downscaled global climate models and 2 future emissions scenarios, for Manhattan (New York) in the 2020s, 2050s and 2080s.
Lauren	Baum	The NCA should take note of the report that links arctic amplification to extreme weather in mid latitudes. Abstract: 1] Arctic amplification (AA) – the observed enhanced warming in high northern latitudes relative to the northern hemisphere – is evident in lower-tropospheric temperatures and in 1000-to-500 hPa thicknesses. Daily fields of 500 hPa heights from the National Centers for Environmental Prediction Reanalysis are analyzed over N. America and the N. Atlantic to assess changes in north-south (Rossby) wave characteristics associated with AA and the relaxation of poleward thickness gradients. Two effects are identified that each contribute to a slower eastward progression of Rossby waves in the upper-level flow: 1) weakened zonal winds, and 2) increased wave amplitude. These effects are particularly evident in autumn and winter consistent with sea-ice loss, but are also apparent in summer, possibly related to earlier snow melt on high-latitude land. Slower progression of upper-level waves would cause associated weather patterns in mid-latitudes to be more persistent, which may lead to an increased probability of extreme weather events that result from prolonged conditions, such as drought, flooding, cold spells, and heat waves.CITATION: Francis, J and Vavrus, S.J. (2012). Evidence linking arctic amplification to extreme weather in mid-latitudes. Geophysical Research Letters. Link: http://onlinelibrary.wiley.com/doi/10.1029/2012GL051000/abstract	22. Alaska and the Arctic				We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include. We do cite this reference (Francis and Vavrus) and inter-regional interactions in the climate system are addressed in chapter 2.
Cato	Institute	Forecast is not consistent with observations. Sentence could stay as long as it acknowledges the actual	9.		334	22	The sentence in the chapter reports on

		behavior of low-level ozone is opposite to what it asserts.(Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Both the observed trend in May–September ozone (red line) and the trend corrected for varying weather conditions (blue line) show a significant decline from 1997–2009 (EPA).In general, warming temperatures should increase the rates of the chemical reactions that create urban smog, ozone, and other noxious compounds, including NOx. Nonetheless, as cities have warmed, air quality has improved. This has occurred despite major increases in economic activity and vehicular traffic in most cities. According to EPA estimates, total emissions of six major pollutants declined by more than 60% over that same time period.(Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Despite an increasing population, energy consumption, and economic productivity, U.S. pollution emissions declined by 63% since 1980 (EPA).There are several reasons for this. Regulations regarding pollutants arecertainly a major factor, and, despite increasing the rates of associated chemical reactions, climate change also plays a role. Pollutants tend to concentrate in stable air masses in which temperature increases with height above the surface. However, because the surface has been warming relative to the overlying atmosphere, the long-term tendency has been to destabilize the atmosphere, resulting in more vertical mixing and less concentrated pollutants. This trend is particularly true in cities (the areas of greatest pollution concern) because of the urban heat island effect in which cities are generally warmer than the surrounding rural areas. Furthermore, precipitation serves to wash pollutants out of the atmosphere. While nationally-averaged rainfall has increased, there is another increment that is strictly related to urban warming itself (e.g., Dixon et al., 2003) and so played a role in air quality improvements. Given the historic trends in air quality, technology, and climate, it is highly likely that U.S. air quality in future decades will be even better than it is today and that the populace will be healthier and have an even longer life expectancy.References:Dixon, P. Grady, Thomas L. Mote, 2003. Patterns and Causes of Atlanta's Urban Heat Island–Initiated Precipitation. J. Appl. Meteor., 42, 1273–1284.U.S. Environmental Protection Agency, Air Trends, http://epa.gov/airtrends/index.html	Human Health				peer-reviewed studies on modeling the effect of climate change in the future, with details of past observed trends in air quality less relevant given space constraints. Commenter's points about the complexity of atmospheric processes associated with climate change are well taken, and will be incorporated as more information about uncertainty in the Traceable Account, due to text space constraints. Authors will add text to mention other factors that influence ground-level ozone.
Cato	Institute	Why rag on ragweed? Yes it produces pollen that is allergenic, but also, from anecdotal reports (e.g. Illinois Wildflowers), "Common Ragweed is very valuable to many kinds of wildlife. Honeybees have been observed collecting pollen from the male flowers, otherwise flower-visiting insects are not attracted to this plant. The caterpillars of several moths eat the foliage, flowers, or seeds, including Schinia rivulosa (Ragweed Flower Moth), Synchlora aerata (Wavy-Lined Emerald), Tarachidia erastrioides (Small Bird-Dropping Moth), Tarachidia candefacta (Olive-Shaded Bird-Dropping Moth), and others (see Moth Table). In my experience, some species of grasshoppers are quite abundant around colonies of Common Ragweed, probably because they eat the foliage and prefer the disturbed, open habitats where this plant occurs. Many upland gamebirds and granivorous songbirds are attracted to the oil-rich seeds (see Bird Table). Because the spikes of seeds often remain above snow cover, they are especially valuable to some of these birds during winter. The seeds are also eaten to some extent by the Thirteen-Lined Ground Squirrel, Meadow Vole, and Prairie Vole. The seeds are probably semi-digestible, thus some of them are likely distributed far and wide by these animals. On the other hand, the foliage is quite bitter, therefore mammalian herbivores do not often consume it…"Common Ragweed is a major cause of hay fever during the late summer and fall. Aside from this unfortunate characteristic, it has considerable ecological value to various birds and moths, and therefore it isn't necessarily desirable to destroy this plant on sight.Reference:Illinois Wildflowers, http://www.illinoiswildflowers.info/weeds/plants/cm_ragweed.htm	9. Human Health	9.2	336		The commenter's points about the ecological value of ragweed are well taken. However, the focus of this chapter is on the human health impacts. There is no recommendation in this chapter to eliminate ragweed plants.
Lauren	Baum	Presumably, the NCA will receive comments in defense of the Sheffield study on drought. A few notes on why that study is flawed: • The conclusions of Sheffield are likely wrong. • Sheffield re-examines the Palmer Drought Severity	2. Our Changing Climate				Note that the figure using PDSI has been moved the appendix and a detailed discussion of the limitations of this drought index added. The new

		Index (PDSI) used to measure drought. However, this has already been done by others who came to a different conclusion than Sheffield: Dai, A. Characteristics and trends in various forms of the Palmer Drought SeverityIndex during 1900–2008. J. Geophys. Res. 116, D12115 (2011) and van der Schrier, G., Jones, P. D. & Briffa, K. R. The sensitivity of the PDSI to the Thornthwaite and Penman–Monteith parameterizations for potential evapotranspiration. J. Geophys. Res. 116, D03106 (2011).• Ironically, the Sheffield paper acknowledges that others have already looked at this issue, but Sheffield dismisses their findings. • Adding insult to irony, Sheffield et al commits the very sin that they accuse others of doing: drawing conclusions that are based on inconsistent and incomplete data sets.• Sheffield also fails to account for natural variation in the moisture cycle driven by the El Nino/ La Nina cycle, which has swung to the wet side in recent years, the past 2 years have been the wettest on record. • Climate change is making wet areas wetter and dry areas dryer. By averaging out the results of this process, Sheffield hides the extent and intensity of drought where it occurs.• The bottom line is that climate change adds extra heat to the system and that much of heat goes into drying. A natural drought for whatever reason sets in quicker, becomes more intense, and possibly is longer lasting and more extensive as a result. Climate change does not manufacture drought, but it does exacerbate them and expand where they occur.• Ironically, Nature's sister publication Nature Climate Change just published the results of a large study that IS able to do what Sheffield could not: detect the climate signal in drought. http://www.nature.com/nclimate/journal/vaop/ncurrent/full/nclimate1633.html					discussion about drought in chapter 2 focuses on soil moisture projections in the western US (a similar calculation for the entire country being yet unavailable) and Consecutive Dry Days. Both of these measure suggest increased drought risk for much of the US.
Cato	Institute	Yes, pollen counts rise with increasing carbon dioxide—because it makes for a greener world, which is being observed (see many Myneni and Nemani and NASA NDVI references).Rising temperatures and carbon dioxide concentration increase and/or decrease pollen production and the pollen season in some plants and/or others.Because increased levels of CO2 enhance plant growth and higher temperatures lengthen the growing season, many plants and crops are blooming earlier and growing over a longer period of time. This is advantageous for certain commercial crops (e.g. grapes) that require a very long growing season to fully mature.This enhanced plant growth also affects pollen. With an earlier onset of spring, this will shift the timing of the pollination of most plants. But the impact of higher temperatures and CO2 on pollen is uncertain, as some species of plant seem to produce more pollen given the longer growing season (e.g., Rasmussen, 2002), while others are negatively impacted (e.g., Matsui et al., 1997).Higher levels of atmospheric CO2 ameliorate, and sometimes fully compensate for, the negative influences of various environmental stresses on plant growth, including the stress of high temperature.Atmospheric CO2 enrichment has also been shown to help ameliorate the detrimental effects of several environmental stresses on plant growth and development, including high soil salinity (e.g., Azam et al., 2005), high air temperature (e.g., Aranjuelo et al., 2005) , low light intensity (e.g., Sefcik et al., 2006), high light intensity (e.g., Rasineni et al., 2011), UV-B radiation (e.g., Zhao et al., 2004), water stress (e.g., Robredo et al., 2007), and low levels of soil fertility (e.g., Barrett et al., 1998). Elevated levels of CO2 have additionally been demonstrated to reduce the severity of low temperature stress (Boese et al., 1997), oxidative stress (e.g., Donnelly et al., 2005), and the stress of herbivory (e.g., Newman et al., 1999). In fact, the percentage growth enhancement produced by an increase in the air's CO2 concentration is generally even greater under stressful and resource-limited conditions than it is when growing conditions are ideal.(Figure emailed to comments@usgcrp.gov as per instructions)CAPTION. Percent growth enhancement as a function of atmospheric CO2 enrichment in parts per million (ppm) above the normal or ambient atmospheric CO2 concentration for plants growing under stressful and resource-limited conditions and for similar plants growing under ideal conditions. Each line is the mean result obtained from 298 separate experiments (Idso and Idso, 1994).Among the list of environmental stresses with the potential to negatively impact agriculture, the one that elicits the most frequent concern is high air temperature. In this regard, there is a commonly-held belief that temperatures may rise so high as to significantly reduce crop yields, thereby diminishing our capacity to produce food, feed, and fuel products. It has also been suggested that	9. Human Health	9.3	337		Thank you for your comment, however we have taken out this figure.

warmer temperatures may cause a northward shift in the types of crops grown by latitude that could have additional adverse impacts on agricultural production. However, frequently left out of the debate on this topic is the fact that the growth-enhancing effects of elevated CO2 typically increase with rising temperature. For example, a 300-ppm increase in the air's CO2 content in 42 experiments has been shown to raise the mean CO2-induced growth enhancement from a value of zero at 10°C to a value of 100% at 38°C (Idso and Idso, 1994).This increase in CO2-induced plant growth response with increasing air temperature arises from the negative influence of high CO2 levels on the growth-retarding process of photorespiration, which can "cannibalize" 40 to 50% of the recently-produced photosynthetic products of C3 plants. Since this phenomenon is more pronounced at high temperatures, and as it is ever-more-inhibited by increasingly-higher atmospheric CO2 concentrations, there is an increasingly-greater potential for atmospheric CO2 enrichment to benefit plants as air temperatures rise.A major consequence of this phenomenon is that the optimum temperature for plant growth generally rises when the air is enriched with CO2. For a 300-ppm increase in the air's CO2 content, in fact, several experimental studies have shown that the optimum temperature for growth in C3 plants typically rises by 5°C or more (e.g., Cowling and Sykes, 1999). These observations are very important; for an increase of this magnitude in optimum plant growth temperature is greater than the largest air temperature rise predicted to result from a 300-ppm increase in atmospheric CO2 concentration. Therefore, even the most extreme global warming envisioned by the Intergovernmental Panel on Climate Change will probably not adversely affect the vast majority of Earth's plants; for fully 95% of all plant species are of the C3 variety. In addition, the C4 and CAM plants that make up the rest of the planet's vegetation are already adapted to Earth's warmer environments, which are expected to warm much less than the other portions of the globe; yet even some of these plants experience elevated optimum growth temperatures in the face of atmospheric CO2 enrichment (Chen et al., 1994). Consequently, a CO2-induced temperature increase will likely not result in crop yield reductions, nor produce a poleward migration of plants seeking cooler weather; for the temperatures at which nearly all plants perform at their optimum is likely to rise at the same rate (or faster than) and to the same degree as (or higher than) the temperatures of their respective environments. And other research indicates that even in the absence of a concurrent increase in atmospheric CO2, plants may still be able to boost their optimum temperature for photosynthesis as the temperature warms (Gunderson et al., 2010).References:Aranjuelo, I., Irigoyen, J.J., Perez, P., Martinez-Carrasco, R. and Sanchez-Diaz, M. 2005. The use of temperature gradient tunnels for studying the combined effect of CO2, temperature and water availability in N2 fixing alfalfa plants. Annals of Applied Biology 146: 51-60.Azam, F., Aziz, F., Sial, M.H., Ashraf, M. and Farooq, S. 2005. Mitigation of salinity effects on Sesbania aculeata L., through enhanced availability of carbon dioxide. Pakistan Journal of Botany 37: 959-967.Barrett, D.J., Richardson, A.E. and Gifford, R.M. 1998. Elevated atmospheric CO2 concentrations increase wheat root phosphatase activity when growth is limited by phosphorus. Australian Journal of Plant Physiology 25: 87-93.Boese, S.R., Wolfe, D.W. and Melkonian, J.J. 1997. Elevated CO2 mitigates chilling-induced water stress and photosynthetic reduction during chilling. Plant, Cell and Environment 20: 625-632.Chen, D.X., Coughenour, M.B., Knapp, A.K. and Owensby, C.E. 1994. Mathematical simulation of C4 grass photosynthesis in ambient and elevated CO2. Ecological Modeling 73: 63-80.Cowling, S.A. and Sykes, M.T. 1999. Physiological significance of low atmospheric CO2 for plant-climate interactions. Quaternary Research 52: 237-242.Donnelly, A., Finnan, J., Jones, M.B. and Burke, J.I. 2005. A note on the effect of elevated concentrations of greenhouse gases on spring wheat yield in Ireland. Irish Journal of Agricultural and Food Research 44: 141-145.Gunderson, C.A., O'Hara, K.H., Campion, C.M., Walker, A.V. and Edwards, N.T. 2010. Thermal plasticity of photosynthesis: the role of acclimation in forest responses to a warming climate. Global Change Biology 16: 2272-2286.Idso, K.E., and Idso, S.B. 1994. Plant responses to atmospheric CO2 enrichment in the face of environmental constraints: A review of the past 10 years' research. Agricultural and Forest Meteorology 69: 153-203.Matsui, T., Namuco, O.S.,

		Ziska, L.H., Horie, T., 1997. Effects of high temperature and CO2 concentration on spikelet sterility in indica rice. Field Crops Research 51, 213–219.Newman, J.A., Gibson, D.J., Hickam, E., Lorenz, M., Adams, E., Bybee, L. and Thompson, R. 1999. Elevated carbon dioxide results in smaller populations of the bird cherry-oat aphid Rhopalosiphum padi. Ecological Entomology 24: 486-489.Rasmussen, A., 2002. The effects of climate change on the birch pollen season in Denmark. Aerobiologia, 18, 253–265.Robredo, A., Perez-Lopez, U., Sainz de le Maza, H., Gonzalez-Moro, B., Lacuesta, M., Mena-Petite, A. and Munoz-Rueda, A. 2007. Elevated CO2 alleviates the impact of drought on barley improving water status by lowering stomatal conductance and delaying its effects on photosynthesis. Environmental and Experimental Botany 59: 252-263.Sefcik, L.T., Zak, D.R. and Ellsworth, D.S. 2006. Photosynthetic responses to understory shade and elevated carbon dioxide concentration in four northern hardwood tree species. Tree Physiology 26: 1589-1599.Zhao, D., Reddy, K.R., Kakani, V.G., Mohammed, A.R., Read, J.J. and Gao, W. 2004. Leaf and canopy photosynthetic characteristics of cotton (Gossypiuym hirsutum) under elevated CO2 concentration and UV-B radiation. Journal of Plant Physiology 161: 581-590.					
Marjorie	McGuirk	A discussion about projected polar sea ice loss should include monthly projections, not just the September minimum. For reference, see the article FutureArctic marine access:analysisandevaluation ofobservations, models, and projectionsofseaiceT.S. Rogers ,J.E. Walsh , T. S. Rupp , L. W. Brigham , andM. Sfraga by the The International Arctic Research Center, Fairbanks, AK, Published in The Cryosphere Discuss.: 19 September 2012It contains a graphic showing monthly modeled projections of sea ice loss. It makes a strong case that supports the on-going discussions by NOAA with the Arctic Council to move forward rapidly on development of infrastructure support for increased shipping off the coast of Alaska.	2. Our Changing Climate		66	1	Figure 9 in Rogers et al. (2013) indeed contains projections of pan-Arctic ice extent for all calendar months. The projected changes for the cold season are small (about 10% loss for December-May, compared to a nearly complete loss in September by the middle of the 21st Century. We have added two sentences about the seasonality of projected changes (p. 68), and we have added the reference to Rogers et al. (2013).
Lauren	Baum	The NCA should take note of the study that found that environmental heat stress has reduced labor capacity to 90% in peak months over the past few decades. Abstract: A fundamental aspect of greenhouse-gas-induced warming is a global-scale increase in absolute humidity1, 2. Under continued warming, this response has been shown to pose increasingly severe limitations on human activity in tropical and mid-latitudes during peak months of heat stress3. One heat-stress metric with broad occupational health applications4, 5, 6 is wet-bulb globe temperature. We combine wet-bulb globe temperatures from global climate historical reanalysis7 and Earth System Model (ESM2M) projections8, 9, 10 with industrial4 and military5 guidelines for an acclimated individual's occupational capacity to safely perform sustained labour under environmental heat stress (labour capacity)—here defined as a global population-weighted metric temporally fixed at the 2010 distribution. We estimate that environmental heat stress has reduced labour capacity to 90% in peak months over the past few decades. ESM2M projects labour capacity reduction to 80% in peak months by 2050. Under the highest scenario considered (Representative Concentration Pathway 8.5), ESM2M projects labour capacity reduction to less than 40% by 2200 in peak months, with most tropical and mid-latitudes experiencing extreme climatological heat stress. Uncertainties and caveats associated with these projections include climate sensitivity, climate warming patterns, CO2 emissions, future population distributions, and technological and societal change.CITATION: Dunne, J.P., Stouffer, R., and John, J.G. (2013). Reductions in labour capacity from heat stress under climate warming. Nature Climate Change. Link: http://www.nature.com/nclimate/journal/vaop/ncurrent/full/nclimate1827.html	9. Human Health				This comment is outside of the scope of this chapter, where we assess health effects, not impacts to labor capacity.
Cato	Institute	Assertions run counter to large data analysis. It is incumbent on NCADAC to counter the references and analysis in the following commentary.America's cities predict the adaptation of society to prospective	9. Human		342	1	The statements in the opening paragraph of this section are all

		global warming. The urban heat island effect has raised averaged urban air temperatures by 2 to 5°F over the surrounding countryside, and as much as 20° at night (Grimmond, 2007). This warming takes place gradually and is similar in magnitude to non-urban warming rates predicted for the 21st century from increasing atmospheric greenhouse gases. Cities and their residents are indeed testing whether or not global warming increases heat-related mortality.(Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Heat wave related mortality is declining in almost all US cities and is lowest where in cities with elderly populations in which heat waves are most frequent (Davis et al., 2003).Heat waves for the most part have become less deadly in urban areas. From 1964 to 1998, heat-related deaths declined significantly for 19 of 28 U.S. metropolitan areas, as well as for the 28-city average (Davis et al., 2003). Since then, another study found a reduction in mortality attributable to excessive heat events from 1996 to 2004 for 40 major U.S. metropolitan areas (Kalkstein et al., 2011).Baseline heat wave mortality is much lower in urban areas where they are more frequent (Davis et al., 2003). Notably, the two cities with the lowest such mortality, Tampa and Phoenix, have some of the oldest age-distributions in the world. The Assessment statement “Many cities…have sustained dramatic increases in death rates following heat waves” is profoundly misleading in light of the totality of the data that is shown in the map and references above; it is quite clear that in affluent societies that adaptation to heat more than compensates for the relative inability of the elderly to tolerate very high temperatures.References:Davis, R. E., Knappenberger, P. C., Michaels, P. J., and Novicoff, W. M., 2003. Changing Heat-Related Mortality in the United States. Environmental Health Perspectives, 111,1712–18.Grimmond, S., 2007. Urbanization and global environmental change: local effects of urban warming. Geographical Journal, 171 83-88.111Kalkstein, L.S., Greene, S., Mills, D.M., and Samenow, J., 2011. An evaluation of the progress in reducing heat-related human mortality in major U.S. cities. Natural Hazards, 56 (1): 113-129.	Health				referenced and well recognized by the public health community. The comments do not refute any of those statements. The overall trend in decreasing mortality is discussed by the authors on page 343.
Lauren	Baum	The NCA should take note of the fact that two Great Lakes (Lake Huron, Lake Michigan) hit record low water levels in February 2013, causing heavy economic losses by forcing cargo ships to carry lighter loads, leaving boat docks high and dry, and damaging fish-spawning areas.http://www.wunderground.com/news/great-lakes-record-low-water-levels-20130206	5. Transportation				Thank you for your suggestion. We find that there is no consensus in the climate science community about whether the Great Lakes are rising or falling or both.
Cato	Institute	Unrealistic scenario; inconsequential result. We realize this is repetitive, but the Assessment would do well to eliminate most references to A2, which was generated before the realization that shale gas will become ubiquitous as an electrical generation feedstock and may make strong inroads into vehicular transportation. The glib counter that “current emissions are above A2” is an infrared herring as emissions in A1B are actually supposed to be higher than A2 at this point in time. More importantly, Figure 9.7 ignores a lot of real adaptation to hot weather. The figure above, in the last comment, shows that heat-related mortality is virtually nonexistent in Tampa and Phoenix, the two cities with the oldest population distributions and some of the highest heat indices in the nation. Note Figure 9.7 shows an average (1971-2000) of 100-plus days over the Southwest. Splitting the difference between the unrealistic A2 and B1 yields an average of about 13 nationwide for 2041-70 (about as far as one can realistically project). Given the adaptation in the currently hot cities with relatively elderly population distributions, it is obvious that we will adapt to what is being forecast to occur—which, of course, is why heat-related mortality shows no rise in CDC data (but actually declines; see previous comment (ID 34726)for references).	9. Human Health	9.7	342		Authors shifted Figure 9.7 to a new selection that applies an alternate set of emissions scenarios. Unfortunately, heat-related mortality is not yet "non-existent" in Phoenix, AZ (as documented at: http://www.azdhs.gov/plan/report/heat/heat09.pdf).
Lauren	Baum	The NCA should take note of a February 2013 announcement from the Government Accountability Office that the GAO has added financial risks of climate change and gaps in weather satellite data to its "high risk list."For more information: http://www.gao.gov/press/high_risk_additions_2013feb14.htm	26. Decision Support: Supporting Policy,				We have incorporated this reference into the report.

			Planning, and Resource Management Decisions in a Climate Change Context				
Cato	Institute	Food and Waterborne diseases have declined dramatically in frequency, despite warming temperatures. Text is very misleading with regard to the United States and in complete disregard for observed epidemiological data. Climatic warming the U.S. is not likely to significantly affect food, water, and insect-born disease, as these were major killers in the early 20th century, which is the coldest period in the U.S. instrumental record. They were eradicated not by changing climate but by improved sanitation and prevention. Given the huge natural range of U.S. climate, the hypothesis that a few degrees of warming would suddenly bring back massive disease is risible (as is the notion that West Nile virus spread across the US because of climate change). The cumulative death rate in 1900 from typhoid and paratyphoid, various GI diseases (gastritis, duodenitis, enteritis and colitis) and all forms of dysentery was 1,922 per million (Goklany, 2009). For a population the size of the U.S.'s today, that translates into over 600,000 deaths annually. Currently, however, deaths from all food, water and insect borne diseases are approximately 3,000 annually (Gillis 2011; Hall-Baker 2011). To put these numbers in context, the U.S. has 2,400,000 deaths annually. U.S. death rates from various water-related diseases—dysentery, typhoid, paratyphoid, other gastrointestinal diseases, and malaria—declined by 99.6–100.0% from 1900 to 1970. A severe 1994 outbreak of cryptosporidium is thought to have been responsible for at least 54 deaths in Milwaukee, but this was due to abnormally high concentrations that remained in the water after treatment. As cryptosporidium is present in 17% of sampled U.S. drinking water supplies (Rose et al., 1991), and the lack of any evidence for large scale endemicity indicates outbreaks are more a result of treatment error rather than climatic change. (Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Death rates (deaths per million) for various water-related diseases, U.S., 1900–70. By 1950, these had become (and remain) inconsequential from a public-health standpoint.(Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Malaria was a national scourge in the United States in the late 19th century, when the average surface temperature of the nation was about 1.5° lower than present (Reiter, 2001).In the late 19th century, when the coterminous United States was about 1.5° cooler than the present, malaria was endemic to the Canadian border. Sanitation, not climate change, is the major determinant of the disease.(Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: U.S. annual average temperature (data source: NCDC).Likewise, food, water, and insect-borne diseases were at their peak during the coldest part of the 20th century. Does anyone seriously think that the massive decline in incidence that occurred as surface average temperature warmed 1.5°F will suddenly reverse as it continues to warm?References:Gillis, D., 2011. Vital Signs: Incidence and Trends of Infection with Pathogens Transmitted Commonly Through Food — Foodborne Diseases Active Surveillance Network, 10 U.S. Sites, 1996–2010, MMWR 60 (22): 749-55.Goklany IM. 2009. Have increases in population, affluence and technology worsened human and environmental well-being? Electronic Journal of Sustainable Development 1(3).Hall-Baker, P.A., 2011. Summary of Notifiable Diseases — United States, 2009. MMWR 58 (53): 1-100.Reiter, P., 2001. Climate change and mosquito-borne disease. Environmental Health Perspectives, 109, 141-161.Rose, J.B., C.P. Gerba, and W. Jakubowski, 1991. Survey of Potable Water-Supplies for 21 Cryptosporidium and Giardia. Environment	9. Human Health		345	9	This comment refutes two points that the draft does not make. First, the comment states that food and waterborne disease have declined; the draft does not claim otherwise. The draft states only that such diseases are a "persistent concern" in the U.S.; the authors stand by that statement (see e.g. Brunkard et al., Surveillance for Waterborne Disease Outbreaks Associated with Drinking Water -- United States, 2007--2008. MMWR Surveillance Summary September 23, 2011 / 60 (ss12); 38-68). Second, the comment asserts that improved sanitation and prevention largely account for disease reductions over the 20th century; the authors agree, and the draft does not state otherwise. Finally, the comment asserts that cryptosporidium outbreaks reflect water treatment errors rather than climatic change. While water treatment errors can and do contribute to diarrheal disease outbreaks, this point does not refute the statements in the draft regarding associations between extreme precipitation events and outbreaks.

		Science & Technology, 25, 1393-1400.					
Cato	Institute	Comment above (ID 34756) applies. Frequency of waterborne disease is a function of sanitation and public health, and historically has varied inversely with temperature; i.e. temperature is irrelevant to this in our technologically advanced society. Why would that change?	9. Human Health	9.9	346		As temperature increases, atmosphere is capable of holding more water vapor, hence more extreme rainfall events occurrence tending to increase overall. Very high water volumes can challenge treatment facility capacities, or cause flooding that brings people into contact with potentially contaminated floodwaters, even for "technologically advanced societies."
David	Gassman	This too is excellent.	1. Executive Summary				Thank you for your comment.
David	Gassman	On page 3, line 15 the “economic opportunities” mentioned appear to me to require just a little elaboration. The opposing argument is that because dealing with climate change will be very expensive, actually doing so will harm economic opportunity. The contrary argument needs to be explained a little, not simply declared.	1. Executive Summary		3	15	The authors feel that no additional explanation is needed in this introductory statement, but slight modifications have been made to this language
David	Gassman	On page 4, line 19 I am reminded that particulate matter could produce a cooling effect that possibly should be acknowledged there.	1. Executive Summary		4	19	After consideration of this point, we still feel the existing text is clear and accurate.
David	Gassman	page 4, lines 35-41, since I know that calcium carbonate is composed of CO2, I am left wondering why increasing the concentration of this shell component material makes for less shell growth. I understand that acid eats away at shells, but there is nevertheless increased CO2 shell building material available now. Does it somehow dilute the calcium that is present? Is there an easy way to explain why increasing this shell building material concentration in the ocean is itself such a problem? I imagine that the proper place to provide such an explanation (assuming that I have made my confusion clear) is in the Ocean Acidification section on Page 69 of Chapter 2.	1. Executive Summary		4	35	After consideration of this point, we still feel the existing text is clear and accurate.
Cato	Institute	Ditto above (comment ID 34761). This is just nonsense given the actual data on waterborne diseases.	9. Human Health	9.10	347		Please see response to comment 34761.
Cato	Institute	Food-security is a non-issue.Food supply is a function of production minus consumption. Production is the product of yield multiplied by acreage. So, while it is obvious that changes in temperature and precipitation have detectable effects on yield, what really matters is how much is produced, which is reproduced below:(Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Global annual total production from maize, rice, soybeans, and wheat. Data source: Food and Agriculture Organization, United Nations, available at http://faostat.fao.org/site/567/DesktopDefault.aspx?PageID=567An exponential fit (Y = 2283.3 -2.32 (year) + .00059(year)2) is significantly better than a linear one, which demonstrates how insignificant the climatic component of global food production is. What’s missing here? There’s simply little, if any, effect of year-to-year global climate variability. That’s because the world food system is highly diverse, in terms of varieties grown and the climates in which they grow. Further, there is a tremendous amount of reserve built into food supply because of the (stupid) diversion towards biofuels. In fact, the amount we divert to ethanol dwarfs the amount that is lost to climate. Lobell (2011) reported that, after allowing for the growth enhancement from atmospheric carbon dioxide, global average crop	9. Human Health		348	11	This comment makes two major points. First, it refers to Lobell et al (2011) to argue that climate has little impact on agricultural production. That paper documents significant impacts, contrary to the commenter's characterization. Moreover that paper refers to the period 1980-2008, while the draft refers primarily to coming decades, when climate change will have accelerated. The authors stand by their statements. Second, the comment argues that ethanol production has diverted corn from

		yields were reduced by a bit less than 1% (which is small compared to the amount that they increased because of technological advances) during the period 1980-2008.But consider this. The U.S. produces about 36 percent of the world's corn. And about 40 percent of U.S. corn is used to produce ethanol for use as a gasoline substitute instead of being consumed by humans or animals. Globally, corn makes up 30 percent of total worldwide production of the four crops studied by Lobell's group.And even this less than 1 percent impact was described by Lobell et al. as perhaps being "overly pessimistic" because it did not fully incorporate long-term adaptive farming responses to changing climate conditions (i.e., farmers are not as dumb as statistical models make them out to be).What this means is that even under overly pessimistic scenarios, we still currently burn more than 4 times as much grain as climate change has taken away. Thinking about this in future terms, if we observe twice as much climate change from 2010 through 2038 as we did from 1980 to 2008 (Lobell's study period), all we would have to do is stop burning half as much ethanol as we do now to make up for the entire global climate-related crop reduction. Therefore, climate is an irrelevant overlay on world food supply for the foreseeable future. If we really need the food, just stop the stupid conversion to ethanol.Reference:Lobell, D.B., W. Schlenker, and J. Costa-Roberts, 2011. Climate trends and global crop production since 1980. Science, 333, 616-620.					food to fuel. This does not contradict anything in the draft. Space constraints prevent a full discussion of the complex tradeoff between food and fuel. The authors do not believe this issue undermines any statements in the draft.
Lauren	Baum	The NCA should cite and use the World Resource Institute's report, "Can the U.S. Get There from Here?" which posits if several policies are pursued with "go-getter" level ambition, the U.S. can reduce emissions 17 percent below 2005 levels in 2020. Link: http://www.wri.org/publication/can-us-get-there-from-here.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				The reference is outside of the scope of this chapter to discuss various mitigation policies and thus have chosen not to include it.
Cato	Institute	With regard to age-related mortality, Davis et al. (2003) found that from 1964 to 1998, heat-related deaths declined significantly for 19 of 28 U.S. metropolitan areas, as well as for the 28-city average. Kalkstein et al. (2011) found a reduction in mortality attributable to excessive heat events from 1996 to 2004 for 40 major U.S. metropolitan areas.The Davis et al. study also shows that base heat wave mortality is much lower in urban areas where they are more frequent. The two cities with the lowest mortality, Tampa and Phoenix, have some of the oldest age-distributions in the world. Thus the statement that "the elderly are more vulnerable to heat stress," while physiologically correct, is profoundly misleading; it is quite clear that in affluent societies that adaptation to heat more than compensates for the relative inability of the elderly to tolerate very high temperatures.Chronic respiratory disease deaths: by far the largest cause of this is smoking, and the decline in smoking rates is the main reason that respiratory disease death rates are now in decline. This volitional behavior is far more important than any climate change. Ditto for U.S. obesity and related diabetes rates. The dramatic increases have nothing to do with climate change, and dwarf climate's effects by orders of magnitude. If tens of millions of people are stupid enough to put themselves in harm's way like this, maybe we're kind of wasting our time harping on climate change, given the fact that we can't do much about it anyway?References:Davis RE, Knappenberger PC, Michaels PJ, Novicoff WM (2003). Changing	9. Human Health	9.12	350		Thank you for your perspective on susceptibility to high ambient temperatures. All heat-related mortality should be preventable. The fact that mortality continues to be high in heatwaves indicates a significant adaptation deficit. Whether that can be filled will depend on many interacting factors. A very large number of publications show the highest morbidity and mortality during heatwaves is among older adults. Physiological studies underscore the increase susceptibility of older adults to high ambient temperatures. In additional, behavior plays an

		Heat-Related Mortality in the United States. Environmental Health Perspectives 111: 1712–18.Kalkstein, L.S., Greene, S., Mills, D.M., and Samenow, J., 2011. An evaluation of the progress in reducing heat-related human mortality in major U.S. cities. Natural Hazards 56 (1): 113-129.					important role. For example, studies by Sheridan et al. show that older adults in the US often do not make the necessary behavioral changes to protect themselves during heatwaves even when they know a heatwave warning has been issued. Access to air conditioning or other cooling are important to reduce core body temperatures during heatwaves, but people do not often use them. Significant research is needed on actions to reduce morbidity and mortality during episodes of high ambient temperature.
Cato	Institute	Nice job conflating Katrina, hurricanes and increasing “extreme weather events.” Nice and misleading. Here’s what’s really happening:(Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Last 4-decades of Global and Northern Hemisphere Accumulated Cyclone Energy: 24 month running sums. Note that the year indicated represents the value of ACE through the previous 24-months for the Northern Hemisphere (bottom line/gray boxes) and the entire global (top line/blue boxes). The area in between represents the Southern Hemisphere total ACE. (data source: updates from Maue et al., 2011)The relationship between the global mean temperature anomaly and tropical cyclone energy in the Northern Hemisphere? Not very clear, to say the least! Further, tropical cyclone activity in the Atlantic Basin shows very little secular change. The history of the ACE index shows the relatively high levels of activity in the 1880s-1890s, 1950s-1960s, and the period since 1995. Periods of low levels of Atlantic tropical cyclone activity include the 1850s, 1910s-1920s, and 1970s-1980s. There is simply no relationship between ACE and global mean temperature. (Figure emailed to comments@usgcrp.gov as per instructions)CAPTION: Accumulated Cyclone Energy (ACE) index for the Atlantic Basin from 1851 through 2010. There is obviously no relationship to the temperature rise shown in the last chapter. (data source: http://www.aoml.noaa.gov/hrd/tcfaq/E11.html).A variety of factors act together to influence tropical cyclone development, growth, track, and whether or not a storm makes landfall along the U.S. coast. These include large-scale steering winds, atmospheric stability, wind shear, sea surface temperature and ocean heat content. Tropical storms and hurricanes develop and gain strength over warm ocean waters. However, it does not strictly follow that warmer waters lead to stronger hurricanes. New evidence has emerged that shows that the contrast in sea surface temperature between the main hurricane development region in the Atlantic and the broader tropical ocean plays an important role in hurricane development (Vecchi et al., 2008; Swanson 2008; Knutson et al., 2008). Additionally, other factors such as atmospheric stability and circulation can also influence hurricane frequency and intensity (Bell et al., 2011). For these and other reasons, a confident assessment of the causes of tropical cyclone variability in the Atlantic basin requires further study.Projections are that sea surface temperatures in the main Atlantic hurricane development region will increase during this century under higher emissions scenarios. Other environmental factors are projected to change as well, complicating assessment of future tropical cyclone behavior. This highlights the need to better understand the relationship between hurricane frequency, intensity, climate, and climate change (Knutson et al., 2010).The consensus is still evolving as to how anthropogenic climate change will alter the characteristics of Atlantic basin tropical cyclones. There is growing evidence that the frequency of Atlantic basin tropical cyclones will be little changed, but that some storms may become more intense, although the preferred tracks of storms may be altered in such a way as to reduce the threat of a U.S.	9. Human Health	9.13	352		The map illustrates an example of an impact (in this case, displacement of Louisiana residents) following an extreme weather event. The caption states that increases in the frequency and/or intensity of some extreme weather events is projected. This statement is consistent with the current state of science on this topic. We refer those interested in a deeper treatment of the topic to Chapter 2 of the assessment, "Our Changing Climate" Key Message 8, and its supporting references.

		landfall (e.g., Wang et al., 2011). However, such changes are not anticipated to emerge above the level of natural noise until very late in this century (Michaels et al., 2005). One important fact about the impact of tropical cyclones that is virtually certain is that further development of our coastlines, including growing population, increasing wealth, and expanding infrastructure, will increase the vulnerability to direct hurricane strikes regardless of any influence that a changing climate may impart (e.g., Pielke Jr., 2007).References:Bell, G. D., E. S. Blake, T. B. Kimberlain, C. W. Landsea, J. Schemm, R. J. Pasch, and S. B. Goldenberg, 2011. Tropical Cyclones - Atlantic Basin, State of the Climate in 2010. Bulletin of the American Meteorological Society, 92, p.s115-s121.Knutson, T.R., J.J. Sirutis, S.T. Garner, G.A. Vecchi, and I. Held, 2008. Simulated reduction in Atlantic hurricane frequency under twenty-first-century warming conditions. Nature Geoscience, 1(6), 359-364.Knutson, T. R., J. L. McBride, J. Chan, K. Emanuel, G. Holland C. Landsea, I. Held, J. P. Kossin, A. K. Srivastava,and M. Sugi, 2010. Tropical Cyclones and Climate Change. Nature Geoscience, Review Article, 21 February 2010, DOI: 10.1038/NGEO779, 7 pp.Maue, R. N., 2011. Recent historically low global tropical cyclone activity. Geophys. Res. Letts. VOL. 38, L14803, 6 PP., 2011 doi:10.1029/2011GL047711Michaels, P. J., P. C. Knappenberger, and C. W. Landsea, 2005. Comments on “Impacts of CO2-Induced Warming on Simulated Hurricane Intensity and Precipitation: Sensitivity to the Choice of Climate Model and Convective Scheme”. Journal of Climate, 18, 5179-5182. Pielke, R.A., Jr., 2007. Future economic damage from tropical cyclones: Sensitivity to societal and climate changes. Philosophical Transactions of the Royal Society A, doi:10.1098/rsta.2007.2086Swanson, K.L., 2008. Nonlocality of Atlantic tropical cyclone intensities. Geochemistry, Geophysics, Geosystems, 9, Q04V01, doi:10.1029/2007GC001844.Vecchi, G.A., K.L. Swanson, and B.J. Soden, 2008. Whither hurricane activity? Science, 322(5902), 687-689.Wang, C., L. Hailong, S-K. Lee, and R. Atlas, 2011. Impact of the Atlantic warm pool on United States landfalling hurricanes. Geophysical Research Letters, 38, L19702, doi:10.1029/2011GL049265.					
Marjorie	McGuirk	A discussion of the monthly sea ice loss would be warranted, as there has already been an extensive expansion of the shipping season due to ice loss, and these values are more useful to adaption and impact than annual minimum extent. Rogers, 2013, projects ice-free summer months, Ford and Pearce published a lit review in Environ Res Letters 2010, Corbett has published about increased CO2 emissions from shipping. Importantly, Stroeve 2012 paper in Climate Change published weekly ice trends. The paper referenced by Stove in Geo Research Letters has had some reviews published that have questioned some of the conclusions.	22. Alaska and the Arctic		762	11	We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include.
Cato	Institute	Chikengunya has “Devastated populations in other countries”? Here’s a quote from Dwibedi et al, cited on line 22.“Morbidity was high though no deaths were recorded.”Is that “devastation”? Another reference, Rezza et al., 2007 is supposed to be evidence of climate-related spread of this disease. Read for yourself from Rezza—the Italian outbreak was caused by the jet plane, not climate change (also was not very “devastating”):"Analysis of samples from human beings and from mosquitoes showed that the outbreak was caused by CHIKV. We identified 205 cases of infection with CHIKV between July 4 and Sept 27, 2007. The presumed index case was a man from India who developed symptoms while visiting relatives in one of the villages. Phylogenetic analysis showed a high similarity between the strains found in Italy and those identified during an earlier outbreak on islands in the Indian Ocean. The disease was fairly mild in nearly all cases, with only one reported death."This little incident is an example of very bad work. At the very least, it appears to be an attempt to deceive the readers, few of whom would actually check the primary references. The question is why was this done?	9. Human Health		353	20	After consideration of the comment, text has been revised to not focus on chikungunya but rather to incorporate a broader perspective on infectious disease transmission and climate change, and add text to clarify that the introduction of new diseases into non-immune populations has been and continues to be a major challenge in public health. There are concerns that climate change may provide opportunities for pathogens to change their geographic range. The transparent process leading to this report, which aims to document broad

							trends in climate change's effects on human health from recent U.S.-based literature, and provide a summary for the public under limited text space constraints, is documented on our website.
Lauren	Baum	Page 732 in NW region needs better graphics figure 21.6 is not a good representation of forest mortality. As a suggestion, see: http://www.fs.fed.us/pnw/news/2012/02/1b_cedar_decline_landscape.jpg (Credit: Paul Hennon/USDA Forest Service)	21. Northwest	21.6	732		The suggested photo is from Alaska and should not be used to illustrate change in the Northwest. The goal here was to illustrate LANDSCAPE disturbance, not stand level as in the suggested photo. We have cropped and brightened the photo.
Cato	Institute	An amazing section pushing an integrated, intrusive agenda. Did Mayor Bloomberg write this?Specifically, it advocates for “eliminating short vehicle trips” (Page 354, line 38), improvement of “fitness and health through increased physical activity” (Page 355, line 2), [Volleyball will begin at 7am], “Innovative urban design” with “increased access to active transport” (Line 4), [All must ride the bus, bike, or walk from their crowded Stalinesque dense housing], “improved building construction, provision of services, and infrastructure creation (lines 6-7)”, [more expensive housing and more government spending from an economy 17 trillion dollars in hock], “promoting social interaction”, [required Kumbaya begins around the campfire at 9pm], a reduction in red meat consumption (lines 12-13), [darn that consumer choice! We’ll do something about that!!], “a reduction [in methane] achieved through an overall decrease in the consumption, and therefore the production, of red meat (lines 15-16), [I’m sure the required flatulence tax will go over well with the farm lobby], that a reduction in red meat consumption will reduce cardiovascular disease and cancer incidence, [not statistically significant in the largest study ever performed (Rohrmann et al., 2013), but who cares, we’ve got an agenda here!], climate change mitigation and adaptation policy could also reduce health-related disparities between wealthy and poor communities, [by making energy more expensive and forcing people onto public transportation? Well, yes, everyone suffers.] “Hurricane Katrina demonstrated that communities of color, poor communities…are more vulnerable to the adverse effects of extreme weather events”. [Yes it is a fact that houses build on or near floodplains are much cheaper; perhaps the authors would prefer none at all?] “urban planning policies that ensure new building, including homes, are constructed to resist extreme weather events. [Of course the expense is passed on to those who will not live in them], “improve the food security of low-income residence by preventing decreased crop production due to climate change, [when three times as much effective production loss is a result of ethanol diversion, when compared to climate change (see earlier comment ID 33721)].This last section is the quintessence of why so many people think that climate “science” is merely a stalking horse for a larger interventionist agenda. Reference:Rohrmann, S., et al. 2013. Meat consumption and mortality. Results from the European Prospective Investigation into Cancer and Nutrition. BMC Medicine, 11:63 doi:10.1186/1741-7015-11-63.	9. Human Health		354	36	The commenter cites the Rohrmann 2013 study to counter the cited literature. Not only is the Rohrmann study not the largest study ever done (Rohrmann in fact states the NIH_AARP study is the largest study) but it is not in a US population, and therefore less relevant to a US National Assessment. All US studies have shown strong associations between red meat consumption and cardiovascular disease and cancer. The authors themselves explain the difference in results as follows: "The difference between the US studies and our result is likely due to the stronger risk estimates observed in the US cohorts compared with our cohort, but may also be explained by higher meat consumption in the US than in Europe."
Marjorie	McGuirk	This comment is general for all the Region Chapters that follow this introduction. More coherence between the Regions, following similar outlines more closely, for example, would help the reader distinguish climate change impacts across the US.It is not clear why some Regions use a baseline of 1971-2000 and others use 1981-2010 when showing regional trends, particularly in the figures.Some regions show the US National disaster map. It may be more beneficial to the reader to discuss instead to limit the discussion on disasters to that region, discussing occurrence, any trends, and those with climate change attribute. Climate analogues would be very helpful. That is, showing where and how	Introduction to Regions				Although a general structure was suggested, the authors of the regional chapters were free to include in their chapter those topics that best responded to their consensus on the salient impacts and vulnerabilities. The base period for maps has been fixed to

		climate zones have shifted, This is done in the science chapter on plant hardiness zones, but there is little analysis in the Regional Chapters to show trends in climate normals.For example, shifts in North Carolina in average max and min temperature (box plots perhaps?) distinguish amounts of changes in Wilmington, Raleigh, and Asheville, representing shifts in Coastal, Piedmont, and Mountain areas. More consistency between the type of analysis done in each Regions would be valuable.					consistently use 1971-2000. Only the SE used the NOAA disaster map, and the MW mentioned their 2011 ranking, but in both cases they were specifically in the context of their regional disasters rather than a national perspective.
Lauren	Baum	The NCA should take note of the Hansen et al. study published in Sept. 2012 that found, with a high degree of confidence, that extreme anomalies such as those in Texas and Oklahoma in 2011 and Moscow in 2010 were a consequence of global warming because their likelihood in the absence of global warming was exceedingly small. Abstract: “Climate dice,” describing the chance of unusually warm or cool seasons, have become more and more “loaded” in the past 30 y, coincident with rapid global warming. The distribution of seasonal mean temperature anomalies has shifted toward higher temperatures and the range of anomalies has increased. An important change is the emergence of a category of summertime extremely hot outliers, more than three standard deviations (3σ) warmer than the climatology of the 1951–1980 base period. This hot extreme, which covered much less than 1% of Earth’s surface during the base period, now typically covers about 10% of the land area. It follows that we can state, with a high degree of confidence, that extreme anomalies such as those in Texas and Oklahoma in 2011 and Moscow in 2010 were a consequence of global warming because their likelihood in the absence of global warming was exceedingly small. We discuss practical implications of this substantial, growing, climate change.Citation: Hansen, J., Mki. Sato, and R. Ruedy, 2012: Perception of climate change. Proc. Natl. Acad. Sci., 109, 14726-14727, E2415-E2423, doi:10.1073/pnas.1205276109. Received from: http://ateson.com/ws/r/www.pnas.org/content/109/37/E2415.full	2. Our Changing Climate				Additional discussion on attribution has been added to the chapter (that also suggests the reader to read the appendix). The more recent paper by Hoerling et al. (2013) would be a better reference for the 2011 event. The 2012 Hansen et al paper appears to be fundamentally flawed as an attribution study (based on Stone et al, 2013: Inferring the anthropogenic contribution to local temperature extremes. PNAS, doi:10.1073/pnas.1221461110). Principal among these flaws is the lack of a falsifiable hypothesis. We have added the reference for the Hoerling et al., paper to the text.
Depart ment of Interior	Depart ment of Interior	Add after text at line 37: Potential impacts to treaty rights and trust resoruces include: A. Ground water decline - aquifer monitoring and studies needed to quantify water available and to exercise tribal rights over ground water. B. Possible decline in ground water quality from various new methods of oil and natural gas production - to assure water quality for future generations oversight and production method limitations may be needed. C. Decline in Ocean water quality (decreased salinity) from melting glaciers - will have adverse impact on sea life by reducing or increasing habitat which could disrupt lower end of food chain and cause additional competition for resources available from the sea. (adverse impact to ecosystem). D. With a rising sea level there will be an issue of salt water intrusion into coastal freshwater aquifers putting drinking water at risk. (Stated in Chap. 3 Water Resources is there a need to restate because applies to tribal lands and resources?). E. With a rising sea level saltwater intrusion puts coastal forests and wildlife habitat at risk. Saltwater intrusion could have an adverse impact on forest production and wildlife sustainability miles inland. (E. also applies to Chap. 7, Forestry) (Stated in Chap. 3 Water Resources is there a need to restate because applies to tribal lands and resources?).	12. Impacts of Climate Change on Tribal, Indigeno us, and Native Lands and Resource s		447	37	The text has been revised to incorporate this suggestion by adding a couple sentences on potential impacts and suggestions for research.
Depart ment of Interior	Depart ment of Interior	Regional scenarios are a valuable addition. Some additional analysis would be valuable, for example, the Midwest scenario includes probability of higher rainfall amounts and increased peak events so it is unclear if the additional moisture will actually be available (to plants /ecosystems/people) if the net result is increased drought conditions due to run off of rain during storms.	18. Midwest				While the comment suggests a good specific example, the authors feel the existing examples are appropriate and adequate.
Lauren	Thie	Change elderly to older citizens.	9. Human Health		345	14	We changed "elderly" to "older adults."
Lauren	Thie	Harmful bloom of algae wasn't mentioned in the text at all - would be nice to have a text connection to	9.	9.11	348		Authors appreciate this observation,

		the image.	Human Health				yet are aware that some readers will concentrate on the figures and captions rather than read the text. We will let the caption text stand to provide context for both audiences.
Lauren	Thie	The effects of loss of livelihood due to droughts, wildfires, or sea level rise would have profound impact on mental health. Is there any evidence that could be included to that end?	9. Human Health		349	15	Thank you for your comment, however space constraints prevented including an analysis of how and why people suffer mental health problems following disasters; we limited ourselves to documenting that it occurs. With regard to mental health impacts of long-term, slow-moving changes such as sea level rise, the authors considered a range of literature and did not find sufficiently strong evidence to include this.
Lauren	Thie	In the caption, change all 'elderly' references to 'older Americans', 'older citizens.' Additionally, I felt some of the caption discussed more about the connection than the vulnerability trends. Would it be worth focusing more on what the graphs are showing? For example, 'Similarly, people who are obese and/or have diabetes, heart disease, or asthma are more vulnerable to a range of climate-related health impacts.' could read 'Similarly, there is an increasing number of people who are obese and have diabetes, heart disease, or asthma, which makes them more vulnerable...'	9. Human Health	9.12	350		Thank you for the suggested edits, which improve the clarity of the text; the changes were made.
Lauren	Thie	Change elderly to older people	9. Human Health		351	13	We changed "elderly" to "older adults."
Lauren	Thie	Maybe mention Hurricane Sandy as example?	9. Human Health		351	22	Thank you for your comment, however given chapter space limitations, we have decided to leave the example of Hurricane Katrina only. Other chapters such as Chapter 16: Northeast discuss Hurricane Sandy.
Lauren	Thie	Felt the ending could be made more compelling.	9. Human Health		352	10	We reorganized the paragraph to put the last sentence before the example, adding extreme weather and climate events to the list in the last sentence and dropping "other" from the sentence.
Lauren	Thie	Overall, excellent!! I appreciate all the peer-reviewed literature cited. Y'all did a great job of distilling down quite a lot of information to a few important points!!! I'm impressed!	9. Human Health				We greatly appreciate your positive comment.
Frank	Sturges	What are some of the “societal choices about forest policy” that will affect mitigation through carbon cycles from forestry? What impacts might they have?	7. Forestry		271	11	Due to the size of the sector, and the page limit for the chapter, we focused on broad trends rather than delving too deeply or providing such a level of specficity.

Frank	Sturges	If Florida has already seen greater wildfire due to rising temperatures combined with other stressors, why are other Eastern forests not at or near the "point" where they would likewise experience such impacts in the near future?	7. Forestry		266	41	We appreciate this suggestion but space is limited. We focused on broad trends rather than delving too deeply or providing such a level of specificity. We include a note to see the chapter on the southeast.
Department of Interior	Department of Interior	We have already informed Dr. Glynis Lough of the USGCRP that figure 2.20, which is attributed to Hirsch and Ryberg (2012), is incorrect. Specifically, the symbols on the figure are identical to the ones in our 2012 paper (except that they have been colored in this version) but the legend indicates the wrong units. In our paper, the symbols represent the term beta1, which is the slope of a regression of the log of the annual flood on global mean CO2. The caption says that they represent trend magnitudes, which is not true. Note that the implication of the current version of figure 2.20 is that trends in flood magnitude for the Red River of the North is about 0.017% per decade. The graphic in the Peterson et al. (submitted) paper shows them to be about 15% per decade (an error of about 3 orders of magnitude). We have been working with Dr. Lough to correct the figure (essentially to make it match what is in the Peterson, et al., submitted), with proper attribution. We believe that Dr. Lough has the necessary materials to make the change.	2. Our Changing Climate	Figure 2.20	56		This figure has been corrected and is now consistent with the figure from Peterson et al. 2012.
Department of Interior	Department of Interior	We have three general comments regarding freshwater related issues in Chapters 2 and 3. 1) The first concern is one of balance. With respect to water, the report seems to highlight situations in which conditions appear to be getting "worse" and tends to ignore situations in which conditions appear to be getting "better." We think that this undermines the credibility of the many useful and valid points that the Draft Report makes. 2) We have strong objections to the idea that our paper (Hirsch and Ryberg, 2012) provides the observational basis for some of the messages of the Draft Report. The Draft Report's flood message is one of increased flood magnitudes. Our observations and study demonstrate a mixture of increases and decreases. 3) Finally, the idea that "confidence" on the topic of floods is anything but "low" strikes us as unfounded. It is widely recognized that there are serious uncertainties for both changes to date and projections for the future. The fact that reported precipitation trends and reported flooding trends appear so contradictory should be sufficiently alarming as to indicate the need to assess the flood conclusions as ones with "low confidence."					Thank you for your comment. 1) Throughout the report, the authors have made revisions to improve the balance of tone about the positive or negative nature of impacts. 2) The language about increased flood magnitudes in Chapter 2 has been edited to address these concerns. 3) The authors of the Climate Science chapter and the Water chapter have responded in detail to your specific comments on those chapters, including comments about confidence.
Department of Interior	Department of Interior	We applaud the authors for the statement "The debate is over whether this trend is part of a multi-decadal climate cycle, and, at some future time, it will reverse direction." We also applaud the statement "GCMs continue to be uncertain with respect to precipitation, but they are very consistent with respect to temperature. Runoff, streamflow, and soil moisture depend on both variables and are thus less susceptible to GCM precipitation uncertainty." However, we would note that when it comes to floods, the matter of importance is precipitation. Temperature plays a very minor role. In addition, the matter of importance is extreme precipitation, which we would suggest is even more uncertain than precipitation in general. These matters are reasons why one should exercise great caution in relying on GCMs in the projecting of flood magnitude and frequency. It might be useful to add some statement to that effect.	3. Water Resources		141		Temperature DOES play a key role in flooding in the West, and absolutely has more than a ""minor"" role. Warming is projected to result in storms dropping more rain (rather than snow) over mountain catchments. Warming is projected to yield more storms that fall into the major storm-threat category. The observation that storms are likely to intensify with projected atmospheric warming is not initially based on GCM outputs; rather it stems from the basics of moist thermodynamics and energetics of the atmosphere. It is ""observed"" in GCMs but is understood from virtual first principles

							(e.g., Trenberth 1999 Clim Chg; Kunkel et al, in press, ""PMP & Climate Change"", GRL). We have revised the Key Message to indicate that floods may intensify to allow for uncertainties to resolve themselves. We have added a box on floods, which includes discussion of precipitation.
Department of Interior	Department of Interior	This section lacks balance. In addition to those areas that have gotten dryer, there are large parts of the US that have been getting wetter in terms of annual runoff and in terms of low flows. Is there a reason not to mention this?	3. Water Resources		125	24	After consideration of this point, we still feel the existing text is clear and accurate. This section is about drought, in other sections of the chapter, particularly the precipitation section, we identify areas where annual average precipitation increases have been observed.
Department of Interior	Department of Interior	We can point to other individual years or short sequence of years in past decades that had large numbers of extraordinary floods. The question that needs to be asked is, are we experiencing more extreme floods than we have in the past? This question has been asked and answered for topics like extreme temperatures. We do not believe that it has for floods. Without a reference to demonstrate that something very different is happening, we think this selective list of floods has no place in a scientific assessment.	3. Water Resources		123		We have revised the flooding box and the first key messages on floods. We note that no strong regional-scale climate driven changes in flood regimes has been documented. We also note that floods may intensify in many regions of the U.S.
Department of Interior	Department of Interior	What is the evidence for this increase in flood magnitudes because of a change in the ratio of rain to snow? The Draft Report references Knowles, Dettinger and Cayan (2006), which simply has a comment about flood risks in the last paragraph. There is no accompanying analysis to back up that comment. McCabe et al. (2007) has no analysis of floods, only of precipitation and temperature. The two Mote papers are entirely about snowpack or snow water equivalents and not floods [by the way, the reference for Mote (2003) is incomplete]. Again, what can be said about the connection to floods? This is not, in any way, a challenge to the conclusions about streamflow timing. The question we are raising is, what does this mean for flood hazards? Peterson et al. (submitted) makes the following statement about this topic. "For some regions of the U.S. where snowpack is an important component of the hydrologic system, there is evidence for earlier melt and changes in the rain to snow ratio (see Dettinger and Cayan, 1995; Hodgkins et al., 2003). These changes may be influential in changing river flood behavior, but their nature could be either decreases or increases in flood magnitudes depending on watershed characteristics."	3. Water Resources		114	4	The text has been revised to clarify in response to this perspective, and a reference has been added.
Department of Interior	Department of Interior	We do not understand why the confidence on the matter of floods would be anything higher than "Low" ¬— the evidence is clearly "inconclusive", the sources are "limited", findings are "inconsistent" (e.g. different types of findings by Groisman versus a body of work by Wolock, McCabe, Lins, Slack, Douglas, Hirsch, and Ryberg), "methods not tested," and finally "disagreement among experts." Let us elaborate on "methods not tested": In general the methods of projection are based on GCMs, typically downscaled by RCMs, then run through hydrologic models. Our question is: do the authors know of any tests of this method? A test, in our minds, would involve using the method to hindcast the 20th century and demonstrate that an ensemble of such hindcasts would show flood records that bear even a rough similarity to the observed. For example, would any model hindcast with historical greenhouse forcing give us upward trends like those observed in the eastern Great Plains or in southern New England, or the downward trends observed in the Southwest? To us, the body of science on this topic is just about	2. Our Changing Climate		83		Additional references have been added to the main text, wheich then become the basis for the Traceable Accounts.

		a perfect fit to the definition of "Low Confidence Level."					
Department of Interior	Department of Interior	It is curious that this section on groundwater appropriately pays attention to the influence of humans living on the local landscape, as well as the influence of climate change. Why would the same approach not be used in discussing floods? We think that the approach for groundwater is appropriate (particularly since we think the activities on the landscape will likely be large drivers of hydrologic change). Perhaps these local actions (e.g. pavement and land drainage) may be much more significant than anthropogenic climate change.	3. Water Resources		107	27	Key message and his been revised, and we have revised and expanded the discussion of floods to reflect a fuller range of influences.
Department of Interior	Department of Interior	"Floods have become more frequent and intense in some regions." We have two issues here: What are the studies that show that they are becoming more frequent? The material in Peterson et al. (submitted) relates to the annual flood and has nothing to do with a change in the frequency of floods above some threshold. It says that floods have become more "intense" in some regions (by this we assume the authors mean larger in peak flood discharge, but intense could have other meaning, such as days above flood stage or accelerated rate of rise, and should be defined). Indeed, there are some regions where floods have become larger in magnitude, but the entire US west of the 100th meridian has a very strong preponderance of watersheds in which the magnitudes have decreased (in some cases by a large amount) over the past century. Is this not worth mentioning?	2. Our Changing Climate		83		Additional references have been added to the main text, which then become the basis for the Traceable Accounts.
Department of Interior	Department of Interior	Although the Draft Report seems to be attempting to deal with both floods and droughts, why is there no mention of the truly widespread increases in annual minimum low flows in streams? This result has been reported in many studies for areas from the Great Plains to the Midwest to the northeast. For example, in a recently published report (Spatial and Temporal Trends in Runoff at Long-Term Streamgages within and near the Chesapeake Bay Watershed, by Rice and Hirsch, USGS SIR 2012-5151) we estimated increases in annual 7-day low flows in the northern part of the Chesapeake Bay watershed of between 2% and 15% per decade over the period 1930-2010 (with no decreases). This comes from a new report, but there are many prior reports that document similar findings regarding low flows. We urge the authors of the Draft Report to consider making the assessment more balanced. Yes, we have drying conditions in the southwest, but perhaps the report should also mention the wetting conditions in other parts of the country. The selectivity of the reporting undermines the credibility of the whole report.	2. Our Changing Climate		56		We have added a new paragraph about the increases in low streamflows, citing papers by Small et al. (2006) and Rice and Hirsch (2012).
Department of Interior	Department of Interior	It is certainly true that there has been a change in the "timing and magnitude of snowmelt and resulting streamflow" but this is a section on hydrologic extremes not a section on timing of runoff. Where has it been shown that this change in timing has resulted in changes in flood magnitudes? In Peterson et al. (submitted) the following statement is made about this topic. "For some regions of the U.S. where snowpack is an important component of the hydrologic system, there is evidence for earlier melt and changes in the rain to snow ratio (see Dettinger and Cayan, 1995; Hodgkins et al., 2003). These changes may be influential in changing river flood behavior, but their nature could be either decreases or increases in flood magnitudes depending on watershed characteristics." The reason is, of course, that less snow means a decrease in the snowpack available to produce catastrophic flooding in rain-on-snow storms. In the interest of balance, the Climate Assessment should make clear that these changes in the snow/rain ratios could result in increases or decreases in the magnitude of floods.	2. Our Changing Climate		55	15	Agree that this material is misplaced and have removed it from the section.
Department of Interior	Department of Interior	A more accurate summary of historical trends would be something like this: "Flood magnitudes have increased in southern New England including areas in and around the Catskill Mountains and in the northern portion of the eastern Great Plains. In the Midwest there are generally increases in the southern part and decreases in the northern part. Flood magnitudes have decreased substantially across the Southwest. For the the Rocky Mountains and Northwest the tendency is toward decreased flood magnitudes as well, although there are a few areas of slight increase.	2. Our Changing Climate		55	9	The text has been revised to incorporate this suggestion.
Depart	Depart	What is the evidence that floods "have become more frequent and intense?" What are the studies of	2. Our		26	15	The text in the chapter under this Key

ment of Interior	ment of Interior	the changing frequency of floods? There are several studies on changes in magnitude, but this statement says there are changes in frequency. What is the documented evidence for this? We should add that most of the studies of changes in flood magnitude indicate a mix of increases and decreases over time.	Changing Climate				Message provides the references. The Key Message itself has been revised for better clarity.
Frank	Sturges	How cost-effective are fuel treatment methods? Wildfires in Colorado in 2012 cost over half a billion dollars, and the governor requested $20 for restoration treatments in an effort to prevent future fires of such a scale. Is this request a reasonable estimate? Information on the economics of fuel treatment would help illustrate what sort of role it should play in climate adaptation.	7. Forestry	7.2	268		Due to the size of the topic, and the page limit of the chapter, we focused on broad trends rather than delving too deeply or providing such a level of specificity with respect to fuel treatments and costs.
Adam	Koranyi	The importance and urgency of mitigation is understated in the report. The other parts of the report make it clear that without an all-out effort in mitigation there is a significant chance of total disaster both nationally and worldwide. It is also clear from the report that there are no reliable existing or imaginable other means than rapidly and radically reducing greenhouse gas emissions. This has to be considered a national emergency, and a total shift in policies is required.The international aspect being equally important, every effort has to be made to get a fair and universally accepted binding agreement on reducing greenhouse gas emissions. This should be analogous to the Kyoto agreement rejected in 1997, of course with the difference that it should be much stronger and stricter because of the missed opportunities of the last sixteen years making the present situation much more dangerous.	1. Executive Summary				Although the authors agree that the need for both adaptation and mitigation activities is critical, this is a scientific document and does not make policy recommendations.
Depart ment of Interior	Depart ment of Interior	"damaged the newly renovated, multi-million dollar U.S. Park Service Visitor Center." National Park Service; Where is this center located?	8. Ecosyste ms, Biodivers ity, and Ecosyste m Services		301	2	We have added text to clarify that the visitor center is at Bandelier National Monument.
Depart ment of Interior	Depart ment of Interior	What species of owl(s) does this refer to? Confusing as written, since none is given.	8. Ecosyste ms, Biodivers ity, and Ecosyste m Services		303	4	Added species name and specific climate driver information.
Depart ment of Interior	Depart ment of Interior	"impact weight gain of bison" Does this mean slow or reduce? State as such.	8. Ecosyste ms, Biodivers ity, and Ecosyste m Services		303	23	This study evaluated trends in Bison weight changes, interannual variation in precipiation patterns, and grass (grazing) biomass production. The study revealed underlying relationship between climate variability and trophic dynamics. Text in Box has been modified to better communicate climate change influence.
Depart ment of	Depart ment of	"including Yellowstone Nation Park" >> "National"	8. Ecosyste		310	2	Fixed.

Interior	Interior		ms, Biodiversity, and Ecosystem Services				
Department of Interior	Department of Interior	It should be noted (and added as a Key Message) that for natural ecosytems there will be a mismatch of land ownership and the protection provided by that ownership to where existing ecosystems will move or where novel ecosystems will develop. This will likely result in numerous ecosystems no longer occurring in areas that provide at least some protection and as such are less impacted other stressors. To minimize the negative impacts of this mismatch, adaptive strategies for this could be an increase in restoration of currently less protected areas, minimizing other stressor impacts in less protected areas, increased public and private land swaps and an increased need for protected connectivity of currently protected, restored and newly protected lands.	8. Ecosystems, Biodiversity, and Ecosystem Services				No change. It is too late to add a new key message to the report, especially one that will be difficult to support with published literature.
Department of Interior	Department of Interior	The policies governing the currently protected areas (e.g., national parks) will need to be re-evaluated and possibly modified to make sure that novel ecosytems will be allowed to develop within the boundaries of (e.g., policies on non-native species, assisted migration etc.).	8. Ecosystems, Biodiversity, and Ecosystem Services				No change. This topic is covered, at least generally, in the adaptation section.
Department of Interior	Department of Interior	The discussion on ecosytem and large-landscape conservation should be developed further and not lumped together with the discussion on adaptive management.	8. Ecosystems, Biodiversity, and Ecosystem Services				No change. Adaptive management is clearly listed as "one strategy."
Department of Interior	Department of Interior	Connectivity as an adaptation startegy should further developed - including identifying examples of where it has been successfully used and examples where it might be most helpful.	8. Ecosystems, Biodiversity, and Ecosystem Services				No change. Wildlife corridors are listed, and specific examples are provided in the citations.
Department of Interior	Department of Interior	A discussion on reintroductions and assisted migration as a management strategy for adaptation should be included under adaptation.	8. Ecosystems, Biodiversity, and Ecosystem Services				No change. These are listed, albeit briefly in the adaptation section.

Department of Interior	Department of Interior	The need for full life cycle conservation should be discussed under the Adaptation Section.	8. Ecosystems, Biodiversity, and Ecosystem Services				No change. It is too late to add a new key message to the report, especially one that will be difficult to support with published literature.
Department of Interior	Department of Interior	Plants and Animals should be broken out into their own sections - issues and adaptation strategies are different enough that it is confusing to have them lumped. Even within these 2 gross categories there will be many differences in issues and adaptation strategies among terrestrial, marine and coastal species.	8. Ecosystems, Biodiversity, and Ecosystem Services				No change. We feel that the current organization is best given our focus on ecosystems, biodiversity and ecosystem services.
Department of Interior	Department of Interior	Climate change-induced sea level rise is anticipated to displace millions of coastal residents. Internally displaced people are at greater risk for numerous adverse health outcomes, including mental illness, lack of health care, and other adverse psychosocial outcomes. Furthermore, internal displacement of individuals can place burden on receiving health care centers and communities especially given the loss of coastal health care centers, further exacerbating health impacts and resource constraints. Loss of coastal communities and ecosystems will also affect biodiversity loss, with important health impacts as addressed below. Finally, displacement of coastal populations will disproportionately impact vulnerable people and communities, such as the elderly, poor, homeless, and minority populations.	9. Human Health				This comment does not seem to raise any question or suggest any revision.
Department of Interior	Department of Interior	Although biodiversity loss is addressed in Chapter 8, we feel that this important topic should be addressed in chapter 9 due to the numerous effects it will have on human health. Specific effects that should be addressed include a) the diminished dilution effect (as resilient host reservoirs of corvids, white-footed mice, and deer mice are expected persist while less-resilient, predator and non-host species are lost, resulting in the increased spread of several zoonotic pathogens (West Nile Virus, Lyme, and hantaviruses, respectively)); b) exacerbation of the addressed human health impacts of flooding (lost protective effect of wetlands); c) increases in diseases carried by insects and rodents (decreased ecosystem regulation); d) harmful algal blooms (decreased filtration and micro-organism competition in algal communities); and e) biodiversity loss is projected to also impact food security as pollinators, such as bees, bats, and some birds, are lost due to anthropogenic changes exacerbated by climate change. Overall, biodiversity loss will have a significant impact on human health, both directly and indirectly, and we feel it should be addressed in this section.	9. Human Health				We agree that biodiversity loss will have important impacts on human health, but it is properly considered an "additional" stressor that sometimes is a product of climate change, but most often is the result of poor land management and land use practices. Due to space constraints, we are unable to provide a thorough discussion of the synergies/interactions between biodiversity loss, climate change, and health.
Department of Interior	Department of Interior	A map or list of states at the outset, comprising the "Southwest" in this report would be helpful.	20. Southwest				We appreciate the suggestion, but feel the current text is appropriate and adequate given the chapter's space limitations and the multiple maps that show which states are included. It also conforms to the other regional chapters.
Department of	Department of	Using different emissions scenarios to project different temperature increases for different time periods is confusing and a difficult form to understand.	20. Southwe		688	34	Thank you for pointing out this confusing text. We have rewritten this

Interior	Interior		st				section to eliminate confusion in comparing the scenario projections.
Department of Interior	Department of Interior	This sentence is confusing. Mega-droughts have been around for past 2000 years, so nexus to climate change is not clear.	20. Southwest		690	1	Thank you for your comment. The text has been revised to incorporate this suggestion and reduce confusion.
Department of Interior	Department of Interior	Is SWE calculated for a single maximum point, total snowfall over season, or what?	20. Southwest	Fig. 20.2	691		Thank you for your question. We agree that a definition of SWE would be helpful, and will add one when this draft is converted to its final electronic format.
Department of Interior	Department of Interior	Not clear what this figure is intended to represent. Is it "reductions" as the title says, or is it a portrayal of emissions sources at some unstated point in the future?	20. Southwest	Fig. 20.3	693		Thank you for your comment. The figure and caption have been amended for clarity.
Department of Interior	Department of Interior	What is "rain-fed"? Dryland pasture? Or are you including irrigated pasture as the next sentence suggests, in which case much is "snow-fed" to use your construction.	20. Southwest		693	19	Thank you for your question. We have changed the text to make the meaning clearer.
Department of Interior	Department of Interior	This sentence is largely incorrect and is contradicted by the subsequent paragraph.	20. Southwest		695	5	Thank you for your comment. The section has been modified to accommodate your suggestion.
Department of Interior	Department of Interior	The invasion of the desert southwest by non-native grasses and dicots (e.g. cheatgrass and Sahara mustard) is playing a key role in the size of fires in those ecosystems.	20. Southwest		694	17	Thank you for your comment. The section you identified has been modified to incorporate your suggestion.
Department of Interior	Department of Interior	Do you mean to say that sea level will increase, or that SLR will accelerate?	20. Southwest		695	36	Thank you for your comment. The text on sea level rise has been revised to be consistent with the NCA Coastal Impacts, Vulnerabilities and Adaptation Report language.
Department of Interior	Department of Interior	It would make more sense to say "California coast" instead of "Southwest coast."	20. Southwest		695	39	Thank you for your comment. The text has been revised to incorporate this suggestion.
Department of Interior	Department of Interior	What does "Traceable Accounts" mean?	20. Southwest		700	1	Thank you for your question. Traceable accounts are described in detail in Chapter 1. They document the process the authors use to come to the conclusions in their key messages and provide additional information about the information used.
Department of Interior	Department of Interior	This doesn't make sense: "Historical changes over the past 50 years have shown a reduction in the amount of snow in the total annual precipitation and the associated streamflow timing of snowfed rivers"	20. Southwest		700	18	Thank you for pointing this out. We have aimed to clarify this point by modifying the text.
Department of	Department of	"These climate changes have increased background tree mortality rates from 1955 to 2007 in old-growth conifer forests in California, Colorado, Utah, and the Northwest (Van Mantgem et al. 2009)"--	20. Southwe		704	2	Thank you for your comment, but we have elected to maintain the text as it

Interior	Interior	This is not caused by nor evidence of increased wildfire.	st				was in the draft report. Tree mortality is an increased impact to ecosystems in the Southwest.
Department of Interior	Department of Interior	The National Park Service has completed a Climate Change Response Strategy, a Climate Change Action Plan and a Green Parks Plan. These documents need to be listed in this table. http://www.nps.gov/climatechange/docs/NPS_CCRS.pdf, http://www.nps.gov/climatechange/docs/NPS_CCActionPlan.pdf, http://www.nps.gov/greenparksplan/	28. Adaptation	Table 28.1	987		We thank the commenter for the suggestion, but space is limited. As such, we are asking the INCA to reconcile table 28.1 such that each agency has 6 lines to fairly and accurate represent illustrative adaptation actions within the various federal agencies.
Frank	Sturges	What are the projections of how will afforestation from tree and shrub encroachment into grasslands, rangelands, and savannas creating new carbon sinks balance against loss of U.S. forests from expansion of urban and suburban areas along with loss of forests due to wildfire? How might management decisions alter this balance?	7. Forestry		272		The points the comment raises are beyond the scope of this chapter/report. Additional research is needed to address the quantitative questions raised.
Department of Interior	Department of Interior	Reclamation would like to complement the community of authors who contributed to the various chapters and to the steering group that helped facilitate the development of this new assessment structure. The new structure was very easy to navigate and this new organization of key messages and supporting accounts is very well designed for sustained assessment going forward.					Thank you for the positive comment.
Department of Interior	Department of Interior	It is not clear what is meant by "over the period…" it is assumed you are comparing the difference between the two thirty year windows.					That is correct. We have attempted to clarify figure captions throughout the report.
Department of Interior	Department of Interior	The addition of Traceable Accounts for each key message is very helpful and readers will find this narrative structure to be very useful.					Thank you for the positive comment.
Department of Interior	Department of Interior	Consistency between 20th vs. 20th ("th" superscripted) or 21st vs. 21st ("st" superscripted).					Thank you for the comment. The final version will be carefully edited to ensure consistency on formatting with the intended NCA style.
Department of Interior	Department of Interior	Consistency is needed between NW and Northwest.					Thank you for the comment. The final version will be carefully edited to ensure consistency on formatting with the intended NCA style.
Department of Interior	Department of Interior	Consistency between % and percent and using numbers vs. spelling out the number when referring to percentages.					Thank you for the comment. The final version will be carefully edited to ensure consistency on formatting with the intended NCA style.
Department of Interior	Department of Interior	Consistency between adding a space between year ranges and the dash or not.					Thank you for the comment. The final version will be carefully edited to ensure consistency on formatting with the intended NCA style.
Department of Interior	Department of Interior	Change Columbia River basin to Columbia River Basin.					Thank you for the comment. The final version will be carefully edited to ensure consistency on formatting with

							the intended NCA style.
Department of Interior	Department of Interior	All references to "U.S. Bureau of Reclamation" should be "Reclamation."					Thank you for the comment. The final version will be carefully edited to ensure consistency on formatting with the intended NCA style.
Department of Interior	Department of Interior	Change 1970-99 to 1970-2099; change 2070-99 to 2070 to 2099.					Thank you for the comment. The final version will be carefully edited to ensure consistency on formatting with the intended NCA style.
Department of Interior	Department of Interior	NARCCAP is not distinct from CMIP3 since it is a downscaled version of several CMIP3 projections and one time slice (2041-2070) in those projections. Add this clarification to this bullet.	2. Our Changing Climate		29	21	The text has been revised to further explain the North American Regional Climate Change Assessment Program (NARCCAP).
Department of Interior	Department of Interior	"decreases are observed and projected in southern states": Regarding projected precipitation, it seems as though this key message is inappropriate for the southeast (except for maybe Florida).	3. Water Resources		107	20	We have revised Key Message #1 to reflect this and other comments
Department of Interior	Department of Interior	"surface and groundwater supplies are already affected": please explain what they are affected by.	3. Water Resources		108	3	We have revised the Key Message on drought affecting water supplies to reflect this and other comments. We have noted that precipitation and runoff combined with changes in consumption and withdrawal have affected surface and groundwater supplies.
Department of Interior	Department of Interior	These are nice process-specific summaries. It would be useful to explain to some readers at the start of this passage that evapotranspiration, soil moisture, runoff and streamflow trends are inextricably linked. Thus, the challenges in understanding trends for any single process add to the challenges in understanding trends of related processes.	3. Water Resources		110	9	We appreciate the reviewer comment, and we have revised the text to describe the linkages between these processes in more detail.
Department of Interior	Department of Interior	Can any studies be cited summarizing projected changes in PET or AET? Subsequent discussions on soil moisture and runoff offer statements summarizing projected results.	3. Water Resources		110	9	Thank you for this comment. Regarding ET projections, we have revised the text to include additional discussion and references, including Dai (2012); Hay et al. (2011); Hoerling et al. (2012); Milly and Dunne (2011); Sheffield et al. (2012); Wehner et al. (2012); and Winter and Eltahir (2012).
Department of Interior	Department of Interior	"The projected streamflow changes and associated uncertainties…": The figure presents ensemble-median runoff changes and does not illustrate projected runoff uncertainties. Can you offer a parenthetical list of uncertainty sources to the caption; and/or insert references to reports that explore projected runoff uncertainties (e.g., Hoerling et al. 2009, Vano et al. 2012)?	3. Water Resources		113	7	We appreciate the reviewer suggestion and have included information on streamflow uncertainties in the revised text.
Department of Interior	Department of Interior	"surface and groundwater supplies are already affected": Please explain what they are affected by.	3. Water Resources		125	25	The Key Message has been revised to clarify.
Department of	Department of	Remove citation "Brekke 2011" from this list. It does not address this statement.	3. Water Resource		113	18	The text has been revised to incorporate this suggestion.

Interior	Interior		s				
Department of Interior	Department of Interior	", and these challenges wil rise as aging hydropower infrastructure needs to be replaced (Brekke 2011)." … Brekke 2011 (p. 150) does not directly address the issue of aging infrastructure.	3. Water Resources		124	11	Thank you for your comment. The text in which this reference appeared has been deleted.
Department of Interior	Department of Interior	This sentence implicitly comments on projected actual evapotranspiration (ET). Suggest alluding to this reference in the ET narrative (pp. 110-111).	3. Water Resources		113	19	We're referring to multiple processes when we use the term "water cycle processes", therefore we feel the text is clear and accurate
Department of Interior	Department of Interior	[VERIFY……..] Suggest adding citation to Sale et al. 2012 (SECURE 9505 report), available at: http://nhaap.ornl.gov/content/climate-change-impacts	3. Water Resources		124	1	Thank you for your comment. We were unable to access the report at the suggested website.
Department of Interior	Department of Interior	"Confidence is therefore judged to be high that precipitation and runoff decreases will continue in southern states." … It seems to be that this statement is appropriate for the southwestern states, but not necessarily for all southeastern states.	3. Water Resources		132	1	After consideration of this point, we still feel the existing text is accurate.
Department of Interior	Department of Interior	Last line… where it says "medium-high", suggest simply saying "medium".	3. Water Resources		133	2	After consideration of this point we still feel the existing text is accurate.
Department of Interior	Department of Interior	Citing Brekke et al. 2009b at this part of the sentence incorrectly implies that this study evaluated historical changes. It actually focuses on projected changes and would be more appropriately inserted as an example citation later in the sentence (e.g., where Cayan et al. 2010 is cited).	3. Water Resources		125	29	The text has been revised to incorporate this suggestion.
Department of Interior	Department of Interior	To be consistent with citation in the water sector chapter, "DOI 2011" should be "Bureau of Reclamation 2011" and the reference should be: SECURE Water Act Section 9503(c) – Reclamation Climate Change and Water, 16 Report to Congress, U.S. Department of Interior, Bureau of Reclamation, , p. 226. [Available online at: http://www.usbr.gov/climate/SECURE/docs/SECUREWaterReport.pdf]	11. Urban Systems, Infrastructure, and Vulnerability		428	9	Thanks for correcting the reference. Changes were made to the reference.
Department of Interior	Department of Interior	Citation should be Brekke et al. 2009 and the Reference should be: Brekke, L.D., Kiang, J.E., Olsen, J.R., Pulwarty, R.S., Raff, D.A., Turnipseed, D.P., Webb, R.S., and White, K.D., 2009, Climate change and water resources management—A federal perspective: U.S. Geological Survey Circular 1331, 65 p. (Also available online at http://pubs.usgs.gov/circ/1331/.)	19. Great Plains		680	17	The text has been revised to incorporate this suggestion.
Department of Interior	Department of Interior	USDA 2011a reference is the same as U.S. Bureau of Reclamation 2011a reference listed on p. 756 lines 8-10. Check reference. Based on use of USDA 2011a on p. 735 line 9, I suspect there's a different USDA that was meant to be referenced.	21. Northwest		756	22	The text has been revised to incorporate this suggestion.
Department of Interior	Department of Interior	Change "preserving fish habitat" to "supporting ecological resources". Fish habitat is too restrictive to capture all of the environmental purposes of reservoirs.	21. Northwest		725	9	Text has been broadened to refer to "preserving habitat for aquatic species", a key objective of Northwest reservoir systems.
Department of Interior	Department of Interior	Change 1978-97 to 1997 (It is assumed it's the 1900s).	21. Northwest		725	30	The text has been revised to incorporate this suggestion.
Department of	Department of	Change sentence to read,"…2080s (Stockle et al. 2010), respectively, again with…"	21. Northwe		736	2	The text has been revised to incorporate this suggestion.

Interior	Interior		st				
Department of Interior	Department of Interior	Key message 1 - Evidence for far-reaching ecological and socioeconomic consequences of the above is based on: (2) model simulations showing the impacts of climate change on water supply and agriculture have been conducted in more than just the Yakima. Bureau of Reclamation (2011a, in the references) showed that those water right holders with storage rights would likely fair better than those with just in-stream rights due to the decreasing summer time flows.	21. Northwest		738	1	The text has been revised to incorporate this suggestion.: model simulations of future agricultural water allocation in the Yakima (Vano et al. 2010) and elsewhere (USBR 2011), showing increased likelihood of water curtailments for junior water rights holders.
Department of Interior	Department of Interior	In the sentence, "A major uncertainty is the degree to which water resources management…" It should be noted that this is for regulated rivers only. Those that are not regulated, of which there are many, cannot be managed to address amount and timing of flow and prioritizing competing resources.	21. Northwest		738	1	The text has been revised to incorporate this suggestion.
Department of Interior	Department of Interior	Change "_____, 2011a" to "Bureau of Reclamation, 2011a".	21. Northwest		756	8	This is the citation format in this report
Department of Interior	Department of Interior	It's difficult to observe the difference among the fire, the beetle, and the cloud coverage. Perhaps describing the pix with more detail or providing arrows to show the reader where specifically to look would help.	21. Northwest	21.6	732		We have cropped and brightened the photo.
Department of Interior	Department of Interior	Line 3 in the "caption top" description - space needs to be added between (1984-2008) and (Eidenshink…)	21. Northwest	21.7	734		The text has been revised to incorporate this suggestion.
Frank	Sturges	In evaluating carbon emissions from bioenergy in order to determine the finding regarding bioenergy as a potential method to reduce emissions from fossil fuels, what life cycle is being considered for bioenergy? How are cumulative impacts, such as emissions from road construction, transportation, mechanized harvesting techniques, and processing of biomass into a useable fuel included in assessing whether or not the bioenergy potential of forests is actually a net positive in climate change mitigation? Some data on this technology in the report would make it more useful to policymakers beyond how much of it could potentially be made.	7. Forestry		274	23	Due to the size of this sector, and the page limit for the chapter, we focused on broad trends rather than delving too deeply or providing such a level of specificity. The five studies reported in this paragraph use different approaches to obtain their estimates.This is a highly complicated issue, and we try to present it in a few words. The methods are certainly under debate and that is why we cite so many papers that come from different perspectives. The Bright et al. (2012) paper is a critique of the time accounting approches used by Schulze et al. (2012).
Department of Interior	Department of Interior	A brief description of sublimation should be included in this section that acknowledges the potential for increased runoff due to a loss of albido. One of the causes of this loss of albido is an increase in atmospheric dust resulting from reduced soil cover.	3. Water Resources		110	9	Sublimation has been incorporated into the discussion of ET, in brief. However, although dust on snow can accelerate sublimation and melt in the short term, Painter et al (2010) have shown that the longer term influence on the overall water balance is not (always) an increase in runoff. Thus we find the conclusion suggested in this

							comment to be premature (or at least too general).
Department of Interior	Department of Interior	This section discusses the water cycle yet does not include a discussion on storage in ice (glacial or permafrost). The cycle is not a cycle like a wheel. Water occurs in various forms through time. With climate change more water will likely be in liquid and vapor form and potentially less in ice. This should be discussed under the hydrologic cycle. The report touches on snow pack (page 109), but this is more short term. It also touches on permafrost, but in a different context. I'm referring to the long term temporal change in water available to cycle (primarily liquid or vapor).	3. Water Resources		108	18	We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include. We did include some language about lake ice cover.
Department of Interior	Department of Interior	Sugggest removing this figure from the chapter since it will confuse many readers due to a lack of causality. Yes, there are historic trends pointing toward an increasing number of high-risk individuals who will be at greater risk due to climate change. However, climate change didn't cause these vulnerability trends. The more important point is that everyone in the US and in the world will be vulnerable.	9. Human Health	9.12	350		The risks of climate change are a function of the hazard associated with climate change, such as increasing temperature, who or what is exposed to these hazards, and their underlying vulnerability trends. While it is true at some level everyone is vulnerable, it is very helpful for public health programs to be able to appropriately target those who are particularly vulnerable. The figure gives an indication of trends of importance for describing future vulnerability.
Department of Interior	Department of Interior	Add a sentence or two to discuss the effects of forest management and how it affects the frequency and intensity of fires.	13. Land Use and Land Cover Change		479	14	We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include. In this section, we do refer the reader to Chapter 7, Forestry which discusses forest management and wildfires.
Department of Interior	Department of Interior	Is "greenhouse capacity" a new term? Historically, global warming potential has been used (which hasn't yet been defined in the document). Suggest rewording this to something like "However, methane (CH_4) and nitrous oxide (N_2O) contribute more to climate change on a per molecule basis than CO_2 . . . "	15. Interactions of Climate Change and Biogeochemical Cycles		520	17	Thank you for your comment; the text has been revised in regards to this suggestion.
Department of Interior	Department of Interior	Suggest deleting this figure (or at least simplifying it) since it will probably cause confusion. NOy, NHx, and Norg are not defined or discussed in the caption or surrounding text. Since all N compounds cycle throughout the atmosphere and the two ecosystems, this concept can be explained without the figure.	15. Interactions of Climate Change and Biogeochemical	15.2	522		After consideration of this point, we feel that the existing simple figure is preferred over no figure or a more complex figure. However, we have added to the caption definitions of Noy, NHx, and Norg.

			Cycles				
Department of Interior	Department of Interior	While a worthy goal, "enhancing the livelihoods of the region's people" is not a challenge specific to climate change. Perhaps protecting traditional livelihoods might be a reasonable goal.	19. Great Plains		658	8	The text has been revised to incorporate this suggestion.
Department of Interior	Department of Interior	Suggest that this figure be deleted since the inforamtion in the caption is outdated. Also, while oil and gas develop can fragment Sage Grouse habitat, agriculture and other land uses and ownership issues also fragment habitat. Habitat fragmentation should be discussed in more general terms to identify a wider range of activities.	19. Great Plains	19.5	667		The sections identified have been rearranged to incorporate your suggestion.
Department of Interior	Department of Interior	Why is carbon dioxide the only GHG listed in item 1? This is misleading. While I have noticed that technical pollutant discussions have been avoided in much of the document to this point, this is too great an oversimplification.	27. Mitigation		955	20	The chapter now gives more attention to the non-CO2 greenhouse gases. But the key finding remains, as CO2 and other long-lived gases are such a large component of the overall forcing.
Department of Interior	Department of Interior	Does the 44 billion tons of CO2 really mean CO2 only or CO2 equivalent? Readers should be given information about methane and other pollutants in these summary statements. For technical and political reasons, methane reductions may be easier to achieve than CO2 reductions (especially in the short term).	27. Mitigation		955	24	It really does mean CO2 emissions, and we have made the required editing change.
Department of Interior	Department of Interior	This figure and text is misleading. Although enery development can fragment habitat, by far the leading cause of native grassland loss and fragmentation in the Great Plains is conversion of native habitats to tilled agricultural fields. This is alluded to in the proceeding paragraph. It is unclear why this particular use was singled out as a source of fragmentation, perhaps a better angle in the discussion of climate change would be to discuss the amount of carbon storage in native prairie vs. tilled ag lands.	19. Great Plains		666	32	The sections identified have been rearranged to incorporate your suggestion.
Department of Interior	Department of Interior	Figure 19-5. This figure illustrates O&G and fragmentation as it relates to Climate change and GRSG in the Great Plains. The 'threats' to GRSG from 'energy development' also include other sources, such as wind and solar. Consider incorporating a discussion in the text that associates energy development (including oil and gas, wind, solar, etc.) and habitat fragmentation to GRSG. In short, there is no mention of the other 'contributors' to habitat fragmentation in this 'energy' section, rather the focus seems to be focused/limited to oil and gas energy development and possible leads the reader to believe that oil and gas is the only energy sector that contributes to habitat fragmentation. Add discussion about fragmentation from other forms of land uses and energy development in order to communicate the breadth of uses that impact habitat and climate change. Could consider a review of NREL data for wind development potential and intersect with GRSG priority habitat.	19. Great Plains		666	9	The sections identified have been rearranged to incorporate your suggestion.
Department of Interior	Department of Interior	Figure 19-5. add a source and year for projected well data. Also note current policy for planning and interim guidance with regard to GRSG habitat, including not authorizing new leases on BLM federal mineral estate in priority GRSG habitat (until new planning efforts are completed to address GRSG) Wahington Office Information Memorandum (WO IM)2012-044 and WO IM 2012-043	19. Great Plains		666	18	Thank you for your comment, however policy issues are beyond the defined scope of the National Climate Assessment, a scientific document that provides the basis for decision making, but does not address policy.
Department of Interior	Department of Interior	Replace "made fire-prone ecosystems more vulnerable to "mega-fires"--large fires that are unprecedented in their social, economic and environmental impacts" with "increased the risk of fires exceeding historical size resulting in unprecedented social and economic challenges". Mega-fire is a journalistic term that lacks a precise definition and should be avoided. Larger fires are not just impacting "fire-prone" ecosystems--changes in fire size and severity are changing fire regimes across biomes. The result is more complex than "fire-prone" implies. The environmental impacts of larger fires are not necessarily unprecedented as further research into fire histories (100's of years) and the paleo-	8. Ecosystems, Biodiversity, and Ecosystem		296	15	Edited as suggested.

		record (1000's of years) indicate for some areas. The socio-economic system faces an increased challenge with regard to planning, preparedness, and costs, but not necessarily increased impacts from larger fires.	Services				
Department of Interior	Department of Interior	Remove "Large". The largest fires typically do not have large socio-economic impacts, while those fires that do have large socio-conomic impacts are usually not the largest fires. Replace "urban-wildland" with "wildland-urban" to conform to standard usage.	8. Ecosystems, Biodiversity, and Ecosystem Services		296	17	Edited in response to comment #35496
Department of Interior	Department of Interior	Replace "million" with "billion".	8. Ecosystems, Biodiversity, and Ecosystem Services		296	19	This has been corrected as suggested.
Department of Interior	Department of Interior	Remove "and the southwestern deserts". The increase in fire frequency in deserts is driven by the expansion of exotic annual grasses which increase fuel continuity. Climate change contributes indirectly by aiding the expansion of exotics, but does not appreciably increase their flammability (consistent with p. 297, lines 37-40).	8. Ecosystems, Biodiversity, and Ecosystem Services		296	33	The text has been edited to indicate that expansion of exotic annual grasses plays a role in the increase in fire in southwestern deserts.
Dewey	Odhner	It is possible to restore local environments in a matter of decades or centuries, and to replenish local ecosystems by introducing species from other areas, as long as there is sufficient biodiversity on a global scale. Prehistoric global warming events have occurred at slow enough rates that most species were able to adapt to the change. The current rate of warming is by far unprecedented and is likely to combine with other effects of unsustainable industrial practices, such as deforestation, in bringing about a global mass extinction. New species can evolve, but slowly; the rate of extinction far outpaces the rate of speciation. Our posterity may suffer from depletion of worldwide biodiversity for more than a million years. So climate change may affect trillions of Americans. Surely, despite the difficulty of assessing the probable severity of this impact, it is important to make such an assessment a high priority.	29. Research Agenda for Climate Change Science		1036	20	We have now mentioned the needs for ecosystem assessments under Research Goal on impacts (RG2).
Frank	Sturges	The NCA chapter on Forestry describes four key messages regarding increased vulnerability, reduced forest CO2 uptake, the possibility of bioenergy through salvage logging, and providing information to managers regarding climate change. While each message is discussed in detail, little time is spent drawing connections between the effects of different management actions. For instance, how will salvage logging for bioenergy affect the increased vulnerability of forests to ecosystem change and stressors such as fire and insect damage, and vice versa? One primary area that is lacking from the Forestry chapter is a detailed discussion of how climate	7. Forestry				We have no space to cover these details.

		change will affect the ecosystem services provided by American forests. Beyond the mention of human values of timber, water, recreation, and aesthetic and spiritual benefits on p. 282, there is little information regarding how these ecosystem services will be affected by climate change. For instance, how will increased vulnerability to fire affect the water quality of rivers both in terms of eliminating regular filtration by forests and sediment release during fires? Furthermore, how might different harvest techniques and changes to the ranges of tree species affect the quantity of water in western rivers? How might available habitats change with changes to tree species ranges due to climate? The chapter on ecosystems and ecosystem services does not provide specific information regarding how forestry techniques will affect ecosystem services. The choices made in forestry can not only mitigate carbon emissions but also do a great deal regarding adaptation in order to protect and preserve certain ecosystem services. The discussion of carbon uptake mentions the current slowly accelerating growth of forests and how projections do not see that trend continuing, partially due to land-use change and partially due to increased stressors from climate change. One area that is not covered is the role of urban forests in the future. In addition to providing aesthetic ecosystem services, how will forests outside of traditional timber management and family forest groves change carbon uptake projections? As urban planning incorporates more trees in cities, how could that alter models projecting the change in net carbon uptake even in the face of increased city growth? What data supports the use of bioenergy as a response to climate change? The report discusses the potential of bioenergy to replace up from 3% to 5% of energy consumption, but it does not discuss if a positive or negative emissions change will be caused by bioenergy production opposed to more traditional fuel sources. What emissions will be caused by cumulative efforts to establish harvesting opportunities for bioenergy as well as in processing? Furthermore, even if bioenergy could help as a mitigation measure by in the event that it could lessen carbon emissions, what would be its effects on adaptation to the impacts of climate change on forests? Would it be a case of mitigation efforts working against adaptation measures? Considering these questions, what value does bioenergy really have as a part of America's overall climate planning for forests? Without this information, the message regarding bioenergy remains highly theoretical and it is unclear whether or not aggressively pursuing it, or even pursuing it at all, is a worthwhile policy choice, especially considering the acknowledged point that currently the industry is not profitable. Finally, how will the application of different fuel treatments and theories of restoration ecology alter projections of future stressors and uptake? While the NCA is designed to be science, and not policy recommendations, it does reference current regulatory requirements that may limit innovative management due to how they take into account static considerations. In its 2012 report "Increasing the Pace of Restoration and Job Creation on Our National Forests," the US Forest Service estimated that there are between 65-82 million acres of NFS lands in need of restoration. How might new management policies such as the Collaborative Forest Landscape Restoration Program alter projections of forest growth, species diversity, and vulnerability to impacts? If more acres of public land are treated with restoration techniques, how will models of carbon emissions from large forest fires change? Also, how would restoration activities change adaptation to climate change by lessening the stressors caused by overgrown forests which make them more vulnerable to future climate related impacts? While the chapter on forestry and climate change discusses some of the main roles that forests plan in climate mitigation as well as some of the stressors, it could benefit from more discussion explicitly regarding adaptation measures in forestry, including regarding the myriad ecosystem services provided					

		by forests, as well as the interconnectedness of management choices on both how effective mitigation will be and how management efforts can improve climate adaptation.					
Luisa	Cristini	Is the value $700 billion and $1.1 trillion annually a national estimate? If yes this should be indicated more clearly.	3. Water Resources		124	30	Thank you for your comment. We have removed the valuation estimate.
James	Tolbert	Chapter 27 (Mitigation) avoids the most significant discussions that I would expect in this chapter. While Chapter 27 does attempt to present that existing federal, state, and local actions relate to mitigating climate change, and further voluntary individual and corporate actions, the chapter does not spend adequat time putting these actions into context of what is required to appropriately mitigate climate change. Chapter 27 further fails to present actions being taken or attempted by other countries to mitigate climate change – changes which can be used as bench marks and learning experiences for the necessary changes in the United States. Chapter 27 also completely fails to projects major trends in mitigation for the subsequent 25 to 100 years, which is a direct requirement of the Global Change Research Act. The Global Change Research Act is incorporated in the United States Code, Title 15, Chapter 56A - Global Change Research, defines the purpose and content of the National Climate Assessment report in Section 106 (Scientific Assessment) as follows: “On a periodic basis (not less frequently than every 4 years), the Council, through the Committee, shall prepare and submit to the President and the Congress an assessment which: • “Integrates, evaluates, and interprets the findings of the Program and discusses the scientific uncertainties associated with such findings • “Analyzes the effects of global change on the natural environment, agriculture, energy production and use, land and water resources, transportation, human health and welfare, human social systems, and biological diversity • “Analyzes current trends in global change, both human- induced and natural, and projects major trends for the subsequent 25 to 100 years.” The first sections in the current Chapter 27 discuss forcing agents that would be expected to be presented in Chapter 2 (Our Climate). Then Chapter 27 presents minimalistic actions taken to mitigate climate change without sufficiently documenting how all of these actions combined do not create a meaningful mitigation to climate change. The insufficient nature of our current response is partially recognized in the second key message: “To meet the rapid emissions reduction (B1) scenario used in this assessment, global mitigation actions would, within the next 25 years, need to limit global greenhouse gas emissions to a peak of around 44 billion tons of carbon dioxide per year. In 2011, global emissions were around 37 billion tons, and have been rising about 0.9 billion tons per year for the past decade. The world is therefore on track to exceed this level within a few years.” Please clearly document in the report that the existing actions described in the January 11, 2013 draft are not sufficient to achieve realistic goals for mitigating climate change. Please also clearly address projections regarding the type of changes that will be required to mitigate climate change. This section is on mitigation, not on denial of the problem nor on abatement. To	27. Mitigation				The chapter clearly states that current mitigation efforts (globally and domestically) are not sufficient to meet targets that would hold equilibrium warming to 2C. It is outside the scope of the NCA to suggest or prioritize particular policy approaches, but a discussion of different potential approaches has been added.

		mitigate the upcoming climate change, the authors can project major trends for the subsequent 25 to 100 years. These changes are expected to include the following: Significant re-invention and change in our electrical power generation and transmission system for the United States. Only five states, (Idaho, Washington, Oregon, South Dakota and Maine) generated a majority of their electrical power from renewable resources in 2012 ("Electric Power Monthly, February 2013". Energy Information Administration (EIA) U.S. Department of Energy. Retrieved 3/14/13). Through most of the country, significant changes in our electrical generation system are required to mitigate greenhouse gasses. Significant changes to our transportation system where the majority of the country is still dominated by individual automobiles powered by gasoline. I have a hard time imagining how this chapter can not have a referenced discussions of cap-and-trade and carbon tax options. I find the current draft of Chapter 27 lacking in any real discussion that should be presented to the President and the Congress in an assessment major trends related to mitigation for the next 25 to 100 years.					
Department of Interior	Department of Interior	Please add a row for the Bureau of Land Management (BLM) under the Department of Interior. As the largest manager of federal lands, the BLM is undertaking two connected initiatives to understand, anticipate, and respond to the effects of climate change on the public lands. These initiatives are Rapid Ecoregional Assessments (REAs), which are currently being prepared, and a proposed landscape approach for managing public lands.	28. Adaptation	28.1	988		We thank the commenter for the suggestion, but space is limited. As such, we are asking the INCA to reconcile table 28.1 such that each agency has 6 lines to fairly and accurate represent illustrative adaptation actions within the various federal agencies.
Department of Interior	Department of Interior	This is an excellent report and would like to complement the NCA on a job well done and a first-rate piece of work. Very current, very thorough, very measured, very well-documented.					We greatly appreciate the positive comment.
Department of Interior	Department of Interior	I have reviewed the Chapter 25-Coastal Zone that addresses Coastal Adaptation. I was surprised that there was no mention of the Coastal Barriers Resources Act of 1982 and subsequent reauthorizations. I believe examination of the existing legislation and its 40 years of application to coastal adaptation and potential for expansion both in policy scope and geographic scope could provide a very effective tool. I would recommend that the authors at least identify this existing law and its particular effect on the economic and natural resources of the coastal zone, most notably the prohibition of National Flood Insurance Program and federal funding of infrastructure in the delineated Coastal Barriers Resource System units. There are several references and studies that have been done over the years, as well as the CBRA mapper that identifies all the existing CBRA units and general information that can be found on the Service's website at www.fws.gov/cbra/.	25. Coastal Zone Development and Ecosystems				We appreciate this suggestion, but space is limited and it does not allow us to do an adequate assessment of the CBRA or any other single tool of coastal management. This deserves an entire assessment itself. Several documents and reports are cited that do look critically at a range of land use, zoning, and other tools. Given space limitations and the overall scope of this chapter, we can only mention the act (and add several citations to barrier island and the CBRA/CBIA here and in the Ecosystems section), and thus acknowledge its role in the adaptation tool kit but not explore its potential as an adaptation tool with

							wider applicability.
Department of Interior	Department of Interior	Alaska was well represented in this chapter and although this may be logical given that the changes are most extreme in the Arctic, it would be useful to include more examples of the effects of climate change in the lower 48.	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources				The text has been revised to incorporate this suggestion. We have added a number of new references that include examples of the effects on climate change in the lower 48 states, which we refer you to for more in-depth discussion and examples of which we could not provide due to limited space.
Department of Interior	Department of Interior	The last sentence of the paragraph mentions how tourism may be affected by global warming but similar examples were not given for the oil and gas industry, mining. or fisheries. Here is some text that could be included for the oil an gas industry and fisheries (comparable language could be added for mining): "Currently much of the development related to oil and gas exploration, development, and production occurs during the winter when the land and ocean is frozen. It is already expensive to produce oil and gas in Alaska and with the loss of winter ice and shortening of the winter season the cost of extracting oil and gas from onshore and offshore areas would likely increase. Salmon fisheries are particularily suscpible to changes in water tmperatures particularily in the spawning and rearing areas in streams, lakes, rivers, and estuaries. In addition ocean acidification, rising ocean temperatues, and loss of sea ice could cause regime shifts of pelagic species of fish."	22. Alaska and the Arctic		760	8	The text has been revised to incorporate the first suggestion. The fisheries and ocean acidification are already addressed as impacts under the text of key message 4.
Department of Interior	Department of Interior	Delete the word "typically" and replace with the word "can". Most of the polar bears from the Chukchi/Bering Sea population use terrestial dens. Bears from the Southern Beafort Sea population in northern Alaska have seen a marked shift from 60% on the ice to about 30% on the ice (Fischback et al. 2007). Most of the denning by polar bears in the Arctic is on terrestrail dens.	22. Alaska and the Arctic		764	19	The text has been revised to incorporate this suggestion.
Department of Interior	Department of Interior	Add a space between "Carcasses" and "on"	22. Alaska and the Arctic		788	32	The text has been revised to incorporate this suggestion.
Department of Interior	Department of Interior	Food storage will become more difficult for people who reply on in ground cellars, kept cold by the permafrost, as the erth heats up.	22. Alaska and the Arctic		769	13	After consideration of this point, we feel the existing text is clear and accurate.
Department of Interior	Department of Interior	Earlier Chinook runs may impact subsistence users if the air temperatures and rain amounts are not suitable for drying of fish.	22. Alaska and the Arctic		772	8	Due to the size of the topic, and the page limit for the chapter, we focused on broad trends rather than delving too deeply or providing such a level of specificity.
Department of Interior	Department of Interior	Fish camps used during the harvest of fish are eroding as the rivers change course, leaving subsistence users without places to harvest and process fish. In many cases there is no where to relocate to.	22. Alaska and the Arctic		774	28	The text has been revised to incorporate this suggestion.

Department of Interior	Department of Interior	This is the state of the art science on climate change- great stuff.					We greatly appreciate the positive comment.
Department of Interior	Department of Interior	Re: wording “is projected to correspond closely to the cumulative…” As worded, it makes them sound independent of each other, but it’s a causal relationship (i.e., temperature projected to increase because of emissions).	1. Executive Summary		3	27	The language has been modified to emphasize the linkage.
Department of Interior	Department of Interior	Re: “In the Southeast” and “are at risk from storm surge.” Comment: this is not just in the SE, for example, Superstorm Sandy in the NE.	1. Executive Summary		4	25	This is a Key Message for the Southeast, with multiple events over time. A new header has been developed for the infographic to indicate that the impacts selected are meant to be illustrative.
Department of Interior	Department of Interior	Unclear as to what this sentence means.	1. Executive Summary		6	32	The sentence intends to convey the point that depending on past information about climate will not be adequate in a changing world. Modifications to the language have been made.
Department of Interior	Department of Interior	Re: observations in the Great Plains: Comment: This is applicable to other regions as well? If so, please say so.	1. Executive Summary	Table 1.1	11		The table on the regions has been replaced with a figure. The impacts described for each region are examples with the highest order impact. Given space limitations, it is not possible to show every impact experienced by each region.
Department of Interior	Department of Interior	"impacts because people, livestock *and wildlife* get no respite" (add wildlife)	1. Executive Summary		3	34	The language has been modified.
Department of Interior	Department of Interior	Please add mention of historic properties (cultural resources that are eligible or potentially eligible to the National Register of Historic Places). They are very much a part of the built environment. Vulnerability assessments should include consideration of historic properties.	11. Urban Systems, Infrastructure, and Vulnerability		419	27	While the authors recognize the value of historic properties and their vulnerability, we were limited on page count and could not include everything in our narrative.
Department of Interior	Department of Interior	As plans are formed, should consider/address plans for historic properties.	11. Urban Systems, Infrastructure, and Vulnerability		420	39	The statement does not consider what should go into the plans. Comment is inappropriate in this context.
Depart	Depart	Recommend that adaptation strategies for cultural resources also be addressed in Plans.	11.		426	6	We concur, but there is little evidence

ment of Interior	ment of Interior		Urban Systems, Infrastructure, and Vulnerability				that plans include this element. The statements reflect what has been done, not what should be done.
Department of Interior	Department of Interior	How does NEPA provide incentives? The National Historic Preservation Act (NHPA) offers incentives (i.e., tax credits) to property owners who rehabilitate historic buildings. Other Federal tax credits can be used in historic preservation projects as well (i.e., for acquiring, constructing, rehabbing low-income housing).	11. Urban Systems, Infrastructure, and Vulnerability		428	7	Thank you for your suggestion. Based on your comment, edits have been made.
Department of Interior	Department of Interior	Re: “566 federally recognized tribes.” Comment: The number of federally recognized tribes changes from year to year. Consider adding a reference, for example, “…as of FR Vol. 77 #155, August 2012.	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources		443	3	We added the word “currently” to imply this is not a constant number.
Department of Interior	Department of Interior	The map should show mean position (1979 -2000) of sea ice as well.	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources	Figure 12.4	450		We are restricted in space for the chapter, so the authors feel that the point raised in the comment is illustrated by existing graphics.
Department of Interior	Department of Interior	The IPCC 2007 reference should provide a more specific reference (and reference by authorship).	25. Coastal Zone Development and		869	33	The reference has been revised to incorporate this suggestion.

			Ecosystems				
Department of Interior	Department of Interior	Recommend adding a bullet to reference the high degree of local variation of effective SLR due to local vertical land movement and other factors. Many citations can be used including Tebaldi et al. 2012. A wonderful example of State-level research (high degree of variability in one State) on this can be found at Komar, P. D., J. C. Allan, and P. Ruggiero. 2011. Sea level variations along the US Pacific coast: tectonic and climate controls, Journal of Coastal Research 27(5):808-823. 2011.	25. Coastal Zone Development and Ecosystems		870	13	The references have been added there to further demonstrate the effect of local conditions.
Department of Interior	Department of Interior	Re: IPCC 2012 reference. What is this reference? Extremes? Should refer to it correctly.	25. Coastal Zone Development and Ecosystems		870	23	The reference has been revised to incorporate this suggestion.
Department of Interior	Department of Interior	This needs to be explained more fully somewhere. Why regional differences?	25. Coastal Zone Development and Ecosystems		871	3	The caption has been clarified and the source of regional differences is now included. In detail: Regional differences arise in panels a and b as a result of local land subsidence or uplift rates (e.g., land subsidence is rapid in the Gulf region, and land uplift occurs at some West Coast sites), and in panel c and d as a result of varying storm surge risk which varies by location.
Department of Interior	Department of Interior	In Pac Northwest text: "in Seattle area and central Oregon." (per Komar, P. D., J. C. Allan, and P. Ruggiero. 2011. Sea level variations along the US Pacific coast: tectonic and climate controls, Journal of Coastal Research 27(5):808-823. 2011)	25. Coastal Zone Development and Ecosystems		874	3	The graphic has been revised to incorporate this suggestion. Reference added to underlying referencing.
Department of Interior	Department of Interior	In Pac Northwest tex: Atmospheric River systems also affect the PNW region. (Use "persistent storm tracks (Atmospheric River systems)" -- The public will not understand the technical term.)	25. Coastal Zone Development and Ecosystems	Figure 25.4 c	874		The graphic has been revised to incorporate this suggestion.
Department	Department	In California text: Use "persistent storm tracks (Atmospheric River systems)" -- The public will not	25.	Figure	874		The graphic has been revised to

ment of Interior	ment of Interior	understand the technical term.	Coastal Zone Development and Ecosystems	25.4 c			incorporate this suggestion.
Department of Interior	Department of Interior	For Pacific Islands: USGS provided first-ever high-res. topographic and SLR impact estimates for wildlife management in the northwestern HI Islands. See: Reynolds, M.H., Berkowitz, P., Courtot, K.N., and Krause, C.M., eds., 2012, Predicting sea-level rise vulnerability of terrestrial habitat and wildlife of the Northwestern Hawaiian Islands. U.S. Geological Survey Open-File Report 2012-1182, 139 p.	25. Coastal Zone Development and Ecosystems	Figure 25.4 d	875		Thank you for the reference. We include it now in the underlying information.
Department of Interior	Department of Interior	For Pac NW: A very significant example (and very different than all of the other SLR examples) is the State of WA's Blue Ribbon panel report and Executive Order on Ocean Acidification (Dec. 2012). See: http://www.ecy.wa.gov/water/marine/oceanacidification.html	25. Coastal Zone Development and Ecosystems	Figure 25.4 d	875		Thank you for the reference. We include it now in the underlying information; ocean acidification is also more fully treated in the Oceans chapter.
Department of Interior	Department of Interior	Given its importance, add more to the bullet on ocean acification; and consider adding a section devoted to it (see Pac Islands Chapter and State of WA Blue Ribbon Report on OA for example of high risk effects). E.g., for West Coast, over the past 250 years, since the beginning of the industrial revolution, there has been about a 16% decrease in aragonite and calcite saturation state in the Pacific Ocean due ocean acidification processes (Feely et al., 2012). Feely and colleagues recently published the latest repeat oceanographic surveys for the Pacific Ocean showing accelerating ocean acidification trends over the past 14-year period: the observations show an average 0.34% per year decrease in the aragonite and calcite saturation state of surface seawater. This has caused an upward migration of the aragonite and calcite saturation horizons toward the ocean surface on the order of 1–2 m per year. Feely, R. A., C. L. Sabine, R. H. Byrne, F. J. Millero, A. G. Dickson, R. Wanninkhof, A. Murata, L. A. Miller, and D. Greeley. 2012. Decadal changes in the aragonite and calcite saturation state of the Pacific Ocean, Global Biogeochem. Cycles, 26, GB3001, doi:10.1029/2011GB004157	25. Coastal Zone Development and Ecosystems		870	31	We appreciate this suggestion, but space is limited and it does not allow us to duplicate the extensive discussion of ocean acidification (including an example from the west coast) in Chapter 24. We cite Chapter 24 in our text and, in the hyperlinked final version of this chapter, the link to it will assist the reader appropriately. We have added the additional citation suggested here.
Department of Interior	Department of Interior	Unclear what this means. Recommed stating that future climate will be different than the past climate. This is a simpler way of saying it.	28. Adaptation		984	12	We want to thank the commenter for this comment. We meant exactly what we wrote as our ensuing paragraph fully explains that past climate can no longer be a good indicator of future environmental conditions. Therefore, the tolerances of infrastructure, for example, as we included, may no longer be suitable. As such, no change was made.
Depart	Depart	Unclear what this means. Do you mean that planning occurred without considering future climate	28.		984	14	We thank the commenter for this

ment of Interior	ment of Interior	change?	Adaptation				question about clarity. However, the text supporting this statement is well substantiated, so no further refinements were made.
Department of Interior	Department of Interior	Substitute the word “actors” for "leaders"	28. Adaptation		989	17	We thank the commenter for this suggestion. The authors have made this change.
Department of Interior	Department of Interior	Substitute the word “actors” for "leaders"	28. Adaptation		993	6	We thank the commenter for this suggestion. The authors have made this change.
Department of Interior	Department of Interior	Add EdoAdapt and the National Adaptation Forum to the list of NGOs providing assistance for adaptation planning and implementation. Add CAKE to Networking /Best Practice Exchange	28. Adaptation	Table 28.4	1001		We thank the commenter for this comment. The author team has deliberated and listed examples with which we were aware at the time of first drafting. Because space is limited, we will not attempt to list all the possible NGOs that are providing information. We have added CAKE to the list but have not added the NAF.
Department of Interior	Department of Interior	The introduction should describe the selection criteria and process for the 4 sectors/systems chosen for the Chapter. We recommend considering adding interior grasslands/shrublands. Failing the addition, we recommend that short statements be added for other high risk areas especially for interior grasslands and shrublands given the large geographic extent, the high economic importance of these systems to rural communities, and the amount of scientific inquiry and findings on climate sensitivity and vulnerability (we recommend that the reader be dirceted to Finch, Deborah M., ed. 2012. Climate change in grasslands, shrublands, and deserts of the interior American West: a review and needs assessment. Gen. Tech. Rep. RMRS-GTR-285. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 139 p). Finally, we recommend mentioning certain risk factors that will affect all sectors/systems such as increased pests, pathogens and invasive species (Hellman et al., 2008, Rahel & Olden 2008, Willis et al., 2010, Diez et al., 2012, Blaustein et al. 2012). Citations: Hellman, J.J., Prior, K.M., Pelini, S.L. 2012. The influence of species interactions on geographic range change under climate change. Annals of the New York Academy of Sciences Issue: The Year in Ecology and Conservation Biology ISSN 0077-8923; Rahel, F.J., and Olden, J.D. , 2008, Assessing the effects of climate change on aquatic invasive species. Conserv. Biol. 22(3): 521–533. doi:10.1111/j.1523-1739.2008.00950.x. PMID:18577081; Willis CG, Ruhfel BR, Primack RB, Miller-Rushing AJ, Losos JB, et al., 2010, Favorable Climate Change Response Explains Non-Native Species’ Success in Thoreau’s Woods. PLoS ONE 5(1): e8878. doi:10.1371/journal.pone.000887; Diez, J, D’Antonio, C.M., Dukes, J.S., Grosholz, E.D., Olden, J.D., Sorte, C. JB., Blumenthal, D.M., Bradley, B.A., Early, R., Ibáñez, I., Jones, S.J., Lawler, J.J., and L. P. Miller. 2012. Will Extreme Climatic Events Facilitate Biological Invasions? Front Ecol Environ 2012; 10(5): 249–257, doi:10.1890/110137; Blaustein, Andrew R., Stephanie S. Gervasi, Pieter T. J. Johnson, Jason T. Hoverman, Lisa K. Belden, Paul W. Bradley and Gisselle Y. Xie, 2012, Ecophysiology meets conservation: understanding the role of disease in amphibian population declines. Phil. Trans. R. Soc. B 2012 367, 1688-1707 doi: 10.1098/rstb.2012.0011	21. Northwest		721		The selection process is now revised/expanded only in the traceable account. We did not add interior grasslands/shrub lands as a primary sector discussed in the report due to the relatively lower combination of likelihood, level of understanding of the connection to climate, and economic consequences. Increased pests/pathogens are already mentioned in conjunction with aquatic ecosystems, agriculture and forests.
Department of Interior	Department of Interior	Regarding hydology, it is important to note that the Cascades contain many watersheds with a high baseflow index (groundwater contribution) and these are less sensitive to 21st Century climatic change. This should be noted in the text (lines 1-13); and in figure 21.2, the reader should know that the	21. Northwest		724		The text has been revised to incorporate this suggestion.

		hydrologic model used here does not account for areas with high sources of high Cascades groundwater. We expect less sensitivity in many watersheds and recommend listing these watersheds. Supporting documentation includes most recently, Tague et al. (2013, Hydrol. Earth Syst. Sci., 17, 341–354, doi:10.5194/hess-17-341-2013) Also, Safeeq et al, show that broad between-watershed (geologic) differences in drainage rates exert a first-order control on the magnitude of climate warming effects (Safeeq et al. 2013. Hydrol. Process. DOI: 10.1002/hyp. 9628)					
Department of Interior	Department of Interior	Regarding sea level rise, it should be stated that the NRC Report (2012) uses a necessarily broad and conservative approach to vertical land movement due to a lack of sufficient data points for the entire west coast and the complicating issue of local sediment compaction and/or fluid withdrawal. However, it is important to consider analyses that do incorporate more data such as those available for the Oregon coast to Willapa, WA from Komar et al. (2011) and the data points and projections from Telbaldi et al. (2012) in OR and WA. These provide sea level projections for the six tide gauges located in Oregon and Washington, including the gauge at Coos Bay, using the semi-empirical approach of Vermeer and Rahmstorf (2009) with vertical land motion and other local factors taken into account using historical data from each gauge station. Aren't these SLR rates are more realistic for local decision makers? Citations: Tebaldi, C., Strauss, B. H., Zervas, C. E., Modeling sea level rise impacts on storm surges along US coasts, Environ. Res. Lett. 7 (2012), doi:10.1088/1748-9326/7/1/014032 ; Komar, P. D., Allan, J. C., Ruggiero, P., Sea Level Variations along the U.S. Pacific Northwest Coast: Tectonic and Climate Controls, Journal of Coastal Research27 (5), 808-823, (2011), doi:10.2112/JCOASTRES-D-10-00116.1	21. Northwest		726		Addressing this issue at this level of detail given the length constraints is impossible. We have modified the way the NRC work is presented in an attempt to avoid misleading readers that the NRC data alone is sufficient for community-level planning. The sentence referring to "local decision makers" was removed from this text and from Fig. 21.3 caption.
Department of Interior	Department of Interior	Regarding projections for forests, we recommend also incorporating the findings/conclusions of Waring, Richard H., Nicholas C. Coops, Steven W. Running, 2011, Predicting satellite-derived patterns of large-scale disturbances in forests of the Pacific Northwest Region in response to recent climatic variation, Remote Sensing of Environment, 115 (2011) 3554–3566.	21. Northwest		731		The paper suggested does not actually make any quantitative climate-driven projections about changes in the future. Instead, it uses observations in the mid and late 20th century to confront output from a model of intermediate complexity. The paper alludes frequently to climate change, but shows nothing that is compelling to cite here.
Department of Interior	Department of Interior	Regarding invasive species, add "for example" after "(Bradley etal., 2012)." Recommend short sentence to describe why invasive species are a high risk. See: Hellman et al., 2008, Rahel & Olden 2008, Willis et al., 2010, Diez et al., 2012, Blaustein et al. 2012). Citations: Hellman, J.J., Prior, K.M., Pelini, S.L. 2012. The influence of species interactions on geographic range change under climate change. Annals of the New York Academy of Sciences Issue: The Year in Ecology and Conservation Biology ISSN 0077-8923; Rahel, F.J., and Olden, J.D. , 2008, Assessing the effects of climate change on aquatic invasive species. Conserv. Biol. 22(3): 521–533. doi:10.1111/j.1523-1739.2008.00950.x. PMID:18577081; Willis CG, Ruhfel BR, Primack RB, Miller-Rushing AJ, Losos JB, et al., 2010, Favorable Climate Change Response Explains Non-Native Species' Success in Thoreau's Woods. PLoS ONE 5(1): e8878. doi:10.1371/journal.pone.000887; Diez, J, D'Antonio, C.M., Dukes, J.S., Grosholz, E.D., Olden, J.D., Sorte, C. JB., Blumenthal, D.M., Bradley, B.A., Early, R., Ibáñez, I., Jones, S.J., Lawler, J.J., and L. P. Miller. 2012. Will Extreme Climatic Events Facilitate Biological Invasions?	8. Ecosystems, Biodiversity, and Ecosystem Services		297	27	No change. Discussing the effects of invasive species is beyond the scope of this section and chapter.
Department of Interior	Department of Interior	We recommend placing more emphasis on that numerous responses by species, populations, communities and ecosystems. (See for example, Geyer et al., 20111, Claassification of Climate Change Indyuced Stresses on Biological Diversity, Conservation Biology, Volume 25, No. 4, 708–715, DOI: 10.1111/j.1523-1739.2011.01676.x Also, we recommend placing an emphasis on the unpredictability of specie-specific and population-specific repsonses, resulting in a non-analog future for communities and	8. Ecosystems, Biodiversity, and		296	24	No change. While the comment suggests a good specific example, the authors feel the existing examples are appropriate.

		ecosystems (assemblages of disparate species). See for exampole, Tingley et al., Global Cahnge Biology (2012) 18, 3279-3290, doi: 10.1111/j.1365-2486.2012.02784.x This is supported by a large amount of palaeontological evidence.	Ecosystem Services				
Department of Interior	Department of Interior	These are impressive syntheses of a tremendous amount of information about the physical effects of climate change. My only observation is that the biological effects tend to be much less comprehensive.	22. Alaska and the Arctic				The points the comment raises are beyond the scope of this chapter. Additional ecological impacts are addressed in the ecosystem chapter.
Department of Interior	Department of Interior	Recommend adding a reminder that analysis is needed at local and regional scales, as the global projections given in this segement of text tend to be interpreted by readers as what they ought to expect locally or regionally.	1. Executive Summary		4	27	This is explained in Chapter 2 but does not need to appear in the Executive Summary.
Department of Interior	Department of Interior	As written, the text describes loss of biodiversity as being among "non-climate stresses" and this could be interpreted as implying climate change does not contribute to the loss of biodiversity -- yet it clearly will in many areas of the US and likely across the nation as whole.	1. Executive Summary		5	2	The paragraph begins with a phrase about climate change impacts on the entire living world; no change is recommended.
Department of Interior	Department of Interior	I recommend that wildlife be added to the list of things specifically mentoinned, as wildlife-related recreation is important for social, cultural, and economic reasons, and is important for a variety of reasons for US tribes and other indigenous people.	1. Executive Summary		5	23	A change in this language has been made.
Department of Interior	Department of Interior	This paragraph focuses on coastal areas and floodplain wetlands; while important, these are not the only locations and systems for which vulnerability is a major concern. I recommend adding text that relates to drought and other changes in the timing and type of precipitation, and how that impacts availability of water for drinking, crop production, river navigation, inland fisheries, wildlife, and increased risk of wildfire and alteration of entire biomes in some areas (e.g., some forest areas (perhaps especially those that have burned) are likely to shift to shrubland, some shrublands are likely to be more subject to habitat degradation via the spread of non-native invasive plant species that benefit under conditions of climate change. (Some of these topics come up in the findings on pages 9 and 10, and ought to be mentioned here in the summary.)	1. Executive Summary		5	30	Language is amended, but it is not possible to include all of the impacts on ecosystems in the introductory material.
Department of Interior	Department of Interior	This is a major concern regarding the Findings section as a whole, and it involves two aspesct of Finding 9: (1) The heading mentions "biodiversity and location of species" (line 2), but the next sentence frames the resulting impacts entirely in terms of diminishing "the capacity of ecosystems to moderate the consequences of disturbance such as droughts, floods, and severe storms." These are not necessarily related. I recommend deleting the phrase "As a result" at the beginning of the second sentence of the finding. Then the two sentences that comprise the finding will both be accurate. (2) The description of the finding (lines 5-11) needs to be revised to include text about on-going and projected impacts of the climate change on biodiversity, which include increased risk of extinction of many species, including dimished abundance or local extinctions, as well as substantial range shifts of many species of wildlife, fish, and native plants. These changes will alter biological diversity at local, regional, and national scales, with various related social, cultural, and economic effects. In some cases the biodiversity changes will contribute to changes in the capacity of ecosystems in the manner currently indicated in the text, but that will not always be the case, nor should that (ecosystem capacity to moderate consequences of disturbance) be the sole measure of concern regardling diminishment of biodiversity.	1. Executive Summary		10	1	Good suggestion, this language has been changed.
Department of Interior	Department of Interior	Suggest someone check the literature on the extent to which warming ocean temperatures also has impacts on storms and other weather events, and add a sentence about that, if appropriate. Also, the effects described include marine-based food production and fishing communities, and to that a phrase or additional sentence ought to be added about marine biodiversity impacts which are of concern and which also may have other social, cultural, and economic ramifications.	1. Executive Summary		10	12	Material supporting these statements appears in Ch 2 and the Oceans and Marine Resources chapter. The authors believe the level of detail on this topic currently in the Executive

							Summary is acceptable.
Department of Interior	Department of Interior	Only 5 of the 10 descriptions in Table 1.1 mention effects on ecosystems or ecological consequences, which implies the other "regions" do not have such impacts. I recommend including text in each item to refer to impacts to ecosystems. It may also help to modify the heading to indicate these are key examples of regional observations of climate change.	1. Executive Summary	Table 1.1	11		The table on the regions has been replaced with an infographic. The impacts described for each region are high-level examples. Given space limitations, it is not possible to show every impact experienced by each region.
Department of Interior	Department of Interior	The overall emphasis on framing impacts is in terms of social, cultural, and economic concerns. While this focus is understandable, it implies that changes have significance only in that framework, or have to be "measured" in order to be valued. What is missing is text that also points to the intangible aspects of our environment that we prize as a nation and find hard to capture in words, let alone measure. Although "inspiration, and aesthetic and cultural values" are included in the description of "ecosystem services" in Chapter 8 (p. 291, line 35), and acknowlegement that it is "more difficult to say how people will be affected the the loss of a favorite fishing spot or a wildflower that no longer blooms in the spring" (Chapter 8, p. 292, lines 10-11) this gives extremely short shrift to the inherent value of species, ecosystems, and ecological processes. For many people, for example, just knowing that wilderness, wild areas, and certain species exist even though they will never see them, is priceless. The evocative words of two visionary American authors, Wallace Stegner and Charles Wilkinson, come to mind as being potential sources that could be quoted or paraphrased, particularly in the Executive Summary and in Chapter 8 (Ecosytems, Biodiversity, and Ecosytems Services) and would bring the entire document to a higher level of connection to the hearts -- not just the minds -- of many readers.					Thank you very much for the insightful suggestion. The NCA is a scientific document and we have tried to write in a way that will be useful to a broad audience. We hope that the Letter to the American People and the new context added to the Executive Summary will be meaningful to readers.
Department of Interior	Department of Interior	Changes in the timing of critical biological events are being observed already, so it would be appropriate to change the text from "will shift" to "will continue to shift". The same change is needed in sectoin "Key message #4/5" text at the top of page 312, and in the "Assessment of confidence based on evidence" text on page 312.	8. Ecosystems, Biodiversity, and Ecosystem Services		298	6	Changed as suggested.
Department of Interior	Department of Interior	The term "assisted migration" implies that the species that may be the targets of such action are migratory, which is not always going to be the case (and in fact will seldom be the case, since migratory species are able to move and are less likely to need assistance). A recent paper by Schwartz et al. (2012, "Managed relocation: Integrating the Scientific, Regulatory, and Ethical Challenges. BioScience 62(8): 732-743) on the topic includes a review of various terms used for the practice described, and suggests using the term "managed relocation"; it would make sense to adopt that term rather than "assisted migration." Also, there is no scientific consensus and some opposing views on whether the approach ought to be used, and if so when, where, or how. Thus it also would be better to refer to "managed relocation, if necessary, to help....." rather than write the text in a way that could be interpreted as endorsing the approach or implying that it is widely accepted. The same changes are needed on page 313 in the section on "New information and remaining uncertainties."	8. Ecosystems, Biodiversity, and Ecosystem Services		300	10	Changed as suggested.
Department of Interior	Department of Interior	The key message ought to be modified to include af reference to the increasing risk of extinction of many plant and animal species. Also, the "Description of the evidence base" for key messatge #3/5 is missing a very high profile "iconic" species, the polar bear, which is listed as a threatened species under the Endangered Species Act. As written, the iconic species mentioned do not include any animals.	8. Ecosystems, Biodiversity, and		310	2	A new paragraph inserted about polar bears, seals, and wolverines addresses the lack of iconic animal species.

			Ecosystem Services				
Department of Interior	Department of Interior	The contining importance of managing for individual species is not mentioned anywhere in the Adapation section and this is a very signficiant problem in light of concerns about biodiversity. While it is appropriate to describe and give attention to "ecosystem-based management," the sole focus on that approach implies there is no continuing role for attention to species-based approaches, which are conducted in the context of the ecosystem of which they are a part. Ecosystem-based approaches are to a great extent like "coarse filter" approaches which need to be coupled appropriately with "fine filter" approaches for individual species of concern, particularly those that are listed as threatened or endangered under the Endangered Species Act or at risk of becoming so. By themselves, ecoystem-based management approaches are best viewed as necessary, but not sufficient for sustaining biodivsity. The text ought to be revised to reflect this, and the same changes need to be incorporated in the text on page 313.	8. Ecosystems, Biodiversity, and Ecosystem Services		299	5	No change. We do not agree that this section neglects managing for individual species. Indeed many of the specific example adaptation strategies listed in thhe following paragraph are focused on individual species. "Guidance on adaptation planning for conservation has proliferated at the federal (CEQ 2011a; EPA 2009; NOAA 2010; Peterson et al. 2011; Weeks et al. 2011) and state levels (AFWA 2009), and often emphasizes cooperation between scientists and managers (Cross et al. 2012; Halofsky et al. 2011; Peterson et al. 2011). Ecosystem-based adaptation (CBD 2010; Colls et al. 2009; The World Bank 2010; Vignola et al. 2009) uses “biodiversity and ecosystem services as part of an overall adaptation strategy to help people adapt to the adverse effects of climate change” (CBD 2010). An example is the explicit use of storm-buffering coastal wetlands or mangroves rather than built infrastructure like seawalls or levies to protect coastal regions (Kershner 2010; Shaffer et al. 2009; Ch. 25 Coastal Zone). An additional example is the use of wildlife corridors (Chetkiewicz et al. 2006)."
James	Tolbert	The current draft of Chapter 27 does not adequately discuss policy actions which can mitigate climate change. Specifically, a carbon tax, which is a primary method to mitigate climate change by adding part of the cost of carbon dioxide emissions back into the transactions that emit carbon dioxide into the atmosphere. I do not believe any assessment of the major trends for the subsequent 25 to 100 years would be complete without a discussion of carbon tax. Upon reviewing the list of authors, I am very confident that you have a substantial knowledge about carbon tax as a mitigation procedure, but since you have omitted it from the January 11, 2013 draft of the chapter, I am compelled to offer a few reference for your review in case you are not familiar with carbon tax as a mitigation practice. (I apologize that the reference format is not standard in this comment tool. I believe these are all available on the internet.) Adkins, Liwayway; Garbaccio, Richard; Ho, Mun; Moore, Eric; Morgenstern, Richard. 2012. Carbon	27. Mitigation		964	28	The chapter has been expanded to include a more complete discussion of policy measures, but these will not be encyclopedic, nor will they recommend any particular action.

		Pricing with Output-Based Subsidies: Impact on U.S. Industries over Multiple Time Frames. Resources for the Future. RFF DP 12-27; June 2012. Dinan, Terry. 2012. Offsetting a Carbon Tax's Costs on Low-Income Households. Congressional Budget Office; Microeconomics Studies Division. Working Paper 2012-16. Fischer Carolyn; Fox, Alan K.. 2009. Comparing Policies to Combat Emissions Leakage: Border Tax Adjustments versus Rebates. Resources for the Future. RFF DP 09-02 Fischer Carolyn; Fox, Alan K.. 2009. Combining Rebates with Carbon Taxes: Optimal Strategies for Coping with Emissions Leakage and Tax Interactions. Resources for the Future. RFF DP 09-12. Fischer Carolyn; Fox, Alan K. 2012. Climate Policy and Fiscal Constraints: Do Tax Interactions Outweigh Carbon Leakage?. Resources for the Future. RFF DP 12-19; August 2012. McKibben, Warwick; Morris, Adele; Wilcoxen, Peter; Cai, Yiyong. 2012. The Potential Role of a Carbon Tax in U.S. Fiscal Reform. Brookings Institute. Parker, Larry; Blodgett, John. 2008. "Carbon Leakage" and Trade: Issues and Approaches. Congressional Research Services. CRS paper R040100 December 19, 2008. Parry, Ian W.H.; Williams, Roberton C. III. 2011. Moving U.S. Climate Policy Forward: Are Carbon Taxes the Only Good Alternative?. Resources for the Future. RFF DP 11-02; February 2011. Ramseur, Jonathan L.; Parker, Larry. 2009. Carbon Tax and Greenhouse Gas Control: Options and Considerations for Congress. Congressional Research Services. CRS paper R40242 March 10, 2009. Ramseur, Jonathan L.; Leggett, Jane A.; Sherlock, Molly F. 2012. Carbon Tax: Deficit Reduction and Other Considerations. CRS paper R42731; September 17, 2012. Sebastian Rausch; John Reilly. 2012. Carbon Tax Revenue and the Budget Deficit: A Win-Win-Win Solution?. MIT Joint Program on the Science and Policy of Global Change. MIT Report 228. Sharp, Philip R.. 2012. Tax Reform: Impact on U.S. Energy Policy. Resources for the Future. Congressional Testimony; June 12, 2012.					
James	Tolbert	The second sentence in the first paragraph on page 956 is not structured correctly. At a minimum, I believe there is a comma missing on the beginning of the phrase "like carbon dioxide and methane,". However, even with this comma, the sentence still feels a bit awkward to me and I suggest re-wording it.	27. Mitigation		956	4	Thank you for the editing suggestion. We have revised the section.
James	Tolbert	The current text proivdes as a key message that "Even absent a comprehensive national greenhouse gas policy, both voluntary activities and a variety of policies and means at federal, state, and local levels are currently in place that lower emissions." This statement is decieving and contradicts key messages number two and three. Greenhouse gas emissions in the united states are projected to increase in the future, and the sum of the existing policies are not adequate as a mitigation response.	27. Mitigation		955	37	We disagree that key message 5 contradicts the previous key messages. Concerning emissions projections, EIA projections to 2040 offer the possibility that CO2 emissions could remain roughly constant.

		Furthermore, the major reduction in greenhouse gas in the United States is attributable to the market decrease in the price of natural gas with more electricity generation shifting from coal to natural gas. This change is more related to a market condition than to a policy. I suggest that key message five is misleading and should be re-worded.					
Julie	Maldonado	Add reference: Klinenberg, Eric (2002) Heat Wave: A Social Autopsy of Disaster in Chicago. Chicago: The University of Chicago Press.Klinenberg's book provides an in-depth depiction of the unequal vulnerability and suffering faced by low-income communiites and families during a heat wave, demonstrating that most of the people who suffer illness and mortality during and shortly following the heat wave are low-income and African-American or Hispanic. This source is often cited as a testament to the environmental injustice experienced during weather-related disasters.	9. Human Health		352	19	We agree and have added a citation to Klinenberg et al.
Julie	Maldonado	The use of the term "refugees" here is inappropriate. This is a loaded term with a very specific set of legal meanings and social connotations. Such labels continue to propogate social inequalities and create a dichotomy between who is and is not considered a citizen, as the refugee definition is based on a person being persecuted and forced outside their country of origin. I would encourage the use of "internally displaced" over "refugees".	9. Human Health		352	2	We deleted "refugees" from the figure title and in the caption.
Julie	Maldonado	The Louisiana Workshop 2012 that this box references specifically explains that the environmental changes the communities are experiencing, such as relative sea level rise, coastal erosion and land loss are due primarily to the exploitation of their lands and destruction of their local environment by the fossil fuel industry, which has dredged canals leading to intense land loss, coastal erosion, and saltwater intrusion. Climate change-induced sea level rise acts as a compounding factor. Therefore, it is both the causes and consequences of climate change leading to these changes. The way it is written now, it sounds like land loss has been due to dam development/river management, which is true, but if you asked locals there they would tell you first and foremost the land loss and erosion has been caused by the dredging of canals by the fossil fuel industry. The Workshop Report discusses the negative impacts it has experienced by the fossil fuel industry, and now climate change is another added component. In line 8, after "saltwater intrusion" you could add that these impacts, as locals have noted, are primarily caused by the fossil fuel industry dredging canals through the marsh for pipelines, leading to land loss, erosion and intense saltwater intrusion. In line 10, instead of saying lack of land and water to grow food, it is much more accurate to say because of saltwater intrusion; if you asked someone from these communities, they would tell you that their gardens are gone because of saltwater intrusion, as well as land loss. Also in that line, saying "connectivity to the mainland" seems a bit obscure because two of the communities are part of the mainland. Line 11, it would be more accurate to say "increased saltwater inundation". In line 13, after "flood-prone" you could add "and people have been forced to relocate" because that is at the heart of some of the reduced social connections.Photos from the Louisiana Workshop Report showing land erosion, ghost forests, and in particular, land loss effects of canal cuts could be used here as visual depictions.	17. Southeast and Caribbean		585	1	The text has been revised to incorporate these suggestions.
Julie	Maldonado	In second caption under 2008 image, after "four major hurricanes" could say "in 4 years" as this shows the significance of what they faced in a short time span. After "with marshland weakened", I would suggest putting in "and loss of barrier islands due to the loss of sediment, saltwater intrusion, dredging of canals, development, erosion, and higher sea levels..." For photographs of land loss due to canal	17. Southeast and Caribbea	17.2	586		The text box for this figure captures some of these suggestions.

		cuts, see Louisiana Workshop 2012 Report, as cited earlier in chapter.	n				
Julie	Maldonado	It should be made clear that if adaptation measures are taken for the threat of these utilities, like Port Fourchon, we need to be aware of second-order effects that could impact local communities instead of protecting them.	17. Southeast and Caribbean		592	9	The revised text has incorporated that concept
Julie	Maldonado	This is the same citation given on pg 466, lines 12-13, but on pg.466 it is cited as: Louisiana Workshop, 2012: Stories of Change: Coastal Louisiana Tribal Communities' Experiences of a Transforming Environment. Input to the National Climate Assessment.	17. Southeast and Caribbean		609	14	This is the correct citation, the Tribal Chapter is revising their's.
Julie	Maldonado	Add reference: Maldonado JK, Shearer C, Bronen R, Peterson K, Lazrus H (2013) The Impact of Climate Change on Tribal Communities in the US: Displacement, Relocation, and Human Rights. Climatic Change. DOI: 10.1007/s10584-013-0746-zMaldonado et al.'s peer-reviewed article provides case study examples of Native communities in Alaska and Louisiana experiencing forced relocation due to the causes and consequences of climate change, along with increased social vulnerability, and discusses the impacts of cost-benefit analyses that leave out vulnerable populations.	25. Coastal Zone Development and Ecosystems		883	13	We have added the suggested citations in our chapter assessment.
Julie	Maldonado	Where it states "cost-benefit ratios don't favor public expense…", I suggest including "cost-benefit ratios don't favor public expense and the social and cultural factors discounted in such analyses". For an example, please see Maldonado JK, Shearer C, Bronen R, Peterson K, Lazrus H (2013) The Impact of Climate Change on Tribal Communities in the US: Displacement, Relocation, and Human Rights. Climatic Change. DOI: 10.1007/s10584-013-0746-z	25. Coastal Zone Development and Ecosystems		883	18	The text has been revised to incorporate this suggestion, and the suggested reference has been added.
Julie	Maldonado	The communities being forced to relocate in Louisiana, as referenced earlier in the chapter, are either on the mainland or have been made into a "barrier island" due to the intense loss of land. The barrier islands that existed to protect them have disappeared. It is not appropriate to state that they are on barrier islands, as this is insensitive to their now being used as "barriers" for communities to the north. For further explanation, please see Maldonado et al. 2013. And to gain a better understanding of the lack of government funding available and institutional barriers, please see Bronen 2011 and Maldonado et al. 2013.Add references: Bronen R (2011) Climate-induced community relocations: creating an adaptive governance framework based in human rights doctrine. NYU Rev Law Soc Chang 35:356–406Maldonado JK, Shearer C, Bronen R, Peterson K, Lazrus H (2013) The Impact of Climate Change on Tribal Communities in the US: Displacement, Relocation, and Human Rights. Climatic Change. DOI: 10.1007/s10584-013-0746-z	25. Coastal Zone Development and Ecosystems		893		The desired correction was made in the Traceable Account where this was mentioned. Bronen and Madonado references were added.
Julie	Maldonado	The following peer-reviewed articles provide examples and case studies that directly address the context of what is being said here. Add references:	25. Coastal Zone Development		883	24	Thank you for pointing us to this literature. We have added some of the references, but space limitations preclude adding them all.

		White, Kyle Powys (2013) Justice Forward: Tribes, Climate Adaptation and Responsibility in Indian. Climatic Change. DOI: 10.1007/s10584-013-0743-2 Lynn K, Daigle J, Hoffman J, Lake FK, Michelle N, Ranco D, Viles C, Voggesser G, and Williams P (2013) The Impacts of Climate Change on Tribal Traditional Foods. Climatic Change. DOI: 10.1007/s10584-013-0736-1 Voggesser G, Lynn K, Daigle J, Lake FK, and Ranco D (2013) Cultural Impacts to Tribes from Climate Change Influences on Forests. Climatic Change. DOI: 10.1007/s10584-013-0733-4 Grah O, Beaulieu J (2013)The Effect of Climate Change on Glacier Ablation and Baseflow Support in the Nooksack River Basin and Implications on Pacific Salmon Species Protection and Recovery. Climatic Change. DOI: 10.1007/s10584-013-0747-y Gautam M, Chief K, Smith Jr. WJ (2013) Climate Change in Arid Lands and Native American Socioeconomic Vulnerability: The Case of the Pyramid Lake Paiute Tribe. Climatic Change. DOI: 10.1007/s10584-013-0737-0 Maldonado JK, Shearer C, Bronen R, Peterson K, Lazrus H (2013) The Impact of Climate Change on Tribal Communities in the US: Displacement, Relocation, and Human Rights. Climatic Change. DOI: 10.1007/s10584-013-0746-z Dittmer, K (2013) Changing Streamflow on Columbia Basin Tribal Lands- Climate Change and Salmon. Climatic Change. DOI: 10.1007/s10584-013-0745-0	and Ecosystems				
Julie	Maldonado	Add reference: Dittmer, K (2013) Changing Streamflow on Columbia Basin Tribal Lands- Climate Change and Salmon. Climatic Change. DOI: 10.1007/s10584-013-0745-0This peer-reviewed case study shows how climate change impacts are effecting the subsistence and water resources of the Columbia River basin tribes and salmon; this article provides a connection to the multiple stressors, barriers, and implications involved with climate change impacts on the Columbia River Basin.	21. Northwest		725	42	We indicate the cross-cutting challenges climate change is projected to bring to Northwest tribes in the introduction to the chapter, and direct to reader to multiple relevant refs (Lynn et al. 2013, Vogesser et al. 2013, tribal chapter of NCA).
Julie	Maldonado	Add reference: Cochran, P, Huntington OH, Pungowiyi C, Tom S, Chapin III FS, Huntington HP, Maynard NG, Trainor, SF (2013) Indigenous Frameworks for Observing and Responding to Climate Change in Alaska. Climatic Change. DOI: 10.1007/s10584-013-0735-2Cochran et al.'s recent peer-reviewed article is a siginificant citation in these places because it speaks directly to the impacts of climate change on Native American communities and provides some of the latest information available.	22. Alaska and the Arctic		760	17	The text has been revised to incorporate this suggestion.
Julie	Maldonado	Add reference: Cochran, P, Huntington OH, Pungowiyi C, Tom S, Chapin III FS, Huntington HP, Maynard NG, Trainor, SF (2013) Indigenous Frameworks for Observing and Responding to Climate Change in Alaska. Climatic Change. DOI: 10.1007/s10584-013-0735-2Cochran et al.'s peer-reviewed article speaks directly to the impacts of climate change on Native American communities and provides some of the latest information available.	22. Alaska and the Arctic		774		We have added the suggested citations in our chapter assessment.
Julie	Maldonado	Add reference: Cochran, P, Huntington OH, Pungowiyi C, Tom S, Chapin III FS, Huntington HP, Maynard NG, Trainor, SF (2013) Indigenous Frameworks for Observing and Responding to Climate Change in Alaska. Climatic Change. DOI: 10.1007/s10584-013-0735-2Cochran et al.'s peer-reviewed article speaks directly to the impacts of climate change on Native American communities and provides some of the latest information available.	22. Alaska and the Arctic		784		We have added the suggested citation in our chapter assessment.
Julie	Maldonado	Add reference: Lynn K, Daigle J, Hoffman J, Lake FK, Michelle N, Ranco D, Viles C, Voggesser G, and Williams P (2013)	16. Northeast		561	7	The text has been revised to incorporate this suggestion.

		The Impacts of Climate Change on Tribal Traditional Foods. Climatic Change. DOI: 10.1007/s10584-013-0736-1Lynn et al.'s peer-reviewed article provides an example case study of climate change impacts on the range, quality, and quantity of Wabanaki berry resources in the Northeast, explaining the health, food, and cultural consequences of these imapcts.					
Julie	Maldonado	Add reference: Voggesser G, Lynn K, Daigle J, Lake FK, and Ranco D (2013) Cultural Impacts to Tribes from Climate Change Influences on Forests. Climatic Change. DOI: 10.1007/s10584-013-0733-4Voggesser et al.'s peer-reviewed article provides examples of forest impacts on tribal communities in regions across the US.	7. Forestry		266		After consideration of this point, we still feel the existing text is clear and accurate. That climate change will impact tribal resources has now been made in the introductory text. This point and reference were added with changes in made in the Traceable Accounts section: "Such changes in disturbances are of concern for tribal forests as well (Voggesser et al. 2013)."
David	Gassman	I have read as much of this as I could (about 50%) & as carefully as I could, and I find the statements to be coherent & the graphical presentations to be effective, although they clearly require study & effort to understand most of the time.	2. Our Changing Climate				We thank the reviewer for the kind words. No effect from this comment directly on the text.
David	Gassman	On page 27, line 28, in order to make this as easy to understand as possible, I would change it to read: The eleven key messages just presented above are repeated below together with supporting evidence for those messages.	2. Our Changing Climate		27	28	The text has been revised to incorporate this suggestion.
Julie	Maldonado	Add reference: Voggesser G, Lynn K, Daigle J, Lake FK, and Ranco D (2013) Cultural Impacts to Tribes from Climate Change Influences on Forests. Climatic Change. DOI: 10.1007/s10584-013-0733-4Voggesser et al.'s peer-reviewed article gives examples of how tribes and agency resource managers are working together to adapt to these challenges.	7. Forestry		277		This topic is too detailed for this chapter.
Julie	Maldonado	Add reference: Grah O, Beaulieu J (2013)The Effect of Climate Change on Glacier Ablation and Baseflow Support in the Nooksack River Basin and Implications on Pacific Salmon Species Protection and Recovery. Climatic Change. DOI: 10.1007/s10584-013-0747-yGrah and Beaulieu's peer-reviewed article provides a case study of climate change impacts on the Nooksack River and consequences for the Nooksack Indian Tribe.	21. Northwest		725	22	A brief description of climate impacts on tribes has been added in the introduction, but referred to the Tribal chapter rather than to such a specific paper.
Julie	Maldonado	Add reference: Swinomish Indian Tribal Community (2010) Swinomish Climate Adaptation Action Plan. La Conner, WA.This sentence should have tribal agencies included as well, so should state: "In the past few years, many federal, state, local, and tribal agencies…" The Swinomish citation could be used as an example.	3. Water Resources		130	12	The text has been revised to incorporate the suggestion
Julie	Maldonado	Add references: Swinomish Indian Tribal Community (2010) Swinomish Climate Adaptation Action Plan. La Conner, WA. Voggesser G, Lynn K, Daigle J, Lake FK, and Ranco D (2013) Cultural Impacts to Tribes from Climate Change Influences on Forests. Climatic Change. DOI: 10.1007/s10584-013-0733-4 The Swinomish example is often used as an exemplary model.	28. Adaptation	28.6	1001		Thank you for the comment. Unfortunately, since the table is not meant to be comprehensive, and since we already use two examples in Washington, we are unable to integrate these examples.

		Voggesser et al.'s peer-reviewed article provides examples of collaborative adaptation initiatives between tribes and government agencies.					
Julie	Maldonado	Add reference: Voggesser G, Lynn K, Daigle J, Lake FK, and Ranco D (2013) Cultural Impacts to Tribes from Climate Change Influences on Forests. Climatic Change. DOI: 10.1007/s10584-013-0733-4This peer-reviewed article provides examples of collaborative adaptation initiatives between tribes and government agencies.	28. Adaptation		991		We want to thank the commentor for suggesting this reference. Because of the timing of accepting literature in 2012 and our word limit, we were not able to include any additional assessment of this reference. In reviewing the reference, we find that the reference reviews the impacts of climate change on forest resources of tribes. The examples given in the reference are aspirational ways that tribes and government agencies could work together in the future but give little concrete examples of current or past collaborations on adaptation. As such, no change was made.
Julie	Maldonado	Add reference: Gautam M, Chief K, Smith Jr. WJ (2013) Climate Change in Arid Lands and Native American Socioeconomic Vulnerability: The Case of the Pyramid Lake Paiute Tribe. Climatic Change. DOI: 10.1007/s10584-013-0737-0Gautum et al.'s peer-reviewed article provides a case study of climate change impacts and tribal vulnerabilities for the Pyramid Lake Paiute Tribe.	20. Southwest		690	9	Thank you for your comment. We have added the suggested citation in our chapter assessment.
Theodora	Tsongas	Chapter 1 - Executive Summary: This part of the NCA is excellent and ties together much of the information from separate chapters. However, a slightly greater emphasis on the health impacts of climate change as a recurring theme through many chapters might enhance the urgency of the message. Line by line comments: Page 6, line 20 refers to Figure 1, of which there are 2 Figures on pages 20 and 21. Might the illustration be more effective if the Figures were moved closer to Page 6? Or, at least the referral to Figure 1 should include the page number where it can be found. Furthermore, emissions scenarios referred to in lines 17-21 are described on pages 18 and 19. It would be helpful to the reader to have that page reference in the text when these scenarios are first introduced. Page 8. Report Finding 5, line 35: Please insert “decreased availability of potable water,” after “...decreased air quality,” Page 9. Report Finding 8, lines 28 through 40. The adverse impacts on crops and livestock are already happening, not waiting until mid century. Witness the droughts in the midwest and central plains during the summers of 2011 and 2012 that have already affected US and worldwide food prices and impacted food security. Page 10. Report Finding 10. It would help to continue the thought on lines 16 through 18 with how this is a threat to health.	1. Executive Summary				References to figures in the Executive Summary have been updated in the final version. Page 8. Report Finding 5, line 35: changes in availability of potable water, have been addressed; Page 9. Report Finding 8, lines 28 through 40. The adverse impacts on crops and livestock are already happening, not waiting until mid century have been addressed; the health related report finding is number 5; regarding the comment on regional observations of climate change, though this is true, this is not the top line finding of the chapter - this table is focused on the top line issues. The Alaska comment is in the same category - an important topic but not considered the top finding for that region. We apologize that you had difficulties with downloading.

		Page 11. Table 1.1 Regional Observations of Climate Change. Great Plains. Drought in Great plains affects world food prices and food security. Alaska. Please add the release of methane from thawing permafrost.The draft NCA Document as a whole was very difficult to access, even downloading a read-only copy. Each Chapter had to be downloaded separately before it was apparent if references to the information in other chapters would be included. It would have helped greatly to have the document available by chapter on-line without having to go through the “reviewer” filter. Members of the public with older computers and no institutional support, such as retirees, had an even more difficult time accessing this document. This appears to be a major defect in the plan for public input into the document.Comments submitted by Theodora Tsongas, PhD, MS, Environmental Health Scientist/Epidemiologist, Portland, Oregon.					
Theodora	Tsongas	Comments on the National Climate Assessment January 11, 2013 Draft for Public Comment Comments submitted by Theodora Tsongas, PhD, MS, Environmental Health Scientist/Epidemiologist, Portland, Oregon.Chapter 9. Human Health Key Messages: The impacts of climate change on availability of potable drinking water and on water scarcity and their effects on human health need to be addressed in this section as well as in the Chapters on Water Resources and Water, Energy, and Land Use. On page 333, lines 26 through 28 could be changed to add “water scarcity and decreased availability of clean drinking water,“ after “decreased air quality”... Page 334: Attention should be given to climate change-related increasing droughts, especially in the midwest and west, the depletion of aquifers, and the impacts of these changes on human health. On pg 334, line 14 & 15, “central plains and western deserts” should be added to the parenthesis about place. As an example, Las Vegas illustrates a city facing economic collapse in the not too distant future because of the depletion of water sources such as Lake Mead (Documentary Film: Last Call at the Oasis, written & directed by Jessica Yu.) Wide-Ranging Health Impacts: There needs to be a section on Water availability/scarcity as it relates to climate change and impacts on health. There are sections on air pollution, allergens, wildfires, temperature extremes, extreme events, diseases carried by vectors, food security, mental health and stress-related disorders, but none on water availability/scarcity. This is an unfortunate omission and needs to be corrected, especially as many of the topics in the above named sections are intricately related to water. For example, the relation of extreme weather events, such as high temperatures, to water scarcity and droughts, leading to increasing draws on aquifers for irrigation, less water for cities with adverse impacts on sanitation and increasing pollution of surface and groundwater, less water for irrigation, adverse impacts on crop yields, and higher food prices, all of which have impacts on health. The chain of events is exemplified by the worldwide increase in food prices related to the drought in the US midwest and plains during the past two years. Very brief, and inadequate mention is made of food security related to climate change on page 355 , lines 33-35, as a benefit of policies to reduce climate change. Food security directly affects health, and	9. Human Health				Key Messages: The authors disagree. There is little evidence or data to support health effects associated with either the changing availability of potable drinking water in the U.S. or any associated health effects. These impacts are evident outside of the U.S. (as your citations describe) but not in the U.S.Page 334: The authors disagree with the text additions: much of the depletion of the Midwest aquifers is related to poor water management practices.Wide Ranging Health Effects: Please see previous comments on water scarcity. Certainly future water management will be challenged by climate change. We cannot use a documentary film as a reference because it does not meet the Guidance on Information Quality Assurance to Chapter Authors of the National Climate Assessment: Question Tools (2/21/2012), which is used by the NCADAC to assure for each source used in the NCA Report: (1) utility, (2) transparency and traceability, (3) objectivity, and (4) Integrity and security. Food Security: Please refer to our section on Food Security under Key Message 1, which mentions connections between lessened rainfall, severe weather and declining crop yields. The chapter focused on broad trends for this topic under space constraints. Please see

		water scarcity directly affects food security, especially for at-risk populations. The chapter needs to describe the chain of events leading to food insecurity, including temperature extremes, extreme weather events and droughts that wipe out crops. Water scarcity results from droughts and reduces resilience. With no water, mitigation or adaptation is difficult. In addition, some consideration should be given to emerging trends in population movements from water-scarce areas of the US to areas where the appearance is one of more water. This can already be seen in the Western US. The human health chapter needs to include more recent examples to amplify the urgency of the messages: for example, information should be available from local governments about the acute health impacts of Hurricane Sandy, including the lack of potable water over extended periods of time for affected populations after the storm. The examples from Hurricane Sandy serve to augment and reinforce the messages of the Hurricane Katrina examples. The section on mental health is very helpful, but does not go far enough. What are the health effects of growing despair among people seeing their world going "down the toilet" and feeling powerless to do anything about it? There is certainly growing despair among people who see changes accelerating. Despair can be a powerful deterrant to mitigation or adaptation. And, where is the discussion of equity in this document? What are the health impacts of the unequal distribution of adverse impacts. Who are the persons feeling these disproportionate impacts, beyond the generalizations about "the poor, the elderly, and children".Line by line comments: Text in captions should be limited to information relating to the content of the figure. The rest of the information should be incorporated into the rest of the document. Page 336. Figure 9.2: The caption is not clear. The vertical axis should say "Change in Ragweed Season Length 1995-2011 (days)" Page 337. Figure 9.3: The caption refers to "the higher emission scenario (A2)" but does not define it. A2 needs to be defined in this chapter (not just in other chapters of the document) if it is going to be discussed or named here. Pages 338-339. Figure 9.4 and 9.5. These figures do not add anything useful and take up valuable space in the document. Page 341. Figure 9.6. Caption: Line 7: change "effect" to "affect". Lines 12 & 13: The citation is confusing: it has "Source" and "ORIGINAL SOURCE". What does this mean? Page 343. Paragraph 1 describes diminishing risks due to air conditioning, without consideration of the potential for power outages during temperature extremes. If the power is not available, air conditioning will not work. This is only mentioned in the Box on page 351, 8 pages later, under Most Vulnerable. A reference to the Chapter on Water, Energy, and Land Use would also be helpful here.					the Agriculture chapter (Ch.6) for further clarification. Most water scarcity issues are related to poor water management practices, and this topic is outside the focus of this report.Urgency of messages: Thank you for this suggestion. The authors feel that we have provided sufficient examples to instill an "urgent" message. This draft was written prior to "Sandy."Mental Health: Pg 349, lines 31-36 deals with this issue. Discussion of Equity in Chapter: Equity is discussed extensively in Key Message #2.Line by line comments: After consideration of this point, we still feel that the caption descriptions are accurate and appropriate. Emissions scenarios are defined in Chapter 2: Our Changing Climate and in the Glossary (accessible from any chapter). Figures 9.4 and 9.5 (in January 11, 2013 draft version) were removed. In Figure 9.6, we changed "effect" to "affect." The Figure 9.6 source information has been revised to be clearer. We added a direct link to Chapter 11: Urban Infrastructure and Vulnerability, which discuss power outages. "Co-benefits " and "co-harms" are described in the sentences before.

		Page 354. Lines 31 - 35. The intent of this paragraph is unclear: “Efforts to improve the resiliency...can also affect human health. Some... efforts will benefit health...some could ... be harmful. ...the magnitude of these health “co-benefits” or “co-harms” could be significant...” What, specifically, are these “co-benefits” or “co-harms”? This needs to be explained so that people will know what is being stated, or it will be ignored. It is irresponsible to leave these statements open to anyone’s imagination.Some additional references on water scarcity: Zakar, M.Z., R. Zakar, F. Fischer. 2012: Climate change-induced water scarcity: A threat to human health. South Asian Studies: A Research Journal of South Asian Studies, 27, 2, 293-312. Delpla, I., A-V Jung, E. Baures, M. Clement, O. Thomas. 2009: Impacts of climate change on surface water quality in relation to drinking water production. Environment International, 35, 1225-1233. Brown, C., M.N.Ward, editors. 2013. Managing Climate Risk in Water Supply Systems. IWA Publishing.					
CJ	Meakes	the word 'area' needs an 's'	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1103	6	The text has been revised to incorporate this suggestion.
CJ	Meakes	It seems like the second reference to 'warmest summer' should be 'warmest fall'.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1065	24	The text has been revised to incorporate this suggestion.
CJ	Meakes	In the legend, the medium blue description should probably use the word "enhancing"	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z	32	1110		The figure has been updated and revised for clarity.

CJ	Meakes	The full intent of this figure is not clear from the caption description. Why do the two lines not meet at the same emissions level in 2050, if the goal is the same, as the caption alludes? And why do the two lines curve at different rates during the decrease? Either a better figure should be produced to show what the caption intends, or a different caption explaining the figure better should be included.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z	33	1112		Yes, there is a cumulative emissions constraint. The figure caption has been modified to include that information.
Jan	Dash, PhD	Replace orange line 1-4 feet with orange line 1-6 feet.	1. Executive Summary	1.2	21		The authors are emphasizing their conclusion that 1-4 feet is the expected range of sea level rise by 2100.
Richard	McNider	Comments on the Executive Summary Unfortunately it is my opinion that the whole report is so flawed in its litany of climate attributes that have dubious attribution to CO2 climate change that I do not have the time or patience to address these point by point. Thus I will summarize in respect to the Executive Summary. From my examination of the National Climate Assessment, I fear that in the future it will be cited as the prime example of the failure of climate science to separate belief from facts and separate facts from causality. Unfortunately, it will likely surpass one of the biggest knowledge blunders of our time which was the consensus of the intelligence community that Iraq had Weapons of Mass Destruction (WMDs). Below I am framing my comments against the backdrop of the WMD intelligence failure. After the Iraq War in which no WMD were discovered, the central question was “how could the intelligence community have been so wrong about its conclusions on WMDs”. These pre-war conclusions were largely expressed in the October 2002 National Intelligence Estimate (NIE) which was a summation of the community’s views and consensus on Iraq’s WMD and the key document available to Congress and the Administration prior to the war. In some respects the 2002 NIE is similar to the IPCC 2007 and the current NCA. Broad acceptance of the findings of the NIE in Congress and Administration was based in part on the apparent consensus within the technical intelligence community. The leaders of the NCA would be well served to study this Commission’s report in detail. A 2004 Presidential Commission came to several conclusions on why the intelligence community failed so completely in its assessments. The most prominent was that the intelligence community was “too wedded to assumptions about Saddam’s intentions”, i.e. past uses of chemical weapons by Saddam, the expressed desire of the Saddam regime to obtain nuclear weapons, Saddam’s previous deception and his continued obstruction of U.N. inspectors. From the report - “At some point, however, these premises stopped being working hypotheses and became more or less un-rebuttable conclusions; worse, the intelligence system became too willing to find confirmations of them in evidence that should have been recognized at the time to be of dubious reliability”. This is exactly the same attitude taken in the NCA. It is too wedded to its beliefs in CO2 climate change. Facts or data periods are cherry picked or interpreted only in the context of the belief in climate change. One example is showing the increase in hurricanes since 1970 rather than showing the whole historic record. The mantra “climate change is real” and “climate change is happening” pervades in the NCA. And like the NIE, the NCA takes as evidence many climate statistics and societal impacts which are of dubious quality. The reliance on extreme events is most disconcerting since these are exactly the type statistics that are least likely to hold up to real statistical scrutiny. In the same way the famous statistician John Tukey tore apart the statistics purporting positive benefits of cloud seeding. For example page 3 line 26 U.S. temperatures	1. Executive Summary				The authors appreciate your comments, but the conclusions in this report are the findings of thousands of scientists working over decades in institutions across the globe, with observations taken on land, in the oceans and in the atmosphere taken through hundreds of independent observing systems. This is not comparable to the examples you cite. Evidence related to the climate science conclusions are found in the climate science chapter and the two associated appendices and in all of the references cited. In response to your comments, there is now an enhanced explanation of the relationship between climate variability and climate change in the Executive Summary. The climate science chapter authors carefully considered all of the existing literature prior to coming to their conclusions on this topic. For more information please refer to Chapter 2 and associated appendices.

will continue to rise, with the next

few decades projected to see another 2°F to 4°F of warming in most areas.

This exposes the inherent “beliefs” that are clouding the entire NCA. It also shows the naivety of the authors of this report. I don’t know of a single real physical climatologist who would make the absurd statement that “temperatures will continue to rise”. It shows a complete lack of understanding of the complexities of the Earth’s Climate System and natural variability. Surely you should say “based on models are expected to rise”. For example page 3 line 33: There has been an increasing trend in persistently high nighttime temperatures, which have widespread impacts because people and livestock get no respite from the heat. Livestock and people may indeed be suffering. Growing up in the South I suffered warm nighttime temperatures in the 1950’s which made sleep problematic. Fortunately air conditioning came within our economic reach. However, significant asymmetrical warming of nighttime temperatures is not an expected global warming signal from climate models. As shown by Walters et al. 2007, Zhou et al. 2010 and McNider et al. 2012 climate models have failed almost entirely in capturing the asymmetrical warming of nighttime temperatures. McNider et al. 2012 did show why climate models may have failed in the nighttime warming but it is due to redistribution of heat by turbulence. Nightime warming can say little to nothing about the accumulation of heat in the atmosphere which is the essence of CO2 climate change. To claim this as an impact of climate change shows how the NCA is acting like the intelligence community in attributing all sorts of information to evidence for WMDs.For example page 3 line 32 The chances of record breaking high temperature extremes will continue to increase as the climate continues to change. This is a false statement. The rate of increase in record breaking temperatures is not increasing. In an analysis by a colleague the number of TMax records in the decade 2001-10 ranks only 7th out of the 11 decades examined. Your figure 2.18 appears to show increasing maximum temperatures but it is record breaking minimum temperatures that are controlling these ratios because the rate of TMax records is falling. Again, the NCA is twisting data to make it consistent with its belief just as the NIE presented evidence only in the light of its evidence of WMDs. A second major fault that the commission noted was that in the end there was little “direct” evidence for WMDs. There were many pieces of indirect data including mountains of satellite images of purported biological labs and incomplete information such as Iraqi attempts to purchase aluminum tubes that could be interpreted in light of the “theory” as related to WMD. The same lack of direct information is a problem in the NCA. The only direct observational data of “global warming” are the observed surface, satellite and balloons that have measured the Earth’s global temperature. In the theory of added greenhouse global warming there are two irrefutable facts - carbon dioxide has increased since pre-industrial times and that carbon dioxide increases downward radiation to the Earth’s surface. This additional direct downward radiation is miniscule relative to the variations in the Earth’s energy balance on daily or even annual time scales. Rather, the concern for climate change is that this heat will accumulate in the Earth’s climate system over many decades and through feedbacks such as increased water vapor (which is a also a greenhouse gas) lead to more warming which in turn will melt snow and ice leading to decreases in albedo and even more warming. The water vapor feedbacks rely on the deep warming of the atmosphere.

However, how much heat the Earth will actually accumulate is based on indirect information or models that have many assumptions about how heat will be partitioned in the atmosphere and oceans and how water vapor and clouds will react to the direct heat added by carbon dioxide. This is not to denigrate the scientists who build these models using their best intellectual capacities. But these models are not first principal models and involve assumptions and engineering fixes. Thus they are like the indirect satellite images and aluminum tubes in the WMD quest.Let us examine the direct

information. As mentioned in the NCA Executive Summary observed land surface data sets show warming since 1895. However, a significant part of this warming has been in minimum temperatures over land (Vose et al. 2005) and which have nothing to do with accumulation of heat in the deep atmosphere. While there was a slight reduction in minimum temperature warming since 1979 in Vose et al. 2005, more recent analyses of NOAA GHCN 3.5 data show a resumption of asymmetric increases in warming of minimum temperatures in the last 10-12 years. Since minimum temperatures in most cases only represent a thin night time boundary layer they are not representative of the deep warming of the atmosphere (McNider et al. 2012). Maximum temperatures which might be more representative measures of the deeper atmosphere have only risen at about 35-45% of the rate of minimum temperatures over the last century.Satellites and balloons since 1979 have shown much less warming of the troposphere than the models. For example the observational data sets including satellite microwave data sets (UAH and Remote Sensing Systems Inc) and balloon data sets show an average warming of about 0.14 C/decade (+/-.02). The surface data show trends of Tmean (Tmean= (Tmax+Tmin)/2) about 0.16 C/decade. Note maximum temperatures trends from the GHCN 3.5 are less than 0.16 since Tmean includes the nighttime warming which cannot be related to warming of the deep atmosphere (see Christy et al 2010). The CMIP5 average warming from all models is +0.273 or twice the observed rate. In fact, the actual observed trend is actually an overstatement if attributed to CO2 alone. The +0.14 C/decade trend in the balloon and satellite data observations contains some natural variability since the early part of the observation record was cool due to volcanoes. Older best estimates of the trends with volcanoes and ENSO signals indicate a trend of about +0.09C/decade (Christy and McNider, 1994). A recent update of this paper through 2010 shows a similar trend about +0.09 C/decade. Thus, we have the best direct observed data – the land surface maximum temperature, satellites and balloons that all show the deep atmosphere is warming at a rate perhaps one third that of models. The NCA has this litany of all of these devastating climate change impacts yet the world in fact is not warming at an alarming rate! I think more telling is that there is not a single mention of the discrepancy between the observed warming rate and models. This is exactly the same problem the intelligence community had in that they never fully questioned data that did not agree with their beliefs in WMDs.

This is the core problem with the NCA. While numerous indirect pieces of information on changes in the climate and in climate impacts are presented in the NCA, the observed fundamental signal of enhanced CO2 global warming of the deeper atmosphere is not very large. Thus, in the NCA Executive Summary we are left with many assertions of climate changes such as changes in frost free days, changes in heavy down pours, changes in glacial extent, sea level rise, changes in intensity and number of winter storms etc. However, because the fundamental direct measure of global warming – the warming of the deep atmosphere – indicates that it is not warming rapidly, we should be very dubious of these indirect measures having an association with or confirming CO2 induced warming. An explanation based on natural variability, which is a very obvious option, has not been ruled out as their main cause. We should not make the same mistake as the intelligence community which was led astray by dubious indirect evidence of WMDs just because it fit the theory. In some sense the litany of changes in the NCA are like the pictures of purported mobile biological laboratories of potential of concern but also subject to other interpretations.

The real danger of the NCA and IPCC is that they are ascribing what indeed may be real societal concerns to CO2 climate change when in fact they may be unrelated. One example is the nighttime warming mentioned above and a second is warming in the Arctic. This is one place where observations show significant warming yet models don't capture the magnitude of this differential warming compared to other regions in the current climate. While it is sometimes ascribed to global warming we

		may be overlooking other factors such as aerosol or CO2 warming in stable boundary layers at high latitude stable boundary layers (Nair et al. 2011, Byrkjedal et al. 2008, McNider et al 2012). However, Arctic warming is not global warming. None of the water vapor feedbacks which make up most of the models response will occur on a global scale if the global deep atmosphere doesn't warm. It is telling throughout the report how much the authors have embraced the dubious evidence and not looked at the real causality between true global warming (the warming of the deep global atmosphere) and the changes they purport. I hope the leaders of this NCA effort are preparing themselves for a day of reckoning before Senate Panels and the public explaining their folly just as the intelligence community had to explain their failure on the existence of WMDs.References:Byrkjedal, Ø., I. Esau, and N. G. Kvamstø (2008), Sensitivity of simulated wintertime Arctic atmosphere to vertical resolution in the ARPEGE/IFS model, Clim. Dyn., 30, 687–701, doi:10.1007/s00382-007-0316-z.Christy, J. R. and R. T. McNider: Detecting Global Warming Using a Precise, But Short (15-Year), Satellite Record. Nature, Vol. 367, pp. 325, 1994.Christy, J.R., B. Herman, R. Pielke, Sr., P. Klotzbach, R.T. McNider, J.J. Hnilo, R.W. Spencer, T. Chase and D. Douglass, 2010: What do observational datasets say about modeled tropospheric temperature trends since 1979? Remote Sens. 2, 2138-2169. Doi:10.3390/rs2092148.McNider, R.T., G.J. Steeneveld, A.A.M. Holtslag, R.A. Pielke Sr., S. Mackaro, A. Pour-Biazar, J. Walters, U. Nair, and J.R. Christy, 2012: Response and sensitivity of the nocturnal boundary layer over land to added longwave radiative forcing. J. Geophys. Res., 117, D14106, doi:10.1029/2012JD017578.Nair, U. S., R. McNider, F. Patadia, S. A. Christopher, and K. Fuller (2011), Sensitivity of nocturnal boundary layer temperature to tropospheric aerosol surface radiative forcing under clear□sky conditions, J. Geophys. Res., 116, D02205, doi:10.1029/2010JD014068.					
David	Wang	The comparison isn't clear -longer and more gradual than what?	10. Water, Energy, and Land use		388	8	The text has been clarified.
David	Wang	Is this citing water scarcity as a driver of solar PV installation when compared to fossil fuel plants?	10. Water, Energy, and Land use		388	23	The text has been clarified to address this question.
David	Wang	This may be a bit confusing – my sense is that U.S. dependence on foreign energy resources is typically associated with oil imports, and solar, biofuels, and NG currently has limited effects on oil imports.	10. Water, Energy, and Land use		388	29	The text has been removed.
David	Wang	A year or range of years for the projection would be helpful	10. Water, Energy, and Land use		399	6	It is not clear what this comment is referring to. No projections are mentioned at the cited text location.
David	Wang	Do the colors have significance?	10. Water, Energy, and Land	10.2	391		The caption has been clarified. The red dots are highlighted and labeled to show the range of values that have occurred across time.

			use				
David	Wang	The connection isn't immediately clear – were ranchers forced to sell livestock before they were "finished"?	10. Water, Energy, and Land use		391	13	The text has been revised to clarify.
David	Wang	A comparison to the average marginal price might be useful as well.Also, did reduced water availability cause utilities to shift production to facilities that were more water efficient? Would be an interesting to note if true.	10. Water, Energy, and Land use		391	20	After consideration of this point, we still feel the existing text is clear and accurate. We appreciate these suggestions, but space is too limited and details on economic information too limited to provide a thorough analysis.
David	Wang	These graphics are somewhat difficult to understand, and it's not clear what the bullet points are meant to communicate (potential risks of climate change?)It may be worth defining "thermoelectric" (in water) and "special" (in land).	10. Water, Energy, and Land use	10.3	396		Additional explanation was added to the caption noting reason for listing risk of climate change bullets. Also changed "special" to "Parks/roads" in the figure and defined thermoelectric in the paragraph above the figure.
David	Wang	Might be helpful to clarify who is making those energy technology choices.	10. Water, Energy, and Land use		397	8	After consideration of this point, we still feel the existing text is clear and accurate.
David	Wang	Might be helpful to explicitly state that the water is being injected into wells (even though the diagram explains it later).	10. Water, Energy, and Land use		399	38	The text was revised to incorporate this explanation.
David	Wang	Is there a way to give a sense of scale to 5M gallons?	10. Water, Energy, and Land use		399	39	The text was revised to include more information on the amounts of water used in hydraulic fracturing.
David	Wang	What percentage of overall agricultural activities in the corn belt is attributable to biofuel production? Is this referring only to growing corn for biofuel purposes? Or is it referring to the entire production process? It may make more sense to frame the contributions to hypoxia and other harmful side effects as a part of the broader agricultural industry - the way it is framed now it could be read as saying food production doesn't have the same effects, or that growing corn for biofuel is inherently more harmful than growing corn for food (if it is, then it should be explicitly stated). Also, it may be helpful to briefly explain how biofuel production contributes to challenges in the Gulf of Mexico.	10. Water, Energy, and Land use		404	10	The biofuels discussion has been revised to incorporate this suggestion.
David	Wang	Slightly unclear - Is this meant to say that existing arid regions will be more arid, making it more difficult to grow crops?	10. Water, Energy, and Land		404	31	Text has been to clarify that climate change may reduce water availability in some areas, which would impact biofuel production in those areas.

			use				
David	Wang	Are there land use challenges associated with storing enormous amounts of CO2 ? E.g. in order to sequester enough carbon to have a material impact on climate change, X many acres of underground land is required? A recent GAO report released in July 2011 notes potential land-use tradeoffs for bioenergy + CCS.	10. Water, Energy, and Land use		404	42	The CCS text has been revised and simplified to acknowledge land and water requirements and availability.
David	Wang	Would have liked to see more detail on challenges to reducing vulnerabilities.	10. Water, Energy, and Land use		405		The text has been revised to add discussion about challenges to reducing vulnerabilities.
David	Wang	Concrete examples of potential adaptation strategies in the region would be helpful.	10. Water, Energy, and Land use		405	18	In recognition of the importance of addressing response strategies, this report explicitly assesses adaptation, mitigation and decision support responses, in addition to identifying research needs associated with these topics, in Chapters 26-29. Many other chapters, including Regional chapters, include assessment of adaptation responses. The adaptation chapter contains many concrete examples, and a reference to that chapter was added to the text.
David	Wang	Is it worth mentioning the tension between hydro production and potential curtailment of wind farms on the BPA system?	10. Water, Energy, and Land use		405	40	We appreciate these suggestions, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include.
L. Drew	Hill	The incorporation of general human health co-benefits into the overarching narrative of this energy chapter would provide more compelling context for the importance of the energy consequences of climate change, especially to those who may only read selected excerpts of the entire report. I have added line-specific suggestions in the passages amenable to the inclusion of health context in my "Text Region" commentary.	10. Water, Energy, and Land use				We agree that human health benefits provide important context for climate information. Responses to the line-specific comments submitted by the commenter are provided under the specific comments.
L. Drew	Hill	(May also be relevant to p. 289, lines 30-31) A brief inclusion of the humanitarian consequences of “water quality issues” would contribute policy-relevant health context to the issue of competition for fresh water between the industrial activities of the energy industry and the domestic and municipal needs of political constituents. Trends in water allocation suggest that the free market increasingly favors energy production over water protection (Morrison 2009), yet the consequences of this may include health and economic losses from reduced access to clean water and sanitation, food scarcity, and increased vulnerability to heat injuries (Ebi 2011). State and municipal governments are beginning to take note, halting the construction of water-intense thermal powerplants due to inadequate cooling water supply or competition with drinking water (Bull 2007). Moreover, climate change will increase the water demands of thermal plants through reductions in thermodynamic efficiencies. Increased water use will be required to offset a net reduction in generation of 1%, or 25 billion kWh, due to	10. Water, Energy, and Land use		387	13	We agree that this is an important point, and have added explanation of social and resource management implications to the text.

		increased ambient temperatures (Bull 2007). Sources:Bull, S., Bilello, D., Ekmann, J., Sale, M., Schmalzer, D. Effects of climate change on energy production and distribution in the United States in Effects of Climate Change on Energy Production and Use in the United States. A report by the U.S. Climate Change Science Program and the subcommittee on Global Change Research. 2007.Ebi, K. Resilience to the health risks of extreme weather events in a changing climate in the United States. International Journal of environmental Research and Public Health. 8:4582-4595. 2011.Morrison, J., Morikawa, M., Murphy, M., Schulte, P. Water scarcity & climate change: growing risks for businesses & investors. The Pacific Institute. 2009.					
L. Drew	Hill	Expounding upon "climate vulnerability" in this section would allow policy makers to glean more context from this section, as not all readers of this document will understand "climate vulnerability" or take the time to read the chapters of this report that expound upon its meaning. Even a modification as slight as this would improve the section's usefulness: "Collectively, such interactions between the energy and water resource sectors increase SOCIAL, HEALTH, AND ECONOMIC vulnerabilities to climate change, particularly in water-limited regions that are projected to, or become, significantly drier." (Bull 2007, Ebi 2011, Morrison 2009)Sources:Bull, S., Bilello, D., Ekmann, J., Sale, M., Schmalzer, D. Effects of climate change on energy production and distribution in the United States in Effects of Climate Change on Energy Production and Use in the United States. A report by the U.S. Climate Change Science Program and the subcommittee on Global Change Research. 2007.Ebi, K. Resilience to the health risks of extreme weather events in a changing climate in the United States. International Journal of environmental Research and Public Health. 8:4582-4595. 2011.Morrison, J., Morikawa, M., Murphy, M., Schulte, P. Water scarcity & climate change: growing risks for businesses & investors. The Pacific Institute. 2009.	10. Water, Energy, and Land use		402	4	We agree that this is an important point, and have incorporated further explanation of social and resource management implications.
L. Drew	Hill	It should be noted that there exist some health & environmental concerns with CCS, and the effectiveness of such a measure is still a cause for debate. Pressure buildup from CO2 storage has been associated with geologic deformation and induced seismicity (Mazzoldi 2012, Zoback 2012a), and the practical implications for CCS are still being debated (Juanes 2012, Zoback 2012b). The potential for migration and leakage of stored CO2, brine, and nearby CH4 from primary injection zones is poorly understood (Damen 2006), and may contribute to accidental human death among other health risks (Roberts 2011). However, scientists agree that the long-term risk profile of CCS is declining, and effective deep geologic CO2 storage in the United States is possible if great care is taken (Hovorka 2006, Gilfillan 2009, Jordan 2009).Sources:Damen, K., Faaij, A., Turkenburg, W. Health, safety and environmental risks of underground co2 storage- overview of mechanisms and current knowledge. Climactic Change. 75: 289-318. 2006.Gilfillan, S., Lollar, B., Holland, G., Blagburn, D., Stevens, S., Schoell M., Cassidy, M., Ding, Zhenju, Zhou, Z., Lacrampe-Couloume, G., Ballentine, C. Solubility trapping in formation water as dominant CO2 sink in natural gas fields. Nature. 458: 6140618. 2009.Hovorka, S., Bensen, S., Doughty, C., Freifeld, B., Sakurai, S., Daley, T., Kharaka, Y., Holtz, M., Trautz, R., Nance, H.S., Myer, L., Knauss, K. Measuring permanence of CO2 storage in saline formations: the Frio experiment. Environmental Geosciences 13(2): 105-121. 2006.Jordan, P., Benson, S. Well blowout rates and consequences in California Oil and Gas District 4 from 1991 to 2005: implications for geological storage of carbon dioxide. Environmental Geology. 57: 1103-1123. 2009.Juanes, R., Hager, B., Herzog, H. No geologic evidence that seismicity causes fault leakage that would render large-scale carbon and stoarage unsuccessful. Proceedings of the National Academy of Sciences of the United States of America. 109(52). 2012.Mazzoldi, A., Rinaldi, A., Borgia, A., Rutqvist, J. Induced seismicity within geological carbon sequestration projects: Maximum earthquake magnitude and leakage potential from undetected faults. International Journal of Greenhouse Gas Control. 10: 434-442. 2012.Roberts, J., Wood, R., Haszeldine, S. Assessing the health risks of natural CO2 seeps in Italy. Proceedings of the National Academy of Sciences of the United States of America. 108(40). 2011.Zoback, M., Gorelick, S.	10. Water, Energy, and Land use		405	3	We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information to include. CCS is a very complex topic, and the author team has attempted to provide a clear and useful overview of the topic. The CCS discussion has been revised to add information on environmental impacts and containment. The Mitigation chapter discusses mitigation aims and context.

		Earthquake triggering and large-scale geologic storage of carbon dioxide. Proceedings of the National Academy of Sciences of the United States of America. 109(26). 2012a.Zoback, M. and Gorelick, S. Reply to Juanes et al.: Evidence that earthquake triggering could render long-term carbon storage unsuccessful in many regions. Proceedings of the National Academy of Sciences of the United States of America. 109(52). 2012b.					
Ryan	Moody	The Water, Energy, and Land Use chapter of the 2013 NCA draft offers an insightful perspective on the nexus of three key sectors that affect and will be affected by climate change. The chapter's emphasis on understanding the interactions of water, energy, and land in the context of a changing climate is a valuable message, delivered cogently with strong examples, yet some key findings and evidence could be enhanced with information more pertinent and useful to the public and decision makers. Particularly, the characterization of renewable and emerging energy technologies in the section "Options for Reducing Emissions" leaves much to be desired, especially when renewables present many potential advantages over conventional systems in the realm of water, land use, and climate impacts.I was most disappointed by this chapter's characterization of solar power generation, especially when compared side by side with natural gas. Solar PV costs have fallen rapidly in the last few years, and solar companies and projects are growing, but the authors exclude this information. Also, whereas a natural gas power plant "emits about 50% less CO2 than… a modern coal plant," data on solar power's emissions advantages are conspicuously absent. There is a line that states how solar could reduce greenhouse gas emissions, followed by a "but." With the noteworthy inclusion of solar farm costs and environmental impacts (desert tortoise relocation), while not one dollar sign appeared in the Natural Gas section, I would go so far as to say there was prejudice apparent in the 4 paragraphs and one picture given to solar energy. Even the picture and caption leave a one-sided impression. With an understandable stress on land use, there is no mention of rooftop photovoltaics or the potential for mixed land use where PV is installed on existing architecture without requiring additional land (and very little water). On utility scale solar, the authors point out that "twice the land area of Delaware" may be required without the immediate explanation that, fortunately, the best land for solar is in Southwest deserts, where empty land is more plentiful than Delaware. The NREL solar resource map indicates that basically the entire state of Nevada has good solar radiation, which is an area 44 times the size of Delaware. Again, an unfair comparison is drawn to natural gas, which has zero mention of how much land would be explored, drilled, and fracked for fuel. Of course, the land use, water use, and environmental impacts of solar power should be brought up as issues, but I argue there is an obvious misrepresentation of solar projects, particularly the omission of PV's potential land, water, emissions, and energy benefits.Moving on, the section on biofuels was much better in terms of objectivity. The inclusion of switchgrass as a biofuel crop suggests that the future direction of biofuels is in the scope of this document, however algae is not included as a potential biofuel feedstock. While a nascent technology, algae grown in coastal, offshore, or unfertile areas could address the major issue of biofuel crops competing for land with food crops. Yet, algae-based fuel presents its own challenges regarding water and land use. Still, I would include algae to better inform and perhaps inspire readers of this document about the possibilities that are on the horizon with biofuels. Finally, the CCS section does not mention how the technology is unproven, and uncertainties exist with not only cost but technical challenges and environmental impacts.On figures, most are clear and relevant. I applaud the hydraulic fracturing diagram, as well as the climate, temperature, and drought graphs and maps. They are simple and easily convey their messages. Two figures though, 10.3 and 10.4, were more complex and either did not clearly support the intended message (10.3) or delivered a message that seemed to be missing from the text (10.4). For Figure 10.3, perhaps when it becomes interactive it will better deliver its ideas, but as is, the intended take-away from the regional climate impacts being coupled with differences in water usage, energy mix, and land allocation is unclear. On the other hand, the idea of Figure 10.4 is pretty clear, but there is no message in the text summarizing how technology choices exist which could	10. Water, Energy, and Land use				We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include. The text on energy technologies has been revised to incorporate this perspective. Figures were also updated in several ways to improve clarity.

		optimize water use in the regions that might need it most.Overall, the chapter's three Key Messages are valuable and are the main take-away ideas that I was left with after reading the chapter. The interactive nature of energy, water, and land systems, Key Message #1, is clearly a running theme throughout Chapter 10, and the third Key Message is essentially the reason for considering these interactions: because considering their risks, vulnerabilities, and opportunities can result in improved decisions on addressing the impacts of climate change. Key Message #2 is also valuable, but it could be modified to be more optimistic. The wording does not capture the opportunities that are presented by analyzing the water-land-energy nexus, particularly how different technologies are favored when taking these interactions into account. I believe this is partly due to the failing in "Options for Reducing Emissions" to properly illustrate renewable technologies, mainly solar power but also wind, geothermal, and biofuels. I hope this section will be reviewed with scrutiny and a critical, objective eye.					
Ryan	Moody	This section mentions some "challenges from climate change," but there is no mention of wild fires or rising sea level, both with possibly severe consequences for water, land, and energy. Increased likelihood of wild fires, from increased severity of droughts and heat, will add to water stress and affect land use patterns. Rising sea levels will impact coastal land and water resources, as well as seaside energy installations.	10. Water, Energy, and Land use		388	1	The text has been amended to describe more examples of types of climate changes impacts.
Ryan	Moody	Why is wind power excluded? Why is wind excluded from the entire chapter? Although wind energy deployment is nascent, the technology's advantages in low land and water intensity should be considered for this chapter.	10. Water, Energy, and Land use		388	29	The text has been revised to incorporate wind as a low water use, low emissions alternative.
Ryan	Moody	Will "heat-related electricity demand" only result in increased demand? Of course, hotter summers will result in greater cooling demands and thus higher peak loads. And those who are well-informed about the energy system will understand that summer peaks (opposed to winter) are the highest loads throughout the year, meaning any increase in summer peak loads will push the limits of the total capacity requirements of the system ultimately increasing electricity costs. But, to those less versed in electric systems, they might wonder about how higher winter temperatures from climate change might reduce heating needs for the winter and possibly offset the average annual demand. So, I think further explanation there (or perhaps in another section) about peak summer loads vs. winter loads could be helpful. It might also help to mention the regional differences for cooling and heating demand.	10. Water, Energy, and Land use		389	33	We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include.
Ryan	Moody	In this figure, there is no explanation for Red dots versus Orange dots. Also, consider switching the X and Y axes so that 2011 will naturally fall to the far right. That is not necessarily better, just a suggestion to consider.	10. Water, Energy, and Land use	10.2	391		The caption has been clarified. The red dots are highlighted and labeled to show the range of values that have occurred across time.
Ryan	Moody	"ranchers were forced to sell livestock at lower value." Not sure what "value" means here. Does this mean lower "profit" due to the higher feed costs?	10. Water, Energy, and Land use		391	13	The text was revised to clarify.
Ryan	Moody	This figure is a bit confusing. First, the population bar is in Million Acres/People? Or is it supposed to actually be number of people? Second, I understand that the figure should portray the regional differences in water usage, energy mix, and land allocation; however the significance of these differences is unclear. Third, the "Climate Impacts" for each region should probably reflect the regional water, energy, and land idiosyncrasies more directly. For instance, if the figure will be interactive, perhaps the reader could select a climate impact (ex: Ecosystem impacts in the Southeast) and the	10. Water, Energy, and Land use	10.3	393		We thank the reviewer for the helpful suggestion, and have made some edits to the figure and caption to improve clarity. Units on population and land use have been clarified.

		corresponding portions of the graph would be highlighted (Agriculture, Public/Domestic, Hydro, Forest, Grassland, and Cropland).					
Ryan	Moody	From Figure 10.4, tradeoffs between water withdrawals and consumption for different cooling methods are discussed. However, there are clearly some technologies that offer the most efficient use of water that are not highlighted in this section whatsoever, namely natural gas combined-cycle, dry-cooled CSP trough, PV, and wind. Don't these technologies deserve some credit for water conservation potential?	10. Water, Energy, and Land use		398		The text has been revised to incorporate wind as a low water use, low emissions alternative.
Ryan	Moody	Biofuels as a considerable electricity feedstock would require major changes to land use and crop allocation. But if biofuels are used in typical combustion generating power plants, there would not need to be "substantial changes to the U.S. power system." This statement applied to solar and wind fittingly implies possible reliability, voltage, transmission and distribution challenges and infrastructure modification. For biofuels, on the other hand, the combustion power plant form factor already resembles conventional coal, oil, and natural gas plants, just with a different fuel.	10. Water, Energy, and Land use		399	11	After consideration of this point, we still feel that the existing text is clear and accurate. Wide implementation of biofuels would require changes in the overall power system, including production and transport of fuels.
Ryan	Moody	For CCS, only costs are mentioned as being prohibitive, while the unproven technology and uncertain environmental impacts are also major concerns at present.	10. Water, Energy, and Land use		399	14	Edited to reflect broader set of issues to consider for all generation options. Also added text to CCS discussion on additional CCS issues.
Ryan	Moody	But natural gas is still far from carbon neutral.	10. Water, Energy, and Land use		399	35	The text has been revised to incorporate this perspective. Information on emissions has been added to the natural gas discussion.
Ryan	Moody	There are no dollar amounts on natural gas project costs, nor land use estimates from natural gas extraction, while both dollar amounts and land area estimates are included in the solar power section.	10. Water, Energy, and Land use		399	26	A figure was added on land use associated with a range of energy technologies. Relative information on costs was provided wherever appropriate information was available to support them.
Ryan	Moody	For Solar Power Generation, there is not enough information about the falling price of photovoltaic technology, or potential for land and water savings from rooftop PV. There does not appear to be fair treatment of solar power here with more negatives and negatively-worded statements than information on benefits of solar energy.	10. Water, Energy, and Land use		402	7	This section was revised to discuss alternative solar technologies and WEL linkages.
Ryan	Moody	Please use the picture from this New York Times article instead: http://www.nytimes.com/2013/04/09/us/lancaster-calif-focuses-on-becoming-solar-capital-of-universe.html?pagewanted=all&_r=0	10. Water, Energy, and Land use	10.6	402		We appreciate the suggestion, but space is limited. The author team has deliberated and agreed on the most important information/illustrations to include.
Ryan	Moody	Saying "as much as 5 gallons of water" makes this sound like a large amount, when relatively it is orders of magnitude smaller than most other technologies. This should be put in better perspective or at least worded better.	10. Water, Energy, and Land use		402	27	We have attempted to be clear about the relative magnitude of volumes, where they are mentioned.
Ryan	Moody	There is lots of detail on solar cooling systems but nothing on natural gas cooling options. Is there a	10.		403	6	We appreciate this suggestion, but

		reason for this?	Water, Energy, and Land use				space is limited. The author team has deliberated and agreed on the most important information and illustrations to include.
Ryan	Moody	“36 billion gallons” would provide over one-fourth of total US gasoline demand. This percentage would be nice to include.	10. Water, Energy, and Land use		403	25	The text has been revised and this number has been removed.
Ryan	Moody	Missing period punctuation.	10. Water, Energy, and Land use		403	40	Editorial issues will be revised in the final publication.
Ryan	Moody	There is no mention of algae in the Biofuels section. I think this is an oversight. Although algae is still developing and presents its own set of water, land, and cost challenges, it also poses possible solutions to the typical land use and water challenges of other biofuel crops. It would be worth including for all the research going into it, and if only to inspire the public’s imagination.	10. Water, Energy, and Land use		403	21	The biofuels section has been revised to incorporate information about algae.
Ryan	Moody	CCS section omits commentary on uncertainty surrounding long-term greenhouse gas containment, how it might be region-specific, and possible environmental impacts.	10. Water, Energy, and Land use		404	36	We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information to include. CCS is a very complex topic, and the author team has attempted to provide a clear and useful overview of the topic. The CCS discussion has been revised to add information on environmental impacts and containment. The Mitigation chapter discusses mitigation aims and context. A note on additional issues to consider was added.
Ryan	Moody	“dialogue and between” – omit “and”	10. Water, Energy, and Land use		408	4	The text has been clarified.
Ryan	Moody	Fragment: “Assessment of confidence based on evidence a”	10. Water, Energy, and Land use		410		Formatting will be corrected in the final version.
Ryan	Moody	Key Message #2 should be reworded to reflect how the availability of land and water also presents opportunities to identify and implement the most sustainable and resilient options for reducing emissions, because some options are favored when optimizing for more of these parameters (emissions, water, and land).	10. Water, Energy, and Land		411		The key message and the text beneath it was revised to incorporate this perspective. The word "constrain", in particular, was removed from the key

			use				message.
Daniel	Botkin	U.S. REPORTEXECUTIVE SUMMARYThis is a political document, not a scientific document, no matter how many scientists were involved. It is heavily biased and full of statements that are unverified, inaccurate, and untrue. Its publication will be a disservice to the American People. I urge that it be withdrawn. I write this have been an ecological scientist for 45 years and played some major roles with some major environmental issues and helped most of the federal agencies that deal with the environment. I have only the best hopes and wishes for the environment, for people in their relationship with environment, and for those federal agencies responsible for environmental actions. This document will be a disservice to all.Given the time available and the serious problems with the report, I can only give examples of the problems with it. Here are some examples.p 3 entire page. The statement " Climate change is already affecting the American people. Certain types of weather events have 2 become more frequent and/or intense, including heat waves, heavy downpours, and, in some 3 regions, floods and droughts. Sea level is rising, oceans are becoming more acidic, and glaciers 4 and arctic sea ice are melting. These changes are part of the pattern of global climate change, 5 which is primarily driven by human activity" is entirely inappropriate and misleading. Any good climate scientist will tell you that short term events cannot be attributed to long term climatic change. I worked with Steve Schneider in the 1980s (one of my graduate students, Jon Bergengren, did his Ph.D. thesis at NCAR when Steve was there directing the modeling work). Steve would repeatedly make this point. This page must be rewritten if the intention is to produce a scientifically sound document.P 3 lines 32-33. This sentence doesn't quite make sense. The subject is chances, so the statement is that the chances will increase. Surely the authors meant to say that it is likely that record-breaking high temperature are likely to increase. But the sentence is not a statement of fact. It is merely repeating the results of computer simulations that are not adequately validated. The sentence would be appropriate and make sense if it read: "If present trends continue, then we may experience more record breaking temperatures in the future. The rest of the paragraph must be rewritten in a similar way.P 4 lines 1-7. The first sentence is false for several reasons. First, if human-induced climate change were to cool things, then it could not lead to hotter weather. Obviously, the authors are using the term "climate change" as a euphemism for "global warming." The sentence can only make sense if the "global warming" becomes the subject. Furthermore, whey "human-induced"? By definition, a warmer climate from any causes, human or not, has to mean warmer weather. That's just a tautology. I emphasize this because it reveals the tenor of the entire document, which is political and ideological, not scientific, with the purpose of persuading America that human-induced global warming is a disaster and will become a worse one. P 4 entire page. This continues the use of short-term weather events as supportive of long-term climate change, which, as I wrote about, is scientifically false.P 4 lines 8-9. This is a gross overstatement and a speculation that is basically unfounded. It is naive to believe that climate change is the only primary driver of disease. See the following papers as examples of temperature not been the primary driver of disease. For contrary and sound scientific analysis for two disease, see: 1. Rogers, D.J. et al., The Global Spread of Malaria in a Future, Warmer World. SCIENCE, 2000. 289 p. 1763-1766. and Sumilo, D., Loreta Asokliene, Antra Bormane, Veera Vasilenko, Irina Golovljova, Sarah E. Randolph, Climate Change Cannot Explain the Upsurge of Tick-Borne Encephalitis in the Baltics.Primary causes of modern diseases are more strongly related to diet, life styles including overweight and lack of exercise, and to invasive species, resulting in part from the great increase in rapid human travel. This is true for all species including our own. For example, visitors to Isle Royale National Park, an island otherwise isolated in Lake Superior, brought pet dogs and these spread a serious disease to the island's wolf	1. Executive Summary				Thank you for your comments. After considering them carefully, the authors do not agree with your conclusions.

		population. Climate change was not involved. I emphasize this example, because it demonstrates how the report views the world through a narrow lense with only one factor seen: human-caused climate change. A document that would benefit America would explain, as scientifically as possible today, how climate change plays a role among all the other actions that people are taking to alter environments.					
Daniel	Botkin	U.S. REPORTEXECUTIVE SUMMARYThis is a political document, not a scientific document, no matter how many scientists were involved. It is heavily biased and full of statements that are unverified, inaccurate, and untrue. Its publication will be a disservice to the American People. I urge that it be withdrawn. I write this have been an ecological scientist for 45 years and played some major roles with some major environmental issues and helped most of the federal agencies that deal with the environment. I have only the best hopes and wishes for the environment, for people in their relationship with environment, and for those federal agencies responsible for environmental actions. This document will be a disservice to all.p 3 entire page. The statement " Climate change is already affecting the American people. Certain types of weather events have 2 become more frequent and/or intense, including heat waves, heavy downpours, and, in some 3 regions, floods and droughts. 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It is merely repeating the results of computer simulations that are not adequately validated. The sentence would be appropriate and make sense if it read: "If present trends continue, then we may experience more record breaking temperatures in the future. The rest of the paragraph must be rewritten in a similar way.P 4 lines 1-7. The first sentence is false for several reasons. First, if human-induced climate change were to cool things, then it could not lead to hotter weather. Obviously, the authors are using the term "climate change" as a euphemism for "global warming." The sentence can only make sense if the "global warming" becomes the subject. Furthermore, whey "human-induced"? By definition, a warmer climate from any causes, human or not, has to mean warmer weather. That's just a tautology. I emphasize this because it reveals the tenor of the entire document, which is political and ideological, not scientific, with the purpose of persuading America that human-induced global warming is a disaster and will become a worse one. P 4 entire page. This continues the use of short-term weather events as supportive of long-term climate change, which, as I wrote about, is scientifically false.P 4 lines 8-9. This is a gross overstatement and a speculation that is basically unfounded. It is naive to believe that climate change is the only primary driver of disease. See the following papers as examples of temperature not been the primary driver of disease. For contrary and sound scientific analysis for two disease, see: 1. Rogers, D.J.a.S.E.R., The Global Spread of Malaria in a Future, Warmer World. SCIENCE, 2000. 289 p. 1763-1766. and 1. Sumilo, D., Loreta Asokliene, Antra Bormane, Veera Vasilenko, Irina Golovljova, Sarah E. Randolph, Climate Change Cannot Explain the Upsurge of Tick-Borne Encephalitis in the Baltics					This scientific report has been mandated by Congress since 1990 and this administration is working diligently to meet the law's requirements. The transparent process leading to the development of this scientific report is documented on our website and has included numerous avenues for the public to engage. The specific statements in your comment are derived from the 30 chapters of the report, assembled by the 240 authors and 60 members of the advisory committee. 1) the language is clear that the report is not attributing short-term weather patterns to climate change, but the Climate Science chapter (CH. 2) clearly describes the recent work that has been done on probabilities that extreme events could have occurred with and without climate change. The science in this area has improved dramatically since the 1980s. 2) The sentence indeed reads as intended. Again we refer the reader to the more detailed description of the underlying science and projections in the Climate Science chapter and appendices. 3) While "global warming" implies warming everywhere, the term "climate change" is used here to make it clear that the authors' assessment of the science includes the understanding that many types of changes can result from the emissions of greenhouse gases. We refer the reader to the Commonly Asked Questions appendix for greater detail. 4) see #1 above, 5) the text does not impy that climate change is the only cause of health impacts, but clearly states that some

							existing health threats may intensify due to climate change, and other new threats may emerge as the climate changes. A very detailed discussion can be found in the Human Health chapter.
Caterina	Lindman	We'd like to thank and congratulate the authors for an excellent assessment of Climate Change. The physical aspects and anthropogenic causes of Climate Change are well researched and presented. We think that the National Climate Assessment report should include a review of policy options for mitigating climate change, because of the seriousness of the issue, and because of the time it will take to implement policies to curb greenhouse gas emissions. Although there is a discussion of cap-and-trade and carbon taxes in the National Academy of Science's report "Limiting the Magnitude of Future Climate Change", it should be included in the National Climate Assessment report in order to help focus the national conversation. Many people in the U.S. have not heard of the alternative to cap-and-trade, which is a carbon pollution fee-and-dividend. Many policy experts support a carbon pollution fee-and-dividend as the best way to move forward. It has many advantages over cap-and-trade, because it avoids the gifting of pollution permits (which can lead to public outcries over windfall profits), and it also avoids speculation and unverifiable emission offsets. By dividing up the revenue collected by the carbon pollution fee, it gives everyone a financial incentive to reduce their emissions, and the policy is progressive, in that lower income households will get more in dividends than they pay in carbon fees. The carbon-fee-and-dividend program would be revenue neutral, which is attractive to many people who do not want to increase the tax burden. It also is a market-based program, as it spurs innovation and sends pricing signals to investors that people will have financial incentives to purchase low-carbon energy. It is much easier to design and implement an efficient carbon-fee-and-dividend program than a successful cap-and-trade system. By having a gradually rising fee, it will give people and industries time to adapt, while giving clear signals that there is a financial incentive to reduce carbon emissions, which lines up with what we need to do to help avoid dangerous disruption to the environmental systems on which we depend for sustenance. A carbon-fee-and-dividend can be implemented by each country, but for best results, all countries need to implement it. In order to not disadvantage the first few countries that implement the program, a country can levy a tariff on imported goods for the excess amount of carbon pollution fee not already charged on imported goods. This tariff is compliant with WTO rules, and it gives an incentive to other countries to implement the carbon fee-and-dividend. Because the U.S. imports a lot of goods from China, China is much more likely to agree to implement a carbon pollution fee-and-dividend than to agree to a cap-and-trade regime. Sincerely,Doug Collins, Tanya Havlicek, Steve Kolk, Caterina Lindman, Vijay Manghnani, Stu Mathewson, Michael Speedling, Tom Strickland, Tom Taylor	27. Mitigation				It is outside the scope of the NCA to suggest or prioritize particular policy approaches, but a discussion of different potential approaches has been added.
Brian	Levy	Thanks to the authors for an excellent assessment of Climate Change. The physical aspects and anthropogenic causes of Climate Change are well researched and presented. We think that the National Climate Assessment report should include a review of policy options for mitigating climate change, because of the seriousness of the issue, and because of the time it will take to implement policies to curb greenhouse gas emissions. Although there is a discussion of cap-and-trade and carbon taxes in the National Academy of Science's report "Limiting the Magnitude of Future Climate Change", it should be included in the National Climate Assessment report in order to help focus the national conversation. Many people in the U.S. have not heard of the alternative to cap-and-trade, which is a carbon pollution fee-and-dividend. Many policy experts support a carbon pollution fee-and-dividend as the best way to move forward. It has many advantages over cap-and-trade, because it avoids the gifting of pollution permits (which can lead to public outcries over windfall profits), and it also avoids					While additional relevant discussion has been added to the Mitigation chapter, policy options are beyond the scope of the NCA, a scientific document.

		speculation and unverifiable emission offsets. By dividing up the revenue collected by the carbon pollution fee, it gives everyone a financial incentive to reduce their emissions, and the policy is progressive, in that lower income households will get more in dividends than they pay in carbon fees. The carbon-fee-and-dividend program would be revenue neutral, which is attractive to many people who do not want to increase the tax burden. It also is a market-based program, as it spurs innovation and sends pricing signals to investors that people will have financial incentives to purchase low-carbon energy. It is much easier to design and implement an efficient carbon-fee-and-dividend program than a successful cap-and-trade system. By having a gradually rising fee, it will give people and industries time to adapt, while giving clear signals that there is a financial incentive to reduce carbon emissions, which lines up with what we need to do to help avoid dangerous disruption to the environmental systems on which we depend for sustenance. A carbon-fee-and-dividend can be implemented by each country, but for best results, all countries need to implement it. In order to not disadvantage the first few countries that implement the program, a country can levy a tariff on imported goods for the excess amount of carbon pollution fee not already charged on imported goods. This tariff is compliant with WTO rules, and it gives an incentive to other countries to implement the carbon fee-and-dividend. Because the U.S. imports a lot of goods from China, China is much more likely to agree to implement a carbon pollution fee-and-dividend than to agree to a cap-and-trade regime.					
Margaret	Walsh	Begin sentence with "Citrus producers in Florida", or add to sentence	Introduction: Letter to the American People				It is not clear what sentence is referred to here.
Margaret	Walsh	The chapters on "Energy Supply and Use" (Chapter 4), "Forestry" (Chapter 7), "Ecosystems, Biodiversity, and Ecosystem Services" (Chapter 8), "Land Use and Land Cover Change" (Chapter 13), and "Rural Communities" (Chapter 14) never mention groundwater (the other chapters were not reviewed). As pointed out in chapter 3 climate change could directly impact groundwater, and indirectly impact it by causing increased groundwater usage. This would have implications for many of the subjects covered in other chapters. These implications should be addressed.					Thank you for the comment. You will find extensive discussion of groundwater in the Water chapter (Ch. 3). If the other chapters did not include it, it was due to space limitations that required the authors to deliberate and select the most relevant topics for each brief chapter.
Margaret	Walsh	There are some key areas lacking in the document. 1) There is a lack of synthesis across chapters. For example, both human health and agriculture face similar threats from pathogens and some of the points made in one are relevant in the other. This disconnect suggests that chapters might have ben structured around threats (i.e., rising sea levels, etc.) rather than areas being threatened; 2) There is a general lack of a global perspective in defining threats. Threats increase with climate change. For example, novel emerging pathogens may have the opportunity to take hold in the U.S. if climate change provides optimal conditions for those pathogens that did not exist previously." (Source: APHIS WS)					Thank you for the comments. 1) We have worked hard to synthesize topics and linkages across chapters. However, there is also some utility in having some topics appear in more than one place, as many readers will likely not read the entire report. 2) Additional description of the international context has been added to the Executive Summary.
Margaret	Walsh	The writing style of this chapter is provocative rather than informative, and as a consequence is not appropriate for a scientific document. Some portions may be used in the transmittal letter, but should be removed from the document itself. An overall change in tone is recommended, as many of the simplifications, presumably to reach a larger audience, fail to meet the necessary standards of accuracy. Recommend a skilled technical writer rewrite the chapter to effectively communicate to nonexperts while maintaining accuracy in content. Selected (non comprehensive) examples are given in	1. Executive Summary				The authors have worked hard to find a balance between scientific accuracy and communicating to non-technical audiences.

		the comments that follow.					
Margaret	Walsh	The first sentence of the ES is the rhetoric of political speech, not of scientific assessment. It does not belong in the document, and is inaccurate - e.g., the effects of climate change are not limited to Americans. Suggest removing from document and including in transmittal letter to Congress.	1. Executive Summary		3	1	Explaining the relevance of this topic to the American people is a major objective of this US National Assessment; no change is needed here.
Margaret	Walsh	Line 11 states that there may be some benefits to climate change in the US, but line 8 declares that the report concerns itself solely with the negative (based on context) impacts. The statement on line 8 is inaccurate - the report considers both. Were it limited to negative impacts only, it would be an indictment of the scope. The authors in fact found that on balance, the overall consequences are problematic. The phrasing as currently provided, though, fails to make that distinction and appears to be catastrophising without consideration of the myriad regional and temporal effects. Recommend language on line 8 that better reflects the report's content.	1. Executive Summary		3	7	The authors believe the existing language is a balanced approach to this issue.
Margaret	Walsh	The story is unambiguous, but the temperature increases are neither uniform, nor is it occuring everywhere, nor is it necessarily the most important element of a changing climate. Recommend different language to express the idea (e.g., "the climate is changing.")	1. Executive Summary		3	20	The authors believe the existing language is a balanced approach to this issue…we are referring to the totality of the evidence here, not each individual piece of data.
Margaret	Walsh	"Excessively" requires definition here - although a definition is found later in the report, the ES must stand alone. Without that information, the statement appears to be an ungrounded judgment rather than an considered consensus.	1. Executive Summary		8	14	After consideration of this point, we but still feel the text is clear and accurate.
Margaret	Walsh	Food security is a minor element of this assessment. To elevate it in the ES is disproportionate to the analysis it receives in the report. Recommend staying closer to the report content as written.	1. Executive Summary		8	38	The authors consider this finding to be a significant component of the agriculture chapter.
Margaret	Walsh	The indirect effects (e.g., pests) of climate on agricultural production are important and are discussed in the chapter, but are ignored in the ES. Recommend inclusion of these significant effects.	1. Executive Summary		9	28	Language has been modified in response to this comment.
Margaret	Walsh	Mitigation is defined here as reducing emissions exclusively. However, it is defined by IPCC as "An anthropogenic intervention to reduce the sources or enhance the sinks of greenhouse gases." Recommned including sinks in definition.	1. Executive Summary		10	19	The text has been revised to indicate that cutting emissions is an example of mitigation. Mitigation is defined in the Glossary of the report.
Margaret	Walsh	The table's title implies these are climate change effects that have already been observed, but it is not entirely clear. Plese clarify in a caption. Dates would be helpful, as well. Also provide info regarding where in the document these effects are documented/more information may be found.	1. Executive Summary	1.1	11		The table has been replaced with an infographic of regional impacts. Further details are provided in the chapters on regions and sectors.
Margaret	Walsh	Why is "risk-based framing" in quotation marks? It does not appear to have been defined here or previously in the chapter (the ES should stand alone), and the punctuation appears to imply that it might mean something other than what the careful reader may themselves glean.	1. Executive Summary		12	24	The change has been made.
Margaret	Walsh	Are "Surprises" somehow differentiated form thresholds or tipping points? If so, define. If not, the introduction of inapplicable jargon should be deleted.	1. Executive Summary		13	1	The authors are comfortable with the existing language.
Margaret	Walsh	Extreme events are important. However, they receive a disproportionate amount of coverage relative to the other four important topics in this section. Recommend editing to better reflect proportionality.	1. Executive Summary		13	12	The section has been edited and combined with other topics in the Context and Background section

Margaret	Walsh	Given the sea level rise figures provided, the better known CO2 trends from Mauna Loa observatory http://www.esrl.noaa.gov/gmd/ccgg/trends/global.html#global_growth may be included in the introduction, as well.	1. Executive Summary		24	6	Additional graphics have been added to the Executive Summary to emphasize the evidence underlying these conclusions.
Margaret	Walsh	Inclusion of articles "in press" is unfortunate but ok, however this citation is simply in review (submitted) and not acceptable. There are other examples of "submitted" references in this section. USDA suggests updating, replacing or deleting.	2. Our Changing Climate		96	10	References have been updated in the chapter. Papers in the chapter conform to the NCADAC's guidance on information quality. Papers can be included if they were in press by April 12, 2013 and available to the authors to review.
Margaret	Walsh	The chapter on "Water Resource" (Chapter 3) seems to do a reasonably good job of addressing groundwater. However, other chapters addressing water uses and other activities that relate in part to groundwater pay little if any attention to it. As pointed out climate change could directly impact groundwater, and indirectly impact it by causing increased groundwater usage. This would have implications for many of the subjects covered in other chapters. These implications should be addressed.	3. Water Resources				We greatly appreciate your positive comment.
Margaret	Walsh	In several places the chapter talks about decreased runoff due to increasing evaportranspiration and reduced precipitation. However, this concept should be clarified. Increased runoff may result from increasing frequency of high intensity precipitation despite reduced annual precipitation. Runoff also increases when vegetation cover is affected by drought and ecosystem changes as well as soil degradation, reducing infiltration, which in turn reduces soil moisture at the same time as runoff, erosion, and sedimentation is increased. On balance, the models may show reduced runoff, but if so, that should be explained.	3. Water Resources				Runoff drivers have been discussed in the water cycle section, especially the drought section, but uncertainties remain.
Margaret	Walsh	Water balance terminology. Figure 3.5 defines total freshwater withdrawals as the sum of consumptive use and return flows to rivers. From an agricultural perspective, consumptive use is defined very broadly here to include actual field-level water consumed in crop production (crop ET), plus water losses (eg. excess system evaporation, phreatophyte loss, deep percolation) that do not return to a surface river system. Two questions: Would it be useful to offer a broad definition of 'consumptive use', as we have for 'withdrawals' on pg.118? And should the Figure 3.5 caption reference to '.. return flows to rivers ..' be changed to '.. return flows to the hydrologic system..'? Water balance terminology. Figure 3.5 defines total freshwater withdrawals as the sum of consumptive use and return flows to rivers. From an agricultural perspective, consumptive use is defined very broadly here to include actual field-level water consumed in crop production (crop ET), plus water losses (eg. excess system evaporation, phreatophyte loss, deep percolation) that do not return to a surface river system. Two questions: Would it be useful to offer a broad definition of 'consumptive use', as we have for 'withdrawals' on pg.118? And should the Figure 3.5 caption reference to '.. return flows to rivers ..' be changed to '.. return flows to the hydrologic system..'? Water balance terminology. Figure 3.5 defines total freshwater withdrawals as the sum of consumptive use and return flows to rivers. From an agricultural perspective, consumptive use is defined very broadly here to include actual field-level water consumed in crop production (crop ET), plus water losses (eg. excess system evaporation, phreatophyte loss, deep percolation) that do not return to a surface river system. Two questions: Would it be useful to offer a broad definition of 'consumptive use', as we have for 'withdrawals' on pg.118? And should the Figure 3.5 caption reference to '.. return flows to rivers ..' be changed to '.. return flows to the hydrologic system..'? Water balance terminology. Figure 3.5 defines total freshwater withdrawals as the sum of consumptive use and return flows to rivers. From an agricultural perspective, consumptive use is defined very broadly here to include actual field-level water consumed	3. Water Resources	3.5	119		After consideration of this point, we still feel the existing text is clear and accurate.

		in crop production (crop ET), plus water losses (eg. excess system evaporation, phreatophyte loss, deep percolation) that do not return to a surface river system. Two questions: Would it be useful to offer a broad definition of 'consumptive use', as we have for 'withdrawals' on pg.118? And should the Figure 3.5 caption reference to '.. return flows to rivers ..' be changed to '.. return flows to the hydrologic system..'?					
Margaret	Walsh	1. Seasonal Precipitation. On pg.108-109, the section on 'Climate Change Impacts on the Water Cycle' offers a general discussion of projected changes in patterns of precipitation due to climate change. The discussion addresses 1) annual average precipitation, 2) intensity of precipitation, and 3) precipitation form (snowfall vs rain). Somewhat surprisingly, there is no mention here of changes in the seasonal timing of precipitation. However, changes in total precipitation are likely to be accompanied by an inter-seasonal shift in precipitation. The literature suggests that a larger share of precipitation is projected to fall in the winter/early spring period, with lesser amounts in the late-spring/summer period (US CCSP, 2008, p140). This may partly explain the earlier peak seasonal runoff and more frequent summer drought events cited in the draft NCA report. But change in the seasonality of precipitation is not identified as a contributing factor. [U.S. Climate Change Science Program (CCSP) and Subcommittee on Global Change Research. 2008. The Effects of Climate Change on Agriculture, Land Resources, Water Resources, and Biodiversity in the United States. Washington, DC, U.S. Dept. of Agriculture.]1. Seasonal Precipitation. On pg.108-109, the section on 'Climate Change Impacts on the Water Cycle' offers a general discussion of projected changes in patterns of precipitation due to climate change. The discussion addresses 1) annual average precipitation, 2) intensity of precipitation, and 3) precipitation form (snowfall vs rain). Somewhat surprisingly, there is no mention here of changes in the seasonal timing of precipitation. However, changes in total precipitation are likely to be accompanied by an inter-seasonal shift in precipitation. The literature suggests that a larger share of precipitation is projected to fall in the winter/early spring period, with lesser amounts in the late-spring/summer period (US CCSP, 2008, p140). 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In the winter and spring, we show the characteristic pattern of large (relative to natural variability) decreases in the far southwest U.S. and large increases in the far north of the contiguous U.S. In the far north, this does imply a larger share of precipitation in winter/spring. However, in the far southwest, it implies just the opposite, a larger share in the summer/fall. In the rest of the contiguous U.S., there are no implications for a shift as the precipitation change signal is generally small in all season.

		period (US CCSP, 2008, p140). This may partly explain the earlier peak seasonal runoff and more frequent summer drought events cited in the draft NCA report. But change in the seasonality of precipitation is not identified as a contributing factor. [U.S. Climate Change Science Program (CCSP) and Subcommittee on Global Change Research. 2008. The Effects of Climate Change on Agriculture, Land Resources, Water Resources, and Biodiversity in the United States. Washington, DC, U.S. Dept. of Agriculture.]					
Margaret	Walsh	ET and CO2. Research has suggested that rising CO2 concentrations may mitigate the increase in plant ET (through increased stomata resistance that limits transpiration through leaf surfaces). In the discussion of evapotranspiration (pg.110-111), there is no mention of the potential effect of CO2 accumulation on future ET. This potentially important interaction is probably worth a mention.ET and CO2. Research has suggested that rising CO2 concentrations may mitigate the increase in plant ET (through increased stomata resistance that limits transpiration through leaf surfaces). In the discussion of evapotranspiration (pg.110-111), there is no mention of the potential effect of CO2 accumulation on future ET. This potentially important interaction is probably worth a mention.ET and CO2. Research has suggested that rising CO2 concentrations may mitigate the increase in plant ET (through increased stomata resistance that limits transpiration through leaf surfaces). In the discussion of evapotranspiration (pg.110-111), there is no mention of the potential effect of CO2 accumulation on future ET. This potentially important interaction is probably worth a mention.ET and CO2. Research has suggested that rising CO2 concentrations may mitigate the increase in plant ET (through increased stomata resistance that limits transpiration through leaf surfaces). In the discussion of evapotranspiration (pg.110-111), there is no mention of the potential effect of CO2 accumulation on future ET. This potentially important interaction is probably worth a mention.	3. Water Resources		110	9	We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information to include.
Margaret	Walsh	Evaporation and water losses. While the draft report addresses the effects of higher evaporation rates on soil moisture, there is no mention of evaporation from water surfaces. Higher evaporative losses from water storage impoundments and water conveyance facilities in an important concern for water managers. This may be worth a mention.Evaporation and water losses. While the draft report addresses the effects of higher evaporation rates on soil moisture, there is no mention of evaporation from water surfaces. Higher evaporative losses from water storage impoundments and water conveyance facilities in an important concern for water managers. This may be worth a mention.Evaporation and water losses. While the draft report addresses the effects of higher evaporation rates on soil moisture, there is no mention of evaporation from water surfaces. Higher evaporative losses from water storage impoundments and water conveyance facilities in an important concern for water managers. This may be worth a mention.Evaporation and water losses. While the draft report addresses the effects of higher evaporation rates on soil moisture, there is no mention of evaporation from water surfaces. Higher evaporative losses from water storage impoundments and water conveyance facilities in an important concern for water managers. This may be worth a mention.	3. Water Resources				The text has been revised to incorporate this suggestion
Margaret	Walsh	Figure title should say Projected changes...for scenario A2.	3. Water Resources	3.1	110		After consideration of this point we don't feel the change is necessary as A2 appears prominently in the caption.
Margaret	Walsh	"The evapotranspiration process responds to both solar energy and moisture availability at the land surface and regulates the amounts of soil moisture, groundwater recharge, and runoff (Mueller et 12 al. 2011)." This is misleading, should include temperature along with solar energy and moisture availability... Also, this section on evapotranspiration should mention the influence of vegetation type and the link to land cover change. "The evapotranspiration process responds to both solar energy and moisture availability at the land surface and regulates the amounts of soil moisture, groundwater recharge, and runoff (Mueller et 12 al. 2011)." This is misleading, should include temperature along with solar energy and moisture availability... Also, this section on evapotranspiration should mention	3. Water Resources		110	11	We have discussed the response of ET to temperature and other factors.

		the influence of vegetation type and the link to land cover change. "The evapotranspiration process responds to both solar energy and moisture availability at the land surface and regulates the amounts of soil moisture, groundwater recharge, and runoff (Mueller et 12 al. 2011)." This is misleading, should include temperature along with solar energy and moisture availability... Also, this section on evapotranspiration should mention the influence of vegetation type and the link to land cover change. "The evapotranspiration process responds to both solar energy and moisture availability at the land surface and regulates the amounts of soil moisture, groundwater recharge, and runoff (Mueller et 12 al. 2011)." This is misleading, should include temperature along with solar energy and moisture availability... Also, this section on evapotranspiration should mention the influence of vegetation type and the link to land cover change.					
Margaret	Walsh	Useless to note the different geologic formation types unless accompanied by capacity/flow implications.	3. Water Resources	3.3	115		The figure on principal U.S. groundwater aquifers and use provide an indication of the geology and the percentage of overall water use that is supplied via aquifers.
Margaret	Walsh	Efficiencies did not "decouple" water use from population growth, they only have counteracted the correlation. The phenomena remain coupled.	3. Water Resources		119	9	The text has been revised to address this observation.
Margaret	Walsh	The chapters on "Energy Supply and Use" (Chapter 4), "Forestry" (Chapter 7), "Ecosystems, Biodiversity, and Ecosystem Services" (Chapter 8), "Land Use and Land Cover Change" (Chapter 13), and "Rural Communities" (Chapter 14) never mention groundwater (the other chapters were not reviewed). As pointed out in chapter 3 climate change could directly impact groundwater, and indirectly impact it by causing increased groundwater usage. This would have implications for many of the subjects covered in other chapters. These implications should be addressed.	4. Energy Supply and Use				The use of the word "water" in this chapter includes fresh water from all sources: surface, ground and rainwater. Since groundwater is replenished by surface water which is replenished from rainwater, the distinction between the source location isn't significant for the purpose of conveying the Key Message.
Margaret	Walsh	The chapter could benefit from more clarification of the implications of disruptions from extreme weather. The impacts from hurricanes are easy to visualize, but how (for example) does "Most areas in the U.S. are projected to experience increases in the number of days with precipitation exceeding one inch (pg. 168, line 20)" cause supply disruptions?	4. Energy Supply and Use				We have removed the first sentence on p. 168, line 20 (of draft version January 11, 2013), in response to other comments.
Margaret	Walsh	It would be useful to include more information about the forecasts for renewable energy (i.e. solar and wind) given on page 183. It is understood that the topic is highly variable, but there have been several years of production that could provide a baseline and the document currently provides several forecasts in areas that could be considered to be more variable.	4. Energy Supply and Use		183	4	The forecasts included in this chapter relate to projected changes in climate (e.g., temperature, precipitation). Due to page length limitations, it is not possible to assess impacts on a range of future energy portfolio scenarios which are dependent on numerous variables.
Margaret	Walsh	Discussion emphasized the possibility that effects of climate change on agriculture production may exceed our current capability to adapt - causing potential shortages. Although of medium confidence level, this is an important concern that requires further substantiation.	6. Agriculture				Thank you for your comment. This is Key Message 1. The articles which are cited are a combination of review articles with over 2000 different references. No changes were made.
Margare	Walsh	The Agriculture Chapter mentioned specific bacterial diseases which are expected to increase with	6.				Mention of vector-borne diseases for

t		climate change, however appeared to overlook the potenial changes in animal diseases transmitted via vectors - some of which are of greater concern than others because of high infectivity and potential impacts. Suggest that this topic receive additional emphasis. The changes in disease prevalence and increased geographic distribution of vectors capable of tranmitting diseases such as Bluetongue, EHD, Schmallenberg, Rift Valley Fever, and tick bourne diseases such as Cattle Fever Tick are examples that may shift in association with climate change factors; these should be better characterized so interventions can be developed. no reference to significant work/research conducted in animal health provided. The authors should reference work published by the OIE (World Organisation for Animal Health) - for example, Climate Change: impact on epidemiology and control of animal diseases.	Agricultu re				animals is found in the chapter. Animal diseases are mentioned elsewhere as well. As is the case with agricultural trade, for animal vector-borne disease it is hard to draw the line between international concerns and U.S. concerns. The OIE (World Organisation for Animal Health) reports focus on global issues, many of which are not a factor in the U.S.
Margare t	Walsh	Agricultural trade risk assessments consider the current known prevalence of diseases in countries. Some of the percieved prevalence in countries is historical, not based on current surveillance, and may be related to climatic factors. If these factors change, and surveillance systems are not in place to identify new incursions of disease, we may see initial spread of disease through international trade. This likely possibility needs to be better considered in the chapter. Reccomend insertion to Line 21: "Surveillance systems must be in place to identify new incursions of diseases and invasive species to mitigate their impacts on agricultural production and trade." Recommend insertion following line 33: "Agricultural trade risk assessments consider the current known prevalence of diseases in countries. Some of the percieved prevalence in countries is historical, not based on current surveillance, and may be related to climatic factors. If these factors change, and surveillance systems are not in place to identify new incursions of disease, we may see initial spread of disease through international trade." (Source: APHIS WS)	6. Agricultu re				We appreciate your comment; however, this comment advocates for establishing new surveillence systems, which is beyond the scope of this chapter.
Margare t	Walsh	For the next report the soils section could be expanded to further emphasize the importance of soil biology changes that may occur under changing climate conditions. Soil biology is being managed for soil sustainability, nutrient management, control of animal and plant pathogens, etc. Climate change research on this is only recently underway.	6. Agricultu re				In the chapter, we mention that research and development of sustainable natural resource management strategies inform adaptation options for U.S. agriculture. While not advocating a policy of more research, this statement should be used as justification for research on soil ecosystems as part of the ongoing continuous assessment.
Margare t	Walsh	The United States produces nearly $300 billion per year in agricultural commodities. Should either provide current data, or indicate that this value is for 2007 and is historical, rather than imply it is a more recent value.	6. Agricultu re		227	34	The 2010 Census reports a value of agricultural production of $330 billion. We have incorporated the recent data in the text.
Margare t	Walsh	This was an excellent point about weeds, insects, and diseases; consider expanding it further in this chapter. Beyond just acknowledging the problem, the chapter could frame the problem more explicitly. For example, several papers have provided a detailed framework that the author committee could follow. See Diez JM, D'Antonio CM, Dukes JS, Grosholz ED, Olden JD, Sorte CJB, et al. Will extreme climatic events facilitate biological invasions? Frontiers in Ecology and the Environment. 2012 2013/01/03;10(5):249-57.; Crowl TA, Crist TO, Parmenter RR, Belovsky G, Lugo AE. The spread of invasive species and infectious disease as drivers of ecosystem change Frontiers in Ecology and the Environment. 2008;6(5):238-46; 1. Epstein PR. Climate change and emerging infectious diseases. Microbes and Infection. 2001;3(9):747-54. (Source: APHIS WS)	6. Agricultu re		228	29	We appreciate your comment. We have added the references.
Margare	Walsh	"There have been detectable impacts on production already due to the increasing temperatures"	6.		228	31	After consideration of this point, we

t		(Lobell et al. 2011). This reference found Impacts on production globally but not in the US. The summation implies that Lobell concluded that climate change has affected US agriculture which does not appear to be accurate.	Agricultu re				have decided to keep the text as is. There are localized temperatures around the world. However, we updated the reference to Lobell et al. 2013 which addresses the specific point of this statement.
Margare t	Walsh	If you ask the question-"How important are weeds, diseases, and pests to US Agriculture?", one very rough estimate is the $120 Billion/year in crop losses and control costs estimated by Pimentel et al (2005) for exotic plant and animal pests versus the $300 billion/year total US agricultural output? Hence, about 1/3 of total. More attention should be paid to this topic. At present there are 23 lines dedicated to the topic; if one adds the 0.5 pages of text, 1.0 page of references (11 references total), 0.5 pages on Fig. 6 (p. 244) and 1.0 page on the evaluation of Key Message #2/6 this sums to 3.0 pages of the 35 pages on Agriculture or ~9%. If the authors feel they are unable to address this disproportionality in this text, we request that it receive greater attention in the next NCA.	6. Agricultu re		238	10	We agree this section is short compared to the remainder of the report; however, the goal is to ensure this topic is not forgotten and as the literature becomes available.
Margare t	Walsh	An issue not addressed is the availability of pest data to researchers, and of pest-climate models in particular. In relative terms there is a relative paucity of good work on this topic; the AgMIP efforts to date noted this and ask if such data could be made available for their work in Round Two efforts.	6. Agricultu re		238	10	We added a sentence at the beginning of the paragraph that addresses the issue you raise.
Margare t	Walsh	Text on use of pesticides is well developed and carefully thought out. One notes, however, that only two references are given on the topic versus several on the topic in published research articles. The topic of what happens to pesticide residues and downstream environmental impacts is absent but is researched in relation to climate change effects. Recommend including the reference below given it is for the US and evaluates climate change effects on use of pesticides. Regarding total US use ....." the current average external cost of pesticide use in US agriculture is calculated at US $42 per hectare. Under projected climate change this value increases up to $72 per hectare by 2100" Nikolinka G. Koleva a &A.B. Uwe A. Schneider 2009. The impact of climate change on the external cost of pesticide applications in US agriculture International Journal of Agricultural Sustainability 7(3): 203-216. http://dx.doi.org/10.3763/ijas.2009.0459 Also, we note that the IPCC 2013 draft Assessment under Agriculture has extensive reference to pesticides - including the consideration that climate variability = more pest = more pesticides = less 'dilution' of residues under drought, and vice versa... hence an important climate change impact.	6. Agricultu re		238	10	We have added the reference to the document.
Margare t	Walsh	The reference below is appropriate given it is for the US and evaluates climate change effects on use of pesticides. Regarding total US use ....." the current average external cost of pesticide use in US agriculture is calculated at US $42 per hectare. Under projected climate change this value increases up to $72 per hectare by 2100" Nikolinka G. K., U.A. Schneider, and R.S.J. Tol 2009. The impact of climate change on the external cost of pesticide applications in US agriculture International Journal of Agricultural Sustainability 7(3): 203-216. http://dx.doi.org/10.3763/ijas.2009.0459	6. Agricultu re		238	10	We have added the reference to the document.
Margare t	Walsh	Text should mention threat from exotics. On line 13 add ... "and other climate change-induced stresses. Pressure from exotic pests will increase also due to increased trade."	6. Agricultu re		238	10	This comment is appropriate, but rather than change the key message, which is meant to be succinct, we added text under this section to address invasive species.
Margare t	Walsh	How will climate change provide optimal conditions in the U.S. such that these organisms can become entrenched and cause similar or worse problems currently being experienced by previous introductions? In addition, how will changing conditions due to climate change affects geographic distributions and habitats for native vertebrate pest species, such as blackbird species, that can cause extensive crop depredations? This section should consider addressing these pressing threats in the face	6. Agricultu re		238	10	These are generally accepted statements; however, the information to support this inclusion in the report is not available.

		of climate change as well.					
Margaret	Walsh	Some of the references (e.g., Garrett et al) are very general frameworks and the stated effects are one-dimensional. Not all diseases or insects will show a one-way linear increase as climate warms. There is little mention of drought effects, stresses on the host plant or animal (and response by fungi, viruses, and other pests), effect of climate on disease vectors, or of reduction of pathogens/parasites/predators affecting disease and pest species (e.g., as a result of drought or soil flooding). What about induced changes in the 'food chain' or 'trophic web' in which the pests are found? There needs to be a balancing statement that many aspects of pest ecology and pest biology remain poorly known, not well-understood, and the good/verified research on what has been done needs to be more completely brought to light, assessed, and entered into the document to achieve dimension and balance. The statement 'A warmer world brings higher humidity in wet years' is not meaningful - this is only one of many possible patterns and the pattern will vary greatly between regions as will the impacts. Hence remove or adjust.	6. Agriculture		238	23	We appreciate the comment. We modified the text in the preceding paragraph that addresses the suggestion you raise. Also, the section that contained “a warmer world brings higher humidity in wet years” is no longer in the chapter.
Margaret	Walsh	Statements made from line 25-line 27 on page 241 are also relevant to outbreaks of certain diseases and pest species. That is, the authors should make similar points about disease and pest outbreaks, as they do not refer only to crops and livestock.	6. Agriculture		241	25	We modified the sentence to incorporate this suggestion and added more detail on the interactions.
Margaret	Walsh	In general, invasives adapt well to new conditions. This seems especially true for invasive weeds.	6. Agriculture		242	4	Thanks for the comment.
Margaret	Walsh	There was no mention of the potential effects for food safety in terms of changing threats of bacterial pathogens, especially antimicrobial-resistant (AMR) strains, in the food supply. This could occur at various points in the food chain, such as on feedlots. There is increasing evidence that synanthropic (peridomestic) wildlife may have a role in the spread and transmission of AMR bacterial strains to feedlots and crops. Again, there should be additional focus on this issue. Relevant citations include 1. Allen SE, Boerlin P, Janecko N, Lumsden JS, Barker IK, Pear DL, et al. Antimicrobial resistance in generic Escherichia coli isolates from wild small mammals living in swine farm, residential, landfill, and natural environments in Southern Ontario, Canada. Applied and Environmental Microbiology. 2011;77(3):882-8; 1. Jardine CM, Janecko N, Allan M, Boerlin P, Chalmers G, Kozak G, et al. Antimicrobial Resistance in Escherichia coli Isolates from Raccoons (Procyon lotor) in Southern Ontario, Canada. Applied and Environmental Microbiology. 2012;78(11):3873-9; Loesch CR, Reynolds RE, Hansen LT. An Assessment of Re-Directing Breeding Waterfowl Conservation Relative to Predictions of Climate Change. Journal of Fish and Wildlife Management. 2012 2012/06/21;3(1):1-22; Fuller T, Bensch S, MÃ¼ller I, Novembre J, PÃ©rez-Tris J, Ricklefs R, et al. The Ecology of Emerging Infectious Diseases in Migratory Birds: An Assessment of the Role of Climate Change and Priorities for Future Research. EcoHealth. 2012;9(1):80-8; Sorenson LG, Goldberg R, Root TL, Anderson MG. Potential Effects of Global Warming on Waterfowl Populations Breeding in the Northern Great Plains. Climatic Change. 1998;40(2):343-69; Lafferty KD. The ecology of climate change and infectious diseases. Ecology. 2009;90(4):888-900.; Leaf A. Potential health effects of global climatic and environmental changes. New England Journal of Medicine. 1989 2012/02/02;321(23):1577-83; Loesch CR, Reynolds RE, Hansen LT. An Assessment of Re-Directing Breeding Waterfowl Conservation Relative to Predictions of Climate Change. Journal of Fish and Wildlife Management. 2012 2012/06/21;3(1):1-22.; 1. Randolph SE. Perspectives on climate change impacts on infectious diseases. Ecology. 2009 2012/02/07;90(4):927-31; 1. Reiter P. Climate Change and Mosquito-Borne Disease. Environ Health Perspect. 2001;109(s1); 1. Rosenthal J. Climate Change and the Geographic Distribution of Infectious Diseases. EcoHealth. 2009;6(4):489-95; 1. Rogers DJ, Randolph SE. The Global Spread of Malaria in a Future, Warmer World. Science. 2000;289(5485):1763-6.; Tabachnick WJ. Challenges in predicting climate and environmental effects on vector-borne disease episystems in a changing world. Journal of Experimental Biology. 2010;213(6):946-54.	6. Agriculture		243	12	While we agree that food safety is an important issue we consider this to be a human health issue and more appropriately addressed in that chapter.

Margaret	Walsh	This is an excellent point and one that was lacking in Chapter 9 on Human Health.	6. Agriculture	Key Message #2/6	247		Thank you for your comment.
Margaret	Walsh	Key Message #2/6 serves as an independent summary and evaluation of the state-of-the-science. It is well-done and a noteworthy approach to the overall assessment -- but raises two questions: (1) why here and not in the main description itself?, and (2) even at the summary level, there is not a clear sense of just how important diseases, pests (e.g., insects), and vectors are to the issue of climate change, or what to expect. One of the 'voids' here (but captured in the new US National Climate Adaptation Strategy) is that (1) climate change is a disturbance that will greatly increase the chances of establishment and expansion of exotic weeds, diseases, and pests in the US. Other important aspects not emphasized include (2) the magnitude of the exotic invasive pest impacts overall is large (~$120Billion/year to US crops, and increasing), and (3) the impact on pest (and pesticides) regulation - such as trade restrictions, FIFRA, NEPA (including GHG emissions, impacts on environment)	6. Agriculture	Key message #2/6	247		Thanks for the comments. The author team has deliberated and agreed on the most important information to include on impacts to U.S. Agriculture. Given the size of this sector and chapter space limitations, we are not able to expand on the topics you raise. We defer those interested in a deeper treatment of diseases and vectors to Chapter 9: Human Health.
Margaret	Walsh	Exotics should be mentioned here. Recommend singling out the following sentence (from Key Message #2/6, p. 247) to make the distinction that in addition to extant species already in the US, exotic weeds, diseases and pests have particular significance in that (i) they can often be invasive (i.e. arrive without normal biological/ecological controls) and highly damaging, (ii) with increasing international trade, there are numerous high-threat, high-impact species that will arrive on commodities from areas where some species even now are barely known to modern science but which have the potential to emerge under a changed climate regime to pose significant risk of establishment in the US and economic loss, and (iii) can take advantage of 'disturbances' where climate variability adds/acts as an additional ecological disturbance. "Improved models and observational data related to how many agricultural regions will experience declines in animal and plant production from increased stress due to weeds, diseases, insect pests, and other climate change-induced stresses." (Source: APHIS-PPD) Inside Key message #2/6 insert " ... insect pests, both domestic and exotic, ... AND In key message #6/6, at the end of the text insert ...in the ways climate affects food processing, storage, transportation, trade patterns, transportation ...(source APHIS PPQ)	6. Agriculture		247	1	We expanded the uncertainty section to address this need.
Margaret	Walsh	Continued from previous comment: "Improved models and observational data related to how many agricultural regions will experience declines in animal and plant production from increased stress due to weeds, diseases, insect pests, and other climate change-induced stresses." (Source: APHIS-PPD) Inside Key message #2/6 insert " ... insect pests, both domestic and exotic, ... AND In key message #6/6, at the end of the text insert ...in the ways climate affects food processing, storage, transportation, trade patterns, transportation ...(source APHIS PPQ)	6. Agriculture		247	1	We expanded the uncertainty section to address this need.
Margaret	Walsh	Soil degradation will make the land more susceptible to weeds.	6. Agriculture		248	1	Thanks for the comment; however, this type of blanket statement is not possible to state.
Margaret	Walsh	References section requires an editor to make consistent with other chapters. There are, for instance, several incomplete references and no concluding periods on any of the references. Also, are citations to "personal communcation" permitted?	6. Agriculture		255	1	We appreciate your comment. The Technical Support Unit has revised and applied consistent formatting to the references. Citations to "personal communication" are permitted in the report. All citations in the chapter meet the Guidance on Information Quality Assurance to Chapter Authors of the National Climate Assessment.
Margare	Walsh	Reference to USDA report is incomplete. Complete reference should be: Malcolm, Scott, Elizabeth	6.		258	30	We revised the citation.

t		Marshall, Marcel Aillery, Paul Heisey, Michael Livingston, and Kelly Day-Rubenstein. Agricultural Adaptation to a Changing Climate: Economic and Environmental Implications Vary by U.S. Region, ERR-136, U.S. Department of Agriculture, Economic Research Service, July 2012.	Agricultu re				
Margare t	Walsh	Reference to Mass et al is incomplete.	6. Agricultu re		258	33	We revised the citation.
Margare t	Walsh	This forestry chapter has quite a different tone than the forestry technical report - the chapter is much more negative than the technical report. After reading the chapter, one is left with the impression that forests are doomed and nothing can be done, whereas the technical report covers how management options can help mitigate changes and help forests adapt (e.g., facilitating resistance, resilience, response, and realignment; managing fuels to reduce fire hazard; and developing stress-tolerant plant varieties).Â The chapter also leaves out information needs covered by the technical report that could help to improve management strategies.	7. Forestry				Thank you for your comment. Given space limitations, we could not cover everything. The technical report is 623 pages long, not 15.
Margare t	Walsh	More than 50% of the nation's water supply originates on forestlands, yet the chapter does not cover the forest hydrological processes from the technical report.	7. Forestry				We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include.
Margare t	Walsh	The chapters on "Energy Supply and Use" (Chapter 4), "Forestry" (Chapter 7), "Ecosystems, Biodiversity, and Ecosystem Services" (Chapter 8), "Land Use and Land Cover Change" (Chapter 13), and "Rural Communities" (Chapter 14) never mention groundwater (the other chapters were not reviewed). As pointed out in chapter 3 climate change could directly impact groundwater, and indirectly impact it by causing increased groundwater usage. This would have implications for many of the subjects covered in other chapters. These implications should be addressed.	7. Forestry				Due to the size of the sector, and the page limit for the chapter, we focused on broad trends rather than delving too deeply in to such topics.
Margare t	Walsh	This is an odd figure that does not contain sufficient description to make it meaningful. There is no indication of the temporal domain of the disturbances indicated. The MODIS Global Disturbance Index is not described. What is meant by "land clearing fire"? What is the difference between "drought/wildfire," "wildfire/drought" and "wildfire"? Why are "insects/logging/wildfire" considered to be a group? How can a percentage be greater than 100% (see legend [red])?	7. Forestry	7.1	265		The text has been revised to incorporate this suggestion. The temporal period has been defined and the technical term removed.
Margare t	Walsh	Comment 1. The statement that "eastern forests have smaller disturbances (than western forests)..." is not accurate - historically there have been successive 'waves' of massive tree mortality related to winter soil frost anomalies followed by summer drought. See comment on text p. 266, Line 21-26, and suggested references, namely (i)Auclair, A.N.D., R.C. Worrest, D. Lachance and H.C. Martin 1992. Climatic perturbation as a general mechanism of forest dieback. Chapter 4, p.38-58, In P.D. Manion and D. Lachance (eds.) Forest Decline Concepts, American Phytopathological Society Press, St. Paul, Minnesota; (ii) Auclair, A.N.D., W.E. Heilman, and B. Brinkman 2010. Predicting forest dieback in Maine, USA: a simple model based on soil frost and drought. Canadian Journal of Forest Research 40: 687-702.	7. Forestry		266	21	While the comment suggests a good specific example, the authors feel the existing examples are appropriate and adequate. We have not chosen to include these citations because they focus on "die-back", or partial crown mortality, which is a different and less serious issue than "die-off" events which are whole plant tree mortality events over a large area. We have also included a new figure to emphasize the focus on warmer temperatures and drought effects.
Margare t	Walsh	The discussion on these pages is a poorly structured narrative that goes back and forth between the direct effects of increasing temperature and the indirect effects of altered forest disturbance. It is very hard to follow. Most scientific syntheses on the effects of climate change, including a seminal paper by one of the lead authors (Dale et al. 2001), concur that disturbances dominate forest response to	7. Forestry		266		The text has been revised to incorporate this suggestion. We have inserted text before the paragraph noted that mentions that, of particular

		climatic variability and change. However, this chapter over emphasizes the direct impacts of temperature on mortality. A large amount of scientific literature emphasizes the importance of increasing frequency and magnitude of large-scale disturbances, many of which are directly or indirectly effected by temperature. Why does the chapter diverge from this consensus and choose such a narrow focus on temperature when cause-effect evidence for direct temperature effects are rare and relationships are inherently complex? This is especially true in Eastern forests, where higher summer temperatures (in the absence of other disturbances) are correlated with decreased mortality rates (Dietze and Moorcroft 2011) in many ecosystem types. Higher winter temperatures were more likely to be correlated with mortality, but this was attributed to a higher incidence of insects and diseases, not warmer temperature per se. This approach misrepresents the weight of scientific evidence available on the effects of climatic variability and change on forest ecosystems.					concern, is the potential for increased forest disturbance as the result of drought accompanied with warmer temperatures, which can cause both wildfire and tree death. Temperatures have generally been increasing and are predicted to so in the future (IPCC 2007). Therefore, although it is difficult to predict trends in future extreme events (IPCC 2012), there is a high degree of confidence that future droughts will be accompanied by generally warmer conditions, and this type of event is particularly important as a trigger for wildfire and tree death. In addition, the Dietze and Moorcroft citation has been corrected to state that mortality of some eastern tree groups is sensitive to rising temperature (Dietze and Moorcroft 2011), and is expected to increase as climate warms (Dale et al. 2010b). In addition, in the Traceable Accounts, Description of evidence base, we have added text that mentions that for eastern forests, there are fewer observational or experimental studies, with Dietz and Moorcroft (2011) being the most comprehensive. Dietz and Moorcroft (2011) report pollution and stand age to be the most important factors, and they find that tree survival increases with increased temperature in some groups; however, for other tree groups survival decreases with increased temperature. In addition, this study needs to be considered in the context that there have been fewer severe droughts in this region. However, physiological relationships suggest that trees will generally be more susceptible to mortality under an extreme drought, especially if it is accompanied by warmer temperatures (McDowell et al. 2008, 2011). Consequently, it is misleading to assume that because eastern forests have not yet experienced the types of

							large scale die-off seen in western forests that they are not vulnerable to such events if an extreme enough drought occurs. We have also included a new figure to emphasize the focus on warmer temperatures and drought effects.
Margaret	Walsh	This sentence is either poorly stated or counterintuitive. Surely forest disturbances such as stand-replacing fire are easier to detect than a response to "changes in average conditions."	7. Forestry		266	11	The text has been revised to incorporate this suggestion.
Margaret	Walsh	This is paragraph that appears to promote "forest die-off" as a universal phenomenon, when in fact it is not. This general inference relies on a narrow selection of the literature and misrepresents the findings of at least one of the citations (Dietze and Moorcroft 2011).	7. Forestry		266	14	The text has been revised to incorporate this suggestion. We have added text before the paragraph noted to mention that of particular concern is the potential for increased forest disturbance as the result of drought accompanied with warmer temperatures, which can cause both wildfire and tree death. Temperatures have generally been increasing and are predicted to so in the future (IPCC 2007). Therefore, although it is difficult to predict trends in future extreme events (IPCC 2012), there is a high degree of confidence that future droughts will be accompanied by generally warmer conditions, and this type of event is particularly important as a trigger for wildfire and tree death. In addition, the Dietze and Moorcroft citation has been corrected to state that mortality of some eastern tree groups is sensitive to rising temperature (Dietze and Moorcroft 2011), and is expected to increase as climate warms (Dale et al. 2010b). In addition, in the Traceable Accounts, Description of evidence base, we added text to mention that for eastern forests, there are fewer observational or experimental studies, with Dietz and Moorcroft (2011) being the most comprehensive. They report pollution and stand age to be the most important factors, and they find that tree survival increases with increased temperature in some groups; however, for other tree groups

							survival decreases with increased temperature. In addition, this study needs to be considered in the context that there have been fewer severe droughts in this region. However, physiological relationships suggest that trees will generally be more susceptible to mortality under an extreme drought, especially if it is accompanied by warmer temperatures (McDowell et al. 2008, 2011). Consequently, it is misleading to assume that because eastern forests have not yet experienced the types of large scale die-off seen in western forests that they are not vulnerable to such events if an extreme enough drought occurs. We have also included a new figure to emphasize the focus on warmer temperatures and drought effects.
Margaret	Walsh	What is a "projected underlying trend"? (line 30)	7. Forestry		266	30	The text has been revised to clarify this issue on the underlying trends such as mean conditions.
Margaret	Walsh	There already have been large, region-wide diebacks in oak forest types in the southeast and south central states. Dale et al 2010b reference is based on findings based on one state and five of Bailey's forest types in TN. Is that sufficient to generalize their findings to the entire "eastern forests"? When exaimed in specifics, diebacks in eastern US have historically been very large and not less extensive or less economically damaging than in the western US. Balanced evaluation is needed.	7. Forestry		267	12	We have considered this comment in the context of other comments that state the risks for eastern forests are being overstated and have modified the text as follows to match our assessment of the current best understanding of the situation. We have also added the Dale et al. 2010b citation earlier in the chapter.
Margaret	Walsh	The scientific literature indicates that growth increases are possible in the eastern U.S. and likely in high-elevation forests.	7. Forestry		267	3	We have modified the text to incorporate this statement of increased productvity and clarify the associated caveat.
Margaret	Walsh	This statement is not correct. Dietze and Moorcroft (2011) did not observe that most Eastern species groups exhibited increasing mortality with rising temperature.	7. Forestry		267	7	The statement has been corrected to mention that although rising temperatures and CO2 levels can increase growth or migration of tree species (Saxe et al. 2008; Vose et al. 2012; Woodall et al. 2009), some eastern species groups have already exhibited increases in mortality with rising temperature (Dietze and Moorcroft 2011).

Margaret	Walsh	The sentence about "die-offs" in Eastern forests is somewhat overstated, based on a modeling study from one reference from one of the lead authors, and diverges from inferences about the relative importance of other causes of forest mortality.	7. Forestry		267	12	We have considered this comment in the context of other comments that state the risks for eastern forests are being understated and have modified the text as follows to match our assessment of the current best understanding of the situation. We have also added the Dale et al. 2010b citation earlier in the chapter. We have also included a new figure to emphasize the focus on warmer temperatures and drought effects.
Margaret	Walsh	Again, this states a focus on single-factor causation, even though other stressors are mentioned just a few lines above. This single-factor interpretation is not supported in the broader scientific literature.	7. Forestry		267	15	We have added text earlier in the report to highlight why we are focused on this type of disturbance. We mention that of particular concern is the potential for increased forest disturbance as the result of drought accompanied with warmer temperatures, which can cause both wildfire and tree death. Temperatures have generally been increasing and are predicted to so in the future (IPCC 2007). Therefore, although it is difficult to predict trends in future extreme events (IPCC 2012), there is a high degree of confidence that future droughts will be accompanied by generally warmer conditions, and this type of event is particularly important as a trigger for wildfire and tree death. We have also included a new figure to emphasize the focus on warmer temperatures and drought effects.
Margaret	Walsh	How does this illustrate or support the text?	7. Forestry	7.2	268		We added a citation to the figure in the text in the sentence that mentions "strong relationships between climate and fire," even when modified by land use and management.
Margaret	Walsh	Why are English units used here?	7. Forestry		268	6	The decision was made by the NCADAC to use English units. No change was made to the text.
Margaret	Walsh	What trends? None have been specified, and if there are any, they would almost certainly be relevant only to certain regions and forest species.	7. Forestry		269	11	The text has been revised to incorporate this suggestion. Additional text added to address the changes.

Margaret	Walsh	What is meant by a "projected case study"?	7. Forestry		269	12	The text has been revised to incorporate this suggestion. Clarification of the changes in growing season was added and the text mentioned here deleted.
Margaret	Walsh	This statement disagrees with what was stated on page 267.	7. Forestry		269	14	After consideration of this point, we still feel that the existing text is clear. The text originally on page 267 (in January 11, 2013 draft) has been extensively revised.
Margaret	Walsh	"Forests" and "vegetation types" will not "shift." However, the distribution and abundance of individual species may change.	7. Forestry		269	16	The text has been revised to incorporate this suggestion. This text was deleted and replaced with a reference to the Chapter on Ecosystems where species shifts are described.
Margaret	Walsh	An "acceleration of harvesting" seems unlikely, especially on public lands where harvesting has decreased greatly and will likely remain low.	7. Forestry		271	8	After consideration, we still feel that the text is clear and accurate. No mention of ownership is made in this list of economic factors that will affect the future carbon cycle.
Margaret	Walsh	Why are data from 2004 used when more recent data are available?	7. Forestry	7.4	271		The text has been revised to incorporate this suggestion. The temporal period is 2000 to 2006 and the methods are from Running et al. 2004.
Margaret	Walsh	What is meant by "increasing prevalence of extreme conditions"? Many scientists disagree with the exaggerated interpretations in Westerling et al. (2011).	7. Forestry		272	13	We stand by our statement.
Margaret	Walsh	This sentence is awkward and needs to be reworded.	7. Forestry		276	4	We reworded the sentence.
Margaret	Walsh	What is meant by "adaptation of new species"?	7. Forestry		276	37	The text was revised to incorporate this suggestion.
Margaret	Walsh	"Aid in impacts" is an awkward phrase.	7. Forestry		277	1	The text has been revised to incorporate this suggestion. 'Aid in impacts' has been revised to 'mitigate impacts.'
Margaret	Walsh	It is curious that confidence is "very high" for increased frequency of large, intense fire, but that no confidence rating is indicated for the effects of higher temperature on tree mortality, a dominant theme in the first section. Furthermore, the sentence "This is based on..." suggests that Adams et al. (2009) and Williams et al. (2012) support the fire inference, when in fact they discuss primarily the hypothesized temperature-mortality connection. Finally the inference about increased frequency of large fires says nothing about the magnitude of fire events, a topic for which abundant scientific literature is available.	7. Forestry		279		The physiology of tree stress and specific causes of mortality are not completely understood, but fire is easier to see.
Margaret	Walsh	This section contains many incomplete citations and inconsistent formats.	7. Forestry		283		The text has been revised to incorporate this suggestion.

Margaret	Walsh	The technical report stresses that interactions among multiple forest disturbances and stressors can have a larger effect than any individual one - this is glossed over in the chapter (and left out of the key message entirely).	7. Forestry		278	2	We mention interactions many times.
Margaret	Walsh	Chapter should have a more clear separation between threats due to climate change and threats due to human changes to the landscape. For example, draining wetlands and increased rainfall could enhance flooding, but if wetlands were not drained the flooding impacts would be lessened. This is acknowledged, but could be covered more clearly and explictly.	8. Ecosystems, Biodiversity, and Ecosystem Services				No change. A major theme in several of the sections is that climate change is acting in concert with a large number of other human changes to the landscape.
Margaret	Walsh	The paper emphasizes those changes associated with more frequent and/or severe weather events. It only briefly acknowledges that there are areas where climate may actually improve from a human standpoint. In terms of ecosystems and biodiversity the paper implicitly values the status quo.	8. Ecosystems, Biodiversity, and Ecosystem Services				No change. Positive responses to climate change are more likely to be found in other chapters.
Margaret	Walsh	The ecosystem services addressed by this section appear limited. Suggest mention of effects on airshed, carbon sequestration, recreational use of landscapes, and pollinators be included.	8. Ecosystems, Biodiversity, and Ecosystem Services				No change. Most of these services are mentioned in the chapter. Not everything could be included.
Margaret	Walsh	The chapters on "Energy Supply and Use" (Chapter 4), "Forestry" (Chapter 7), "Ecosystems, Biodiversity, and Ecosystem Services" (Chapter 8), "Land Use and Land Cover Change" (Chapter 13), and "Rural Communities" (Chapter 14) never mention groundwater (the other chapters were not reviewed). As pointed out in chapter 3 climate change could directly impact groundwater, and indirectly impact it by causing increased groundwater usage. This would have implications for many of the subjects covered in other chapters. These implications should be addressed.	8. Ecosystems, Biodiversity, and Ecosystem Services				Thank you for your suggestion. A mention of groundwater was added to the water section.
Margaret	Walsh	Well written. Covers the topic well, however what is our capacity to adapt?	9. Human Health				We greatly appreciate your positive comment. More information on our capacity to adapt can be found in Ch.28 on Adaptation of the National Climate Assessment report; along with several references cited in this chapter: (1) National Research Council. America's Climate Choices: Adapting to the Impacts of Climate Change . Washington, DC: The National Academies Press, 2010. (2) Hess JJ,

							McDowell JZ, Luber G. 2012. Integrating climate change adaptation into public health practice: using adaptive management to increase adaptive capacity and build resilience. Environ Health Perspect 120:171-179. (3) Bedsworth L. 2009. Preparing for climate change: a perspective from local public health officers in California. Environ Health Perspect 117:617-623.
Margaret	Walsh	Perhaps the concept of One Health needs to be addressed better across the chapters of Agriculture, Human Health, Rural Communities, and Ecosystems. Food security is part of the One Health aspect but the impacts of zoonotic diseases possibly related to climate change factors could be emphasized more.	9. Human Health				We thank the reviewer for the helpful suggestion, and have incorporated a new citation into the draft.
Margaret	Walsh	In terms of major impacts, the chapter focused more on minor impacts from climate change and less on more potentially devastating effects (as presented in the Box labelled Large-scale Environmental Change Favors Disease Emergence). However, this theme was not addressed sufficiently in this chapter; greater emphasis should be placed on this threat.	9. Human Health				We appreciate this comment and our intent with the Key health threats text box was to highlight potential large scale health impacts, but the author team found it essential to detail the various individual health effects to provide a fuller picture of the health consequences of climate change.
Margaret	Walsh	One of the key messages (as well as key drivers) to include was the increased potential threat from 1) introduced globally emerging diseases due to changing conditions that promote favorable environments for the pathogens causing those diseases, 2) geographic shifts in diseases already present in the U.S. due to climate change, 3) increased incidence of disease within their existing geographic ranges due to changes in seasonal effects. In terms of vector-borne diseases, these would also be coupled with the introduction of novel invasive species capable of transmitting novel diseases.	9. Human Health		333	24	Vector borne diseases are included as a threat in the key messages. The drivers mentioned in the comment are not climate drivers, and are more appropriate for a more detailed discussion of vector-borne and zoonotic diseases than in the key messages.
Margaret	Walsh	There should be some discussion here about the potential introduction of novel insect vectors and how climate change might promote their spread/behavior. This is especially relevant if climate change will provide the appropriate environmental conditions that were not previously present. Also, the focus of this section should go beyond just rodents and recognize that oher wildlife species can play roles in zoonotic diseases that affect agricultural and human health. For example, shifts in waterfowl distributions and habitat use due to climate change could have impacts on avian influenza virus transmission to poultry operations. There is a lot of literature on this topic but some relevant references associated with this comment include: Loesch CR, Reynolds RE, Hansen LT. An Assessment of Re-Directing Breeding Waterfowl Conservation Relative to Predictions of Climate Change. Journal of Fish and Wildlife Management. 2012 2012/06/21;3(1):1-22; Fuller T, Bensch S, MÃ¼ller I, Novembre J, PÃ©rez-Tris J, Ricklefs R, et al. The Ecology of Emerging Infectious Diseases in Migratory Birds: An Assessment of the Role of Climate Change and Priorities for Future Research. EcoHealth. 2012;9(1):80-8; Sorenson LG, Goldberg R, Root TL, Anderson MG. Potential Effects of Global Warming on Waterfowl Populations Breeding in the Northern Great Plains. Climatic Change. 1998;40(2):343-69; Lafferty KD. The ecology of climate change and infectious diseases. Ecology. 2009;90(4):888-900.; Leaf A. Potential health effects of global climatic and environmental changes. New England Journal of Medicine. 1989 2012/02/02;321(23):1577-83; Loesch CR, Reynolds RE, Hansen LT. An Assessment of Re-Directing	9. Human Health		343	29	Thank you for your comments. These are indeed important concerns, but we were severely space constrained in our vector-borne diseases section and have included a few examples of future threats to ensure that the readers are aware of the fact that novel diseases may be introduced into the U.S.

		Breeding Waterfowl Conservation Relative to Predictions of Climate Change. Journal of Fish and Wildlife Management. 2012 2012/06/21;3(1):1-22.; 1. Randolph SE. Perspectives on climate change impacts on infectious diseases. Ecology. 2009 2012/02/07;90(4):927-31; 1. Reiter P. Climate Change and Mosquito-Borne Disease. Environ Health Perspect. 2001;109(s1); 1. Rosenthal J. Climate Change and the Geographic Distribution of Infectious Diseases. EcoHealth. 2009;6(4):489-95; 1. Rogers DJ, Randolph SE. The Global Spread of Malaria in a Future, Warmer World. Science. 2000;289(5485):1763-6.; Tabachnick WJ. Challenges in predicting climate and environmental effects on vector-borne disease episystems in a changing world. Journal of Experimental Biology. 2010;213(6):946-54.					
Margaret	Walsh	Climate change may also promote the introduction of novel pathogens and insect pests that would affect food security.	9. Human Health		349	7	We agree and note that this is addressed at the end of the Food Security section.
Margaret	Walsh	This section should consider inclusion of additional prevention strategies for novel pathogens and vectors having a high likelihood of spreading under climate change scenarios. These might include more stringent inspections, development of novel technolgies for pathogen and vector detection, etc. There should be some recognition that 1) increased intervention and 2) rapid response to mitigate or prevent spread of novel pathogens in the face of climate change is a critical component of prevention strategies.	9. Human Health		353	1	We appreciate the suggestion and have mentioned the importance of early monitoring for outbreaks later on in this section. Authors are limited in the amount of additional detail we can provide in the text.
Margaret	Walsh	This message could be strengthened by identifying the roles and responsibilities of federal agencies involved in prevention efforts (e.g, border surveillance, inspection services, etc.) and could highlight programs or reference websites to inform the reader of efforts to address climate change.	9. Human Health	Key message #3/4	363		We appreciate this suggestion, but materials added to the Traceable Account would need to be mirrored by corresponding addition of materials to the text. Space is limited, and after consideration of this point we have included a citation to the 2011 National Research Council's America's Climate Choices report, in which people can find more information on federal agency roles.
Margaret	Walsh	The chapter on "Water, Energy, and Land Use" (Chapter 10) only mentions groundwater three times and two of those are related to hydraulic fracturing. There needs to be an adequate discussion of the issue here.	10. Water, Energy, and Land use				We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on overarching intersects and the most important information and illustrations to include.
Margaret	Walsh	Chapter 10 gives a good broad-brush, layperson overview of expected interactions between energy, water, and land use systems. The report appropriately highlights the key interactions/relationships between these components. This chapter (and the report) should be of value to a nontechnical, general audience.	10. Water, Energy, and Land use				We greatly appreciate your positive comment about our report and hope that it does provide value to its intended - nontechnical, general - audience.
Margaret	Walsh	The chapter appropriately captures the need to "jointly" consider risks, vulnerabilities, and opportunities associated with energy, water and land use interactions under climate change, but it should also give consideration to discussing the merits of "joint consideration" of policy adaptation and mitigation alternatives across local, regional (watershed), State, and Federal entities as a means of using partnerships to devise solution opportunities at a landscape scale. There is an adequate amount of literature highlighting the beneficial merits of this perspective.	10. Water, Energy, and Land use				We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include. Additional information on decision-making has been added to the Introduction. The

							text for Key Message #3 includes expanded discussion of decision making challenges you have highlighted.
Margaret	Walsh	Citation (NRC 2011) is not adequately specific; it refers to a 250 page document. Page number should be specified. Also, the following statement appears to be misleading, "biofuel production has been cited for contributing to harmful algal blooms... and hypoxic condintions in the Gulf of Mexico." Algal blooms have been associated with many agricultural activities along the Mississippi and while they could include biofuel production, they are not specific to them as is implied by the statement.	10. Water, Energy, and Land use		404	10	The references follow the prescribed format for the NCA. This instance is stated clearly on page 10 of the cited document.
Margaret	Walsh	Figure 10.3: Interactions of Water, Energy, and Land Uses is initially somewhat confusing. One, it takes too long for the reader to interpret. Are these "use/production" values and are they values with or without climate change? Suggest a one or two sentence interpretive statement below each figure. Second, theÂ "Caption" should clarify the specifics of the "context of climate change."	10. Water, Energy, and Land use	10.3	396		Additional explanation was added to the caption and text.
Margaret	Walsh	shale gas production, assuming this is fraccing, does use significant amounts of water at the local scale, but not over the life of the extraction, so this water use is short term to establish the well. Statement is correct but misleading.	10. Water, Energy, and Land use		389	8	After consideration of this point, we still feel the existing text is clear and accurate.
Margaret	Walsh	Mention that non-ethanol (and non-biodeisel) biofuels are under development for transportation fuel, particularly in the aviation industry. There are estimates of water use required for commercial scale production.	10. Water, Energy, and Land use		403	21	We appreciate the suggestion. In the course of revisions, this section and some of the detailed examples were shortened. The author team deliberated and selected the most important issues to include.
Margaret	Walsh	The chapters on "Energy Supply and Use" (Chapter 4), "Forestry" (Chapter 7), "Ecosystems, Biodiversity, and Ecosystem Services" (Chapter 8), "Land Use and Land Cover Change" (Chapter 13), and "Rural Communities" (Chapter 14) never mention groundwater (the other chapters were not reviewed). As pointed out in chapter 3 climate change could directly impact groundwater, and indirectly impact it by causing increased groundwater usage. This would have implications for many of the subjects covered in other chapters. These implications should be addressed.	13. Land Use and Land Cover Change				We appreciate this suggestion and while we made an applicable edit to the chapter, space is limited. The author team deliberated and agreed on the most important information and illustrations to include. We would also like to point out that the most extensive discussion of groundwater is in Ch. 3 Water Resources. Accordingly, a number of other NCA report chapters reference the Water chapter.
Margaret	Walsh	Key message #4: This statement is worded too positively based on the information appearing in the Traceable accounts, particularly the "New Information and Remaining Uncertainties" section	13. Land Use and Land Cover Change		471	21	We agree that a qualification is needed. Edits have been made.
Margaret	Walsh	Pg 472, Recent Trends section - in addition to confusion about when the authors are describing land cover vs land use trends, some terms are vague. For example, line 35-36 refers to "Agricultural uses..." when the statistic refers to agricultural cover not use. Also, it isn't clear what types of agricultural 'covers' are included in this term.Pg 472, Recent Trends section - in addition to confusion about when the authors are describing land cover vs land use trends, some terms are vague. For example, line 35-	13. Land Use and Land Cover Change		472	27	Because this sentence is summarizing data from the Nickerson report (as cited) it is correct as stated (i.e., it is dealing with uses, not covers). Minor wording edits have been made.

		36 refers to "Agricultural uses..." when the statistic refers to agricultural cover not use. Also, it isn't clear what types of agricultural 'covers' are included in this term.					
Margaret	Walsh	Pg 476, Projections section - the discussion doesn't make it clear whether land use or land cover data are being used in projections (e.g., lines 11-12 with respect to urban areas). It would be most helpful to be clear whether projections differ depending on which type of data are used, or to be clear if we don't really know enough to say anything about this. Pg 476, Projections section - the discussion doesn't make it clear whether land use or land cover data are being used in projections (e.g., lines 11-12 with respect to urban areas). It would be most helpful to be clear whether projections differ depending on which type of data are used, or to be clear if we don't really know enough to say anything about this.	13. Land Use and Land Cover Change		476	1	We modified the text on projections to make more clear when we are talking about the land cover projections of Wear and the land use and land cover projections of Bierwagen.
Margaret	Walsh	Effects on Communities and Ecosystems section - again the distinctions between land use and land cover are confusing. The opening sentence makes a distinction between decisions about land use and cover, but the rest of the section doesn't explain why this distinction is important. Then the next sentence indicates land USE can be influenced by policymakers - isn't land COVER influenced as well?	13. Land Use and Land Cover Change		478	6	Text has been modified.
Margaret	Walsh	Pg 480 Effects on Climate Processes section - it appears the bullets are supposed to provide examples of how land use interacts with climate, and how land cover interacts with climate. However it isn't clear whether the bullets are examples of one or the other, or both...or (again) how the two differ.Pg 480 Effects on Climate Processes section - it appears the bullets are supposed to provide examples of how land use interacts with climate, and how land cover interacts with climate. However it isn't clear whether the bullets are examples of one or the other, or both...or (again) how the two differ.	13. Land Use and Land Cover Change		480	1	All of these are examples of LULC affecting climate. Text has been modified.
Margaret	Walsh	Pg 482-483, uncertainties deserving further investigation - this section should also mention another uncertainty: the extent to which GHG emission reductions are 'additional', that is, the extent to which the policy induces emission reductions beyond what would have occurred under business-as-usual conditions. Also, it should be noted that crop prices have risen in recent years due to several factors, not just the biofuel market (increasing global commodity demands are another example). Note: the notion of additionality is mentioned in key message #4. Here is some text from the ERS "Ethanol Decade" report (pg. 2) and the relevant CBO citation: Crop Prices and Ethanol Demand The changes in corn production described in this report are not only a response to domestic bioenergy policies but also to other market forces and Government policies. According to the Congressional Budget Office (CBO) (2009), about 20 percent of the increase in corn prices between 2007 and 2008 was due to domestic ethanol demand. The CBO report also cites research by the International Food Policy Research Institute (IFPRI) that 40 percent of the rise in corn prices between 2000 and 2007 was due to global ethanol demand. Other factors influencing corn prices included energy prices, exchange rates, and adverse weather. Recent changes in the corn market allow us to examine how corn production has expanded. As shown in the price series below, corn price increases since 2006 were accompanied by a price increase for soybeans and wheat, but cotton prices have not increased as dramatically. Since farmers react to price trends when making land-use decisions, these price trends influence the pathways the farm sector has taken as it adjusted to increased demand for corn for ethanol production. Congressional Budget Office. The Impact of Ethanol Use on Food Prices and Greenhouse-Gas Emissions, Publication Number 3155, 2009.	13. Land Use and Land Cover Change		482	37	Good suggestion. Text has been modified.
Margaret	Walsh	Continued from previous comment. Here is some text from the ERS "Ethanol Decade" report (pg. 2) and the relevant CBO citation: Crop Prices and Ethanol Demand The changes in corn production described in this report are not only a response to domestic bioenergy policies but also to other market forces and Government policies. According to the ongressional Budget Office (CBO) (2009), about 20 percent of the increase in corn prices between 2007 and 2008 was due to domestic ethanol demand. The CBO report also cites research by the International Food Policy Research Institute (IFPRI) that 40	13. Land Use and Land Cover Change		482	37	We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include. We have, however, added a citation that

		percent of the rise in corn prices between 2000 and 2007 was due to global ethanol demand. Other factors influencing corn prices included energy prices, exchange rates, and adverse weather. Recent changes in the corn market llow us to examine how corn production has expanded. As shown in the price series below, corn price increases since 2006 were accompanied by a price increase for soybeans and wheat, but cotton prices have not increased as dramatically. Since farmers react to price trends when making land-use decisions, these price trends influence the pathways the farm sector has taken as it adjusted to increased demand for corn for ethanol production. Congressional Budget Office. The Impact of Ethanol Use on Food Prices and Greenhouse-Gas Emissions, Publication Number 3155, 2009.					discusses the effect of crop prices on amount of forest land.
Margaret	Walsh	OVERALL - this chapter could make a very useful contribution with its scope including both land use and land cover trends. Several of the key messages are very good. However, in general this draft is very confusing, because the distinctions between land use and land cover are not clearly described and the implications of differences between the two are not well explained. This problem permeates every section of the chapter. Provide clear definitions of land use and land cover, point out that different methods are used to develop land use and land cover estimates, and describe how/when they result in different conclusions about changes. Also, it would help to make the point that the climate implications of land change can in some cases be quite different depending on whether land use data or land cover data is used - and that both types of data are needed to develop well-informed estimates (harvested forest areas with newly planted seedlings provides a classic example - these areas would show up as a decline in forest cover because the seedlings don't meet the forest cover threshold, but would not show up as a decline in estimates of forest-use land). This context, and more clarity about when/why land use or land cover data are used in the discussions, would help prevent confusion for readers about why the authors are talking about both land use and land cover and which really matters.OVERALL - this chapter could make a very useful contribution with its scope including both land use and land cover trends. Several of the key messages are very good. However, in general this draft is very confusing, because the distinctions between land use and land cover are not clearly described and the implications of differences between the two are not well explained. This problem permeates every section of the chapter. Provide clear definitions of land use and land cover, point out that different methods are used to develop land use and land cover estimates, and describe how/when they result in different conclusions about changes. Also, it would help to make the point that the climate implications of land change can in some cases be quite different depending on whether land use data or land cover data is used - and that both types of data are needed to develop well-informed estimates (harvested forest areas with newly planted seedlings provides a classic example - these areas would show up as a decline in forest cover because the seedlings don't meet the forest cover threshold, but would not show up as a decline in estimates of forest-use land). This context, and more clarity about when/why land use or land cover data are used in the discussions, would help prevent confusion for readers about why the authors are talking about both land use and land cover and which really matters.	13. Land Use and Land Cover Change				We have tried to be clear about the distinctions between land use and land cover throughout. Because we are drawing on studies that use different definitions and trying to synthesize that information, it is not always possible to absolutely clear without significantly more text about each case, example, or study.
Margaret	Walsh	Table 13.1 and 13.2 - these tables need definitions for the various land use and land cover categories that are used. It would also help in Table 13.1 to include a row at the bottom showing the Total so the reader understands the columns total to 100%. Both tables would benefit from identifying the sources for the estimates in the notes to the tables.	13. Land Use and Land Cover Change	13.1 and 13.2	474		We've edited the caption to make the source of these data clearer. We appreciate the suggestion to add definitions, but space is limited.The author team has deliberated and agreed on the most important information to include. All definitions can be found in the table references.
Margaret	Walsh	The chapters on "Energy Supply and Use" (Chapter 4), "Forestry" (Chapter 7), "Ecosystems, Biodiversity, and Ecosystem Services" (Chapter 8), "Land Use and Land Cover Change" (Chapter 13), and "Rural Communities" (Chapter 14) never mention groundwater (the other chapters were not	14. Rural Communities				Thank you for your comment. We have revised the text to mention increasing pressure on groundwater systems.

		reviewed). As pointed out in chapter 3 climate change could directly impact groundwater, and indirectly impact it by causing increased groundwater usage. This would have implications for many of the subjects covered in other chapters. These implications should be addressed.					
Margaret	Walsh	On units-Mt should be Mg or megagram, to be consistent with Tg unit also used in this chapter.	15. Interactions of Climate Change and Biogeochemical Cycles				Thank you for your comment. Mt has been changed to Mg.
Margaret	Walsh	It is more accurate to phrase this as "fertilization with nitrogen-containing amendments such as nitrogen fertilizers."	15. Interactions of Climate Change and Biogeochemical Cycles		523	38	Thank you for your comment; after consideration of this point, however, we still feel the existing text is clear and no edits have been made.
Margaret	Walsh	In the section on carbon sinks, it states that nitrogen processes affect ozone, and aerosols, but it does not mention that VOC's and other carbon containing substances (such as methane) also cause aerosols and affect tropospheric ozone. The reaction in the atmosphere to create ozone via N2O requires also organic compounds including VOCs and methane. It gives the impression that nitrogen controls carbon processes but you could also say it the other way around. Each influences the other and the cycles are intimately linked. Of the estimated 70-90Tg/yr organic aerosols produced, it is estimated that 22-24Tg/yr are from reactions with NOx (doi:10.5194/acp-10-11261-2010). It seems that not enough attention is given to the importance of methane versus reactive nitrogen. There is a fair amount of detail on the complexity of the latter, very little on the former.	15. Interactions of Climate Change and Biogeochemical Cycles		529	1	We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information to include.
Margaret	Walsh	Doublecheck Midwest GDP-- cited as $26 trillion, but perhaps should be $2.6 trillion. U.S. GDP is only $15 trillion	18. Midwest		618	2	The text has been revised to incorporate this suggestion.
Margaret	Walsh	p. 662 line 17- It would be more interesting and useful to see where North Dakota ranks relative to the US rather than where it ranks relative to the Great Plains.	19. Great Plains		662	17	While the comment suggests a good specific example, the authors feel the existing examples are appropriate and adequate. We chose to keep the discussion limited to the Great Plains in order to highlight within-region variations.
Margaret	Walsh	p. 664 line 19- Shifting from irrigated to dryland agriculture in the Southern Plains has the potential to reduce crop yields by a factor of two, but this overstates the likely impact on agriculture. Farmers will adopt water-saving management practices and change their crop mix in response to higher et requirements and increased irrigation costs, such as irrigation scheduling, more efficient irrigation systems, and deficit irrigation.	19. Great Plains		664	19	The text has been revised to incorporate this suggestion.
Margaret	Walsh	References throughout the chapter to the emissions scenarios "used in this assessment" are confusing because the scenarios don't actually appear to be used in the chapter (or in the other parts of the	27. Mitigatio				We have added a reference to Ch. 2 in Key findings and first appearance in

		document we reviewed) for any new analysis. Suggest changing the wording to "described in this assessment" and including a reference to Chapter 2 so that reader doesn't expect an analysis that doesn't materialize.	n				the text.
Margaret	Walsh	Has work been done to address feedbacks and unintended consequences of efforts to reduce energy use, etc.? How effective are efforts to reduce GHG emissions and increase C sequestration rate given a global 1 degree rise in ocean temperature? Ocean-atmosphere exchanges of mass and energy are dominant drivers of weather and climate and given the recorded 1 degree rise of ocean temperature, the question how effective mitigation efforts will be arises.	27. Mitigation		955		In this chapter, we have not considered the complicated issue of the ultimate environmental impacts of mitigation activities.
Margaret	Walsh	The inclusion of the qualifier "close to" seems out of place and subjective. Unless a definition for what "close to" means is included, suggest deleting and just leaving the sentence as "...these efforts... are not sufficient to reduce total U.S. emissions..."	27. Mitigation		956	1	Though somewhat imprecise, our intent is to emphasize how far we are from the B1 emissions trajectory.
Margaret	Walsh	Perhaps further elaborate to explain that a reduction of solar radiation may also negatively impact sectors such as agriculture and forestry (this comment is also relevant to the geoengineering box.)	27. Mitigation		956	11	We don't have the space to discuss all possible second-order effects of geoengineering strategies.
Margaret	Walsh	It seems bad form to include a figure (27.2) with projections that are then "corrected" in the text: "These trends are expected to continue in the future, though more recent projections show a slower rate of emissions growth than the figure implies."	27. Mitigation		960	7	Thanks. The figure on drivers of U.S. fossil emissions has been replaced with a more recent analysis, and the now figure does not contain a projection, removing the inconsistency.
Margaret	Walsh	"In addition, most of the other federal agencies... have programs related to greenhouse gas mitigation." The chapter would be a more useful reference if it included an inventory, or simple table, of those federal programs.	27. Mitigation		963	6	We've summarized the existence of these programs, and have been clear that this is only a sample. A full listing of all the many, many programs in the Federal Government is precluded by the space available.
Margaret	Walsh	Perhaps include consumer demand for energy efficiency, energy audits, etc. as a voluntary action? It is later mentioned as a driver, but isn't included in this section.	27. Mitigation		963	24	We strive be clear about the difference between organized, although voluntary, measures and market behavior of consumers. We are illustrating the former as a means to encourage the latter.
Margaret	Walsh	Suggest education and communication of what exactly climate change is and how it affects individuals is a barrier to adaptation. Most citizens only connect extreme weather effects with climate change, and fail to see other environmental effects or signs.	28. Adaptation		983		Language was added to the first bullet in the Climate Change Information section in Table 28.7.
Margaret	Walsh	Would be useful to expand the discussion to emphasize the need for spatially downscaled climate forecasts, plus the need to report forecasts for finer temporal resolution as well, in order to effectively analyze climate change impacts on agriculture, forestry and unmanaged ecosystems.	29. Research Agenda for Climate Change Science		1037	1	This is mentioned in the scenarios section and in climate science (briefly).
Margaret	Walsh	Make clear that the topic involves the role of various processes in determining the impact of changes in precipitation on water supply availability. A broader objective might read: More specific regional information about the role of surface runoff, soil moisture, groundwater recharge, and	29. Research Agenda		1037	17	We have expanded elements relating to water in several research goals including RG1 and RG2.

		evapotranspiration in water supply availability, and how these hydrologic processes may be affected by projected changes in climatic and atmospheric [parameters][conditions].	for Climate Change Science				
Margaret	Walsh	The subject of this chapter appears to be broader than simply a "research agenda" as it involves suggestions related to investments in research, data, decision-making tools, and institution building. Rather than force all the wording into a research framework, it might be more powerful to allow the chapter and chapter title to reflect that broader scope.	29. Research Agenda for Climate Change Science				The chapter is now focused on research for assessments with new title.
Margaret	Walsh	Relevant to both Chapter 6 (Agriculture) and Chapter 9 (Human Health), an important research need will be to understand how climate will shape conditions that 1) promote expansion of critical diseases and pests relevant to human and agricultural health and 2) promote the spread of critical global pathogens and pests should they be introduced into the U.S. This would be analagous to the high priority research need of "Better long-term and regional scale projections of sea level changes" proposed in this chapter.	29. Research Agenda for Climate Change Science				Public Health is now mentioned 14 times in chapter and specifically in impacts research goal.
Margaret	Walsh	Covers broad topics well. However, offers little insight or guidance useful for development of implementation strategies. How is vulnerability defined for this section?	29. Research Agenda for Climate Change Science				Vulnerability is now described in the Impacts research goal (RG2) using the IPCC definition. We have added an introduction which highlights the assessment focus of the chapter. The adaptation and mitigation sections (RG3 and 4) do lead to insights about options.
Margaret	Walsh	Given this chapter's position in the document, readers are likely to expect more of an "action plan" and less of a review of the benefits of a sustained assessment process. Given that the decision has already been made to develop a sustained assessment process, reviewing the benefits of sustained assessments seems a bit superfluous, and the chapter would benefit from more specifics about exactly how this sustained assessment is going to unfold and what it will look like. The few specifics that are offerred are not well explained (i.e. is the Global Change Information Systems something that is being proposed as a foundation for the sustained assessment, or is it a pre-existing effort that is just being referenced?). Suggest at the least swapping chapters 30 and 29, which reads much more like an action plan, to end the document on a stronger, action-oriented note.	30. The NCA Long-term Process: Vision and Future Development				Disagree. The purpose of the chapter was to present a vision for a sustained assessment process and not to be a prescriptive action plan. The NCADAC will be separately providing its recommendations to the government for a sustained assessment action plan via its Special Report on Sustained Assessments. Moreover, since the sustained assessment chapter is visionary, it is appropriate to conclude the report with this chapter versus switching chapters 29 and 30. No changes were made to the chapter in response to this comment.
Margaret	Walsh	A description of procedures for how NCA can deal with "unscientific", often annecdotal information from stakeholders, etc. that provides considerable insight to effects and adaptation analysis? Much of this "data" does not lend itself to rigorous scientific analysis.	30. The NCA Long-term Process:				To address the comment the following text was added at the end of the first paragraph under Data Collection, Access, and Analysis (original line 42 on page 1049): "In addition, for certain

			Vision and Future Development				assessment-related purposes, use of traditional knowledge may be appropriate and require different analytical approaches."
Melisa	Ongun	The term "recent past" seems too general. I think giving a more specific time frame leaves less room for ambiguity and inaccurate assumptions by readers who are looking at the document through different theoretical lenses. Even though this is a general summary portion of the main points that will be covered, I think it will only strengthen these points if they can be as specific as possible.	6. Agriculture		227	16	We have replaced recent with 40 years.
Melisa	Ongun	I really like the inclusion of the specific example on this page of the eight specific crops in California. Much of the portion leading up to this is very general, but then all of the observations mentioned prior to this example are directly demonstrated by the graphs depicting all eight crops in decline. Furthermore, the graphs are easy to understand and interpret, so the information does not get lost in an unnecessarily complex graph. Simple and clear information will be the most effective in generating a compelling report.	6. Agriculture		232		We appreciate the comment because this was the intent of this graphic.
Melisa	Ongun	Pollination is obviously a very important stage in crop production and one that is very delicately balanced and consequently can largely be affected by climate change. This is the perfect place to mention it and is something that is often overlooked in explaining crop yields. Although temperature heavily affects pollination, I think it might be appropriate to mention the role that bees and other pollinating insects play in the success and failure of pollination. Also, the chapter can mention the effect that climate change has on bee/insect populations and how that, in turn, affects pollination and crop yields. I am not sure if this will be too much information to add or if it should go in another chapter, but I feel it would work in this section because it is something that directly affects agriculture and is another reason that can explain the lack of ability for plants to be pollinated as temperature rises and climate changes.	6. Agriculture		233		We agree that pollinators are important to the pollination process; however, this discussion is on the direct impacts of climate stress on plants, thus the text is unchanged.
Terri L	Turner	If only one conclusion can be drawn from the comprehensive 1,146 page draft report – the work of 60 notable scientists, business leaders and other experts – it is that the effects of climate change are a "here and now thing" and not an issue we will have to face in the distant future – it is already upon us – affecting pretty much every aspect of our life here on Earth. The current draft report is far more to-the-point in its boldness and confidence over the 2000 and 2008 reports (there wasn't a report issued during the George W Bush administration). Both of those reports pretty much largely failed to reach the audience they intended to reach; mostly because of the huge propaganda and litigation push made after their release and, at times, even censorship within the administration at that time (and the lack of a report at all in 2004 screamed of "suppression" to many during the Bush years). The scientific evidence within the current report clearly and articulately makes the point of the realities we are currently dealing with in the realm of climatic disruption – the disruption caused by hotter temperatures (2 to 4 degrees Fahrenheit over coming decades and potentially up to 5 to 10 degrees after 2050 under current emissions!), wide-spread drought, rising seas (that could total up to another 6 feet), acidic oceans, intense rain events, increased devastation from wildfire events, melting glaciers and sea ice, decreased air quality, and worsening storms, to not only "just the environment" (our life-sustaining ecosystems), but to our human health, water supply, agricultural needs, infrastructure, energy, and transportation (just a few of the over 100 aspects mentioned within the report) – aspects of the American "way of life" that are being "tested" and often compromised by the day.					Thank you for your comment. We hope you find the report useful. Policy issues are beyond the defined scope of the National Climate Assessment, a scientific document that provides the basis for decision making, but does not address policy.

		The report finds that "Several populations — including children, the elderly, the sick, the poor, tribes and other indigenous people — are especially vulnerable to one or more aspects of climate change". "We have met the enemy and he is us", decries Walt Kelly's cartoon character Pogo; - once this was an observance of the desecration of the landscape after an Earth Day event; now, it is more aptly a guilty verdict of our nation's people on our own impact on our world. The National Climate Assessment is as powerful as it is threatening because there is no more refuting the scientific evidence. With the regional scenarios presented in bold and living color, and, after witnessing many of these devastating events with their very own eyes, our nation's people may just start "caring" about what is happening in their own backyard! While it falls short of making policy recommendations, the report is intended to help our nation's leaders, state and local regulators, city and county planners, and even the public at large on the course of action that must be taken, both now and for future generations, to cope with current outcomes and coming changes – the threats to our natural resources, to our economy and to our very way of life! "Environmentalists and their legislative backers hope the forecast will prompt the White House to move" and not just have a "conversation across the country" as President Obama pledged to do shortly after his reelection. The President has said that dealing with climate change is on his second term agenda. But the President is not the only one that needs to "move" on this subject. This must be an important priority for Congress, as well. For some, there is no evidence that they are listening to the evidence being laid out before them, but I, personally, am not inclined to wait on whether or not they will take any action. In short, our destiny is in our own hands. "[S]ome amount of additional climate change and related impacts is now unavoidable," the report authors wrote. "However, beyond the next few decades, the amount of climate change will still largely be determined by choices society makes about emissions." We can and should start making the hard choices about emissions and we must explore "the flexible solutions that drive investment in clean energy and protecting public health". Additionally, we must continue to explore and build on "the success stories of states like California with their Global Warming Solutions Act and the pioneering spirit of the Regional Greenhouse Gas Initiative found in nine Northeast and Mid-Atlantic states – not only did it cut pollution in the area from 25-30%, but it added $1.6 million to the regional economy for investment in energy efficiency and renewable energy AND create more than 16,000 jobs!" It's a collaborative effort – together, we and our political leaders, must immediately take the steps necessary to protect ourselves from "searing heat, surging seas and terrifying storms" by deep and meaningful cuts in greenhouse gas emissions. Obviously, the Clean Air Act is an impressive weapon in our arsenal for fighting the enemy – that is, if we use it to push back against the fossil fuel industry and it proponents in Congress – to make significant reductions in greenhouse gas pollution and, in turn, curb the effects of "runaway global climate change". The other powerful weapon is us – the American public – our voices, our choices, and our vote. It bears repeating that some amount of additional climate change and its associated impacts are now					

		unavoidable, according to the report. However, beyond the next few decades, when your children's children will need a healthy planet to live on, climate change will still largely be determined by the choices we make today. Our response strategy should be clear and decisive and our response timing should be quick and powerful. Climate change is real and the well proven fact that it is accelerating at an alarming pace must lend itself to the entire nation working toward "developing and refining approaches that enable decision-making and increase flexibility, robustness and resilience in the face of ongoing and future climate impacts". Until we "get it right" as a nation, "fighting climate change should be the very first thing on everyone's mind in the morning and the very last thought before we fall asleep in our beds at night."					
Thomas	Knutson	The sentence beginning "The intensity of the strongest hurricanes is projecte to continue to increase..." is misleading and incomplete in its current form.I suggest replacing it with the following two sentences: "However, it remains uncertain whether any observed hurricane changes exceed the levels expected from natural causes alone. The intensity of the strongest hurricanes is projected to increase as the oceans continue to warm; ocean cycles may delay the detection of an anthropogenic climate change contribution for a number of decades."With these changes, you can delete "the numbers of hurricanes and" from line 27.	2. Our Changing Climate		26	22	Thank you for your comment. We have clarified this in the Key Message by stating the uncertainty in the natural vs. human-caused contributions to the observed changes.
Thomas	Knutson	The sentence beginning "The intensity of the strongest hurricanes is projected to continue to increase..." is misleading and incomplete in its current form.I suggest replacing it with the following two sentences: "However, it remains uncertain whether any observed hurricane changes exceed the levels expected from natural causes alone. The intensity of the strongest hurricanes is projected to increase as the oceans continue to warm; ocean cycles may delay the detection of an anthropogenic climate change contribution for a number of decades."With these changes, you can delete "the numbers of hurricanes and" from line 8.	2. Our Changing Climate		59	4	We have clarified this by stating the uncertainty in the natural vs anthropogenic contributions to the observed changes.

Thomas	Knutson	Delete "further" here.	2. Our Changing Climate		59	34	The text has been revised to incorporate this suggestion.
Laura	Bailey	Climate Change Remediation John and Laura Bailey of Royal Wind have designed and patented an ocean temperature regulatory system using our turbines to power cold water pumps. Our system is designed to pump large amounts of cold water to the surface of the ocean to create cold water thermoclines. We believe that widespread use of our system worldwide would result in a much desired global temperature regulation and reduction. The health of our oceans and the increased carbon sequestration are linked to global sustainability. We feel that without intervention the oceans are in danger of collapse. The health of our oceans is crucial to the maintenance of oxygen levels in the atmosphere. If the oceans die, we will struggle to survive. It's all connected: ocean health, carbon sequestration, and global temperatures. We will install our ocean current powered cold water pumps in strategic locations worldwide, creating cold water thermoclines, increasing the sequestration of carbon dioxide. Our system will also be used to build the polar icecap back to a more acceptable year-round base level, which will also ensure the continued function of the thermohaline and of the North Atlantic drift. Year-round ice will eliminate the danger of methane from being released from hydrates and thawing permafrost. Our system will also be used to create cold water barriers to hurricanes.	1. Executive Summary				Thank you for this information; this assessment report does not include geoengineering as a topic.
Thomas	Knutson	insert after "gases." the following: "Due to strong multi-decadal varaibility in the Atlantic basin, future projected increases of intense hurricane frequency may be difficult to detect and attribute to anthropogenic forcing--at least for a number of decades (Bender et al. 2010)."	2. Our Changing Climate		59	36	We have shored up the text to better reflect the uncertainties in the causes of regional decadal variability, but we feel that a discussion of emergence time-scales is somewhat beyond the scope of this short section. Other parts of the chapter (e.g., supporting text for KM 1; also see Key Message 3 of the Appendix) address natural variability over interannual-to-multidecadal timescales in a broader context, and a discussion of natural variability in the Hurricane context would make many of the same points that are made in these other sections. Given our length constraints, we opt to avoid the repetition here.
Thomas	Knutson	This figure, as we originally developed it, also has dots in addition to the bars. The dots show the projected changes for four individual models (in addition to the ensemble results shown by the bars). This information gives some sense of the robustness of the projection. In fact, one of the individual models shows a negative projected change. This information is important context for the figure/projection. Although it was not available for the development of this chapter, we now have a paper in press at J. Climate which shows somewhat smaller projected increases of Cat 4-5 hurricane frequency for the late 21st century if one uses the CMIP5 model projections instead of the CMIP3. We can provide an updated figure if you would like to use it in the report, although it may be too late to bring in such recently accepted material.	2. Our Changing Climate	2.24	62		The dots that were removed (showing results for some individual models to complement the multi-model ensemble) illustrate the robustness (or roughly the uncertainty) in the projections. While not formal confidence intervals, they serve a similar role. To not provide readers with the context of the robustness of the results (such as an indication of

							the dependence of the result on what model is downscaled) is dumbing things down too much. We need more illustrations of confidence intervals and the like, not less. We will add the dots back in.
Laura	Bailey	We patented A Mechanically Produced Thermocline Based Ocean Temperature Regulatory System is comprised of an ocean current powered mechanical pump to pump water from the mesopelagic or epipelagic zone to the surface, a feed tube that attaches to and runs from the bottom of the mechanical pump down to a depth where the salinity and temperature difference is sufficient to sustain a cold water thermocline on the surface, and a floating separation barrier to eliminate the mixing of surface water and the water pumped from the mesopelagic or epipelagic zone. It is powered by turbines which are powered by ocean currents. This system promotes the growth of phytoplankton, increasing sequestration of CO2 in solution. A Mechanically Produced Thermocline Based Ocean Temperature Regulatory System where the cold water thermocline directly controls the solubility of carbonic acid into solution, reducing acidity. A Mechanically Produced Thermocline to inhibit the dissolution of coral by reducing the level of carbonic acid in solution. A Mechanically Produced Thermocline where multiple systems, placed in strategic groupings, will create a cold water thermocline which will act as a barrier to hurricanes and tropical storms eliminating hurricanes and tropical storms in the area above the thermocline. A Mechanically Produced Thermocline Based Ocean Temperature Regulatory System as described in claim 1 where the cold water thermocline will increase the growth of algae. A Mechanically Produced Thermocline which, when placed in the Arctic, would create high saline sea ice used to ensure the function of the thermohaline circulation, as the cold water's higher salinity will insure the sink in the northern point of the Atlantic conveyor. A Mechanically Produced Thermocline where increased growth of phytoplankton increases available oxygen and food for increased zooplankton growth. A Mechanically Produced Thermocline where an increase in the growth of phytoplankton for zooplankton to consume allows for greater conversion of carbohydrates into calcium carbonates and calcium bicarbonates which are then sequestered into the depths of the ocean for, potentially, thousands of years. A Mechanically Produced Thermocline which during the Arctic summer would increase the amount of high saline cold water flowing off of the cold water thermocline which is in the form of ice; the increase in flow of high salinity cold water would ensure the function of the thermohaline by ensuring the sink in the northern point of the Atlantic Conveyor.	27. Mitigation				Methods of enhancing ocean CO2 uptake are mentioned in the chapter, but space limitations prevent discussion of details.
Thomas	Knutson	Key message #8/11 section:The sentence beginning "The intensity of the strongest hurricanes is projecte to continue to increase..." is	2. Our Changing Climate		84	2	We have clarified this by stating the uncertainty in the natural vs anthropogenic contributions to the

		misleading and incomplete in its current form.I suggest replacing it with the following two sentences: "However, it remains uncertain whether any observed hurricane changes exceed the levels expected from natural causes alone. The intensity of the strongest hurricanes is projected to increase as the oceans continue to warm; ocean cycles may delay the detection of an anthropogenic climate change contribution for a number of decades."With these changes, you can delete "the numbers of hurricanes and" from the last sentence of the paragraph.					observed changes: “There has been an increase in the average intensity and in the number of strong (Category 4 and 5) hurricanes in the North Atlantic since the early 1980s, but the relative contributions of human and natural causes for these increases is still uncertain. Average storm intensity and rainfall rates are projected to continue to increase as the climate warms. Observed and projected changes in storm tracks suggest that landfall locations may shift.”
Laura	Bailey	We patented a Mechanically Produced Thermocline Based Ocean Temperature Regulatory System when placed in the Arctic, would create high saline sea ice used to ensure the function of the thermohaline circulation, as the cold water's higher salinity will insure the sink in the northern point of the Atlantic conveyor. Arctic oil production could be explored by creating Ice that would sink to the bottom of the Sea allowing rigs to be driven out on the Ice. Oil production in the Gulf of Mexico would be protected by multiple systems, placed in strategic groupings, which will create a cold water thermocline which will act as a barrier to hurricanes and tropical storms eliminating hurricanes and tropical storms in the area above the thermocline	4. Energy Supply and Use				Due to page length limitations in the National Climate Assessment, it is not possible to include discussion of advantages and disadvantages of non-commercial technologies.
Laura	Bailey	The Mechanically Produced Thermocline Based Ocean Temperature Regulatory System is a system and a process to pump cold water from a depth sufficient enough to produce a thermocline on the surface of the ocean. The difference in temperature and salinity between the surface water and the water pumped up from the deep keeps the two from mixing. The temperature and salinity differences between the water from a depth of 2000 to 3000 ft and the water on the surface in most tropical and subtropical seas is sufficient to create a thermocline. The system to create the thermocline consists of a floating pump surrounded by a separation barrier, with a feed tube attached to the bottom of the pump. The pump in the system that we have designed is powered by ocean currents, but the concept is not limited to the use of our pump. The pump we have designed is a floating vessel with turbines set into each of its two sides. The turbines are directly geared to an impeller. The impeller pumps water from the top of the column of water in the feed tube. The feed tube is open at the bottom. The water that is replacing the water that is being pumped is coming up from depths up to 2000-3000 ft. The water that is pumped off of the top of the column of water overflows the pump and is caught by the separation barrier. The feed tube is a flexible membrane that is seamed into the shape of a tube which is open on each end. The feed tube is suspended from the bottom of the pump and hangs down into the deep water. The feed tube is kept open with rings which are attached to the inside of the tube at regular intervals. The tube is kept in a vertical position by lines which are attached to the bottom of the pump, hang down the length of the tube, inside the tube, and are attached to a weighted ring, which is attached to the bottom of the feed tube. The separation barrier is a flexible membrane attached to the perimeter of the pump, above the level of the turbines. The separation barrier extends out to an inflated ring, to which it is attached. The separation barrier catches the water that is pumped up. The separation barrier prevents mixing of the pumped up water and the water below it. The barrier allows	2. Our Changing Climate				This comment discusses a system for regulating the thermocline, but has no effect on the climate science discussion in Chapter 2.

		the water to flow out smoothly over the surface of the water as the pumped up water overflows the inflated ring. The thermocline is beneficial in many ways. The mass of cold water promotes phytoplankton growth, increasing food available for fish. The increased growth of phytoplankton sequesters CO2 which can then be consumed by zooplankton in the form of carbohydrates. The zooplankton sequesters the carbohydrates into calcium carbonates and calcium bicarbonates. The calcium carbonates and bicarbonates sink and are sequestered into the depths of the ocean, potentially for thousands of years. A larger scale thermocline can be created by the use of multiple pumps in strategic groupings. These large-scale created thermoclines can be positioned to work as a cold water barrier to hurricanes and tropical storms.					
Thomas	Knutson	The sentence "Much of the climate change of the past 50 years is primarily due to human activities." seems overly broad as well as being too vague. There are many examples of climate change (do mean trends? does this include multidecadal variations?) during the past 50 years that have not been linked primarily to human activities. Multidecadal variations in hurricane activity and the Sahel drought are examples.You could either continue to be vague and replace "Much" with "Some", or you could go with a more specific treatment such as: "Most of the global mean warming of the past 50 years is very likely due to anthropogenic emissions of greenhouse gases."	2. Our Changing Climate		25	28	The Key Message has been revised.
Colleen	Reid	While Hurricane Katrina is a great example of the health impacts of an extreme event, there are plenty of other examples of environmental justice concerns. It could be because of Figure 9.13 and then this sentence, that it will seem that Hurricane Katrina is the only example of injustices. With only one example, people may discredit the example as the only one. Another source of information on environmental justice and climate change are the Climate Gap reports. http://dornsife.usc.edu/pere/documents/The_Climate_Gap_Full_Report_FINAL.pdf	9. Human Health		352	16	Chapter space limitations prevent us from citing additional examples.
Colleen	Reid	The point needs to be made more clearly that we need to act now. That is implied by these statements, but needs to be said explicitly. Here is an idea: “Early action provides the largest health benefits and reduces health costs in the future. Public health impacts are already being felt and public health departments can do much now to ready themselves for further effects in the future. If we wait, and the impacts increase, we will have much less ability to adapt.”	9. Human Health		353	2	While the health sector agrees with the suggested change, there is (of course) no evidence that action today will reduce health future costs. This is presumed to be true based on experience. Further, there is limited detection and attribution studies in the health sector.
Colleen	Reid	I really like these paragraphs. They get at the urgency of action.	9. Human Health		354	1	We greatly appreciate your positive comment.
Colleen	Reid	This paragraph is very vague about what these public health programs are that already address climate-sensitive health issues. This is not helpful for the public, for public health departments, or for policy-makers. Please state clearly which programs are already doing what is needed so that they can be implemented everywhere.	9. Human Health		354	16	A sentence was added that America's Climate Choices: Adapting to the Impacts of Climate Choices (Table 3.5) provides examples of health adaptation options.
Colleen	Reid	The way this sentence is worded makes it something to shrug off, but the impacts of air pollution on health are one of the most economically detrimental environmental health exposures in the US. Reducing air pollution by way of reducing climate acting pollutants is one clear way to have cobenefits with climate mitigation and where there could a political way forward on mitigation. Please reword this sentence.	9. Human Health		354	36	Thank you for these suggestions, but policy issues are beyond the defined scope of the National Climate Assessment, a scientific document that provides the basis for decision making but does not address policy.

Colleen	Reid	There is also evidence of health impacts of reducing short-lived climate acting pollutants. See (Smith et al. 2010). Smith KR, Jerrett M, Anderson HR, Burnett RT, Stone V, Derwent R, et al. 2010. Public health benefits of strategies to reduce greenhouse-gas emissions: Health implications of short-lived greenhouse pollutants. The Lancet 374:2091-2103.	9. Human Health		355	19	The text has been revised to incorporate this citation.
Colleen	Reid	This sentence seems like an afterthought. I would consider putting it into the paragraph on red meat consumption.	9. Human Health		355	33	The text has been revised to incorporate this suggestion. Authors concur since mitigating climate change may not affect food security until at least 2050 and probably longer than that.
Colleen	Reid	The word health is only mentioned five times in this section, and two times are not related to public health but rather to ecosystem health and wetlands health. The other three times are all under the same heading of Research Goal 4 on observations of changes in the climate and its impacts. However, public health should be listed under other research goal such as Research Goal 2 on development of adaptation plans. Public health should also be part of Research Goal 3 which deals with mitigation because efforts should be made to address the public health co-benefits and co-harms of different mitigation strategies. Research goal 5 on enabling researchers to address challenges of climate change and its consequences should address the needs of public health leaders. Research goal 6 should recognize that most schools of public health don't have courses on climate change and health and it is not required in the public health curriculum. This should be changed.	29. Research Agenda for Climate Change Science				Public Health is now mentioned 14 times in chapter and specifically in impacts research goal.
Colleen	Reid	Public health should be listed under other research goals such as Research Goal 2 on development of adaptation plans. This Research Goal is vague in terms of all sectors for adaptation. To be clear to policymakers, the specific sectors should be listed such as public health, transportation, infrastructure, ecosystems, water quality, air quality, national parks, etc. It may be helpful to delineate which state and local government agencies should be involved in adaptation.	29. Research Agenda for Climate Change Science		1037	21	Public Health is now mentioned 14 times in chapter and specifically in impacts research goal. We have not mentioned any other sector specifically under adaptation but there is a whole chapter on health in NCA, and the adaptation chapter has lists of state and local entities engaged in adaptation.
Colleen	Reid	This research goal implies but not address research on mitigation actions. It discusses ways to lessen climate change, but notably, the word mitigation is missing. One important research area on mitigation is on the short-lived climate acting pollutants. Some of these have important public health implications, thus lessening the emissions of these pollutants (i.e. precursors of ozone (NO_2, CH_4), and black carbon) can have significant public health benefits as well and the action both on health and the climate is much more immediate than any mitigation of CO_2. This should be put into this research agenda because there needs to be more research into how to decrease black carbon emissions without also decreasing organic carbon (which is cooling). Also, more evidence on the public health impacts of any policies on short-lived climate acting pollutants can be important for cost-benefit analyses of such policies.	29. Research Agenda for Climate Change Science		1038	24	Mitigation is now mentioned including plans for managing black carbon and short lived forcing agents generally.
Emma	Suddick	The point is well made on page 117, lines 3-15, that climate change will affect hydrologic flows, which in turn affect nutrient processing and export. This point was made thoroughly in our chapter/paper by Baron et al. 2012, which serves as a more up-to-date and synthetic reference than many of those cited in this paragraph.Baron, J.S., E.K. Hall, B.T. Nolan, J.C. Finlay, E.S. Bernhardt, J.A. Harrison, F. Chan, E.W. Boyer (2012) The Interactive Effects of Human-Derived Nitrogen Loading and Climate Change on Aquatic Ecosystems of the United States. Biogeochemistry. DOI 10.1007/s10533-012-9788-y	3. Water Resources		117	3	The Baron reference has been added and discussed. Key Message 6 and associated text was also revised to reflect the reviewer comment.
Emma	Suddick	Nitrogen is mentioned only once (page 237) in this chapter. Given the strong interactions between	6.				This comment relates to greenhouse

		climate and fertilizer and manure management, including the challenges of maintaining or increasing productivity and minimizing pollution and greenhouse gas emissions, this is surprising. Our chapter/paper by Robertson et al. on climate-nitrogen interactions in agriculture is cited frequently in Chapter 18 on the Midwest, but curiously is absent in Chapter 6.Robertson, G.P., T.W. Bruulsema, R. Gehl, D. Kanter, D. Mauzerall, A. Rotz, C. Williams (2012). Climate-nitrogen interactions in agriculture. Biogeochemistry. DOI 10.1007/s10533-012-9802-4	Agriculture				gas emissions from agriculture - a part of global emissions - which are referenced in Chapter 2: Our Changing Climate.
Emma	Suddick	This chapter does not mention nitrogen. As described by Porter et al., 2012 the effects of nitrogen deposition and climate change are likely to be synergistic stressors that reduce biodiversity in many ecosystems.Porter, E., W.D. Bowman, C.M. Clark, J.E. Compton, L.H. Pardo, J. Soong (2012). Nitrogen, climate and biodiversity. Biogeochemistry. DOI 10.1007/s10533-012-9803-3Although Key message 2 in Chapter 8 is "Climate change combined with other stressors is overwhelming the capacity of ecosystems to buffer the impacts from extreme events like fires, floods, and storms," there are few references in the chapter to these other stressors, including nitrogen. In addition to climate change, a key driver of biodiversity loss is the increase in reactive nitrogen resulting from anthropogenic activities. Porter et al. 2012 discuss interactions of nitrogen and climate change on biodiversity. We suggest adding a section to Chapter 8 to discuss "other stressors" including nitrogen and adding some examples from Porter et al. 2012, e.g.: 1. In arid areas of the Southern California, changes in precipitation coupled with increased nitrogen deposition from the Los Angeles Basin has promoted the growth of invasive Mediterranean grasses, creating a nearly continuous fuel layer in arid shrublands (Brooks and Minnich 2006; Rao et al. 2010). Fire frequency has increased, as has fire occurrence in areas previously unburned and unadapted to fire (Rao et al. 2010). Native shrubs may not be able to re-establish in these areas, as invasive grasses change the hydrology of the area, removing rainwater from the top layers of the soil thereby preventing its percolation into the root zone of young shrubs (Wood et al. 2006). 2. In an experiment in annual Mediterranean grassland in California, where N, temperature, precipitation, and CO2 were altered, the effects of these factors were additive, and the total effect led to a large loss of plant species, especially forbs (Zavaleta et al. 2003c). 3. Combined nitrogen and temperature treatments at Toolik Lake Arctic LTER reduced species richness 30-50% in tundra ecosystems (Chapin et al. 1995).4. In the section, you could also add something about excess nitrogen impacts on ecosystem services, i.e., nitrogen has caused significant loss and degradation of ecosystem services (Compton et al. 2011). Compton JE, Harrison JA, Dennis RL, Greaver TL, Hill BH, Jordan SJ, Walker H, Campbell HV (2011) Ecosystem services altered by human changes in the nitrogen cycle: a new perspective for US decision making. Ecol Lett 14(8):804–815 Porter et al. 2012 point out that reducing nitrogen deposition is likely to be an effective strategy for mitigating climate change impacts on biodiversity in many ecosystems.	8. Ecosystems, Biodiversity, and Ecosystem Services				No change. It is too late, and there is no space to add a new section to the chapter. Perhaps this can be highlighted in the next assessment.
Emma	Suddick	While this chapter does refer to temperature sensitivity of ozone production, the only mention of NOx is with regard to wildfire (page 339). As described by Peel et al. (2012) in our report, understanding the interactions of NOx emissions and climate are essential for understanding human health impacts of the regulated air pollutant, ozone, NO2, and PM. Wildfire is one of the sources of NOx and PM discussed by Peel et al., (2012) but soil, transportation, and industrial source are generally more important. Moreover, the "climate penalty" that requires greater NOx emission reduction in order to achieve the ozone abatement in a warmer world is a critical missing point.Peel, J., R. Haeuber, V. Garcia, L. Neas, A.G. Russell (2012). Implications of nitrogen-climate interactions for ambient air pollution and human health. Biogeochemistry. DOI 10.1007/s10533-012-9782-4	9. Human Health				Thank you for your comment. The text has been revised to incorporate this citation, as well as a Fiore et al. (2012) citation. We appreciate the suggestion to discuss the climate penalty, but space is limited.
Emma	Suddick	Chapter 15 (Biogeochemistry) of the NCA cites extensively the technical report on climate-nitrogen interactions submitted by Suddick and Davidson (editors) and colleagues. Aside from a few minor	15. Interacti				Thank you for your comment, however policy issues are beyond the defined

		corrections that we offer below and some missed opportunities to highlight more examples of the importance of links between biogeochemistry and climate change, it generally presents a sound case for understanding such links.Opportunities for strengthening links:Interactions between climate and biogeochemical cycles are manifest in numerous issues regarding climate mitigation, adaptation, and impacts. Here are a few examples that could be added to chapter 15:Mitigation: Although it is true that CO2 is the dominant greenhouse gas, N2O may be the most difficult to stabilize in the atmosphere because it is inextricably connected to growing food. That said, there are many opportunities to partially and significantly mitigate N2O emissions, with many co-benefits of reducing water and air pollution. Indeed, climate change mitigation could be the "co-benefit" of generally reducing the many forms of nitrogen pollution in air and water, for which there is considerable political and social support. This argument is clearly articulated in the chapters/papers by Robertson et al. and Houlton et al. Adaptation: Proper nutrient management will enhance the resiliency of crops to climate stress (Robertson et al.).Impacts: • Extreme and unpredictable weather events will make more difficult the task of matching nutrient applications with crop demands (Robertson et al.), resulting in greater losses of N to the environment. Extreme events such as droughts and large storm events, and timing/sequence of these events, may have important consequences for coastal N (and P) loading and losses of ammonia and N2O to the atmosphere. • Droughts and floods are also likely to result in greater hydrologic discharge of nitrogen through rivers to estuaries (Baron et al.), which affects water quality. • Higher average temperatures will likely result greater emissions of ammonia from animal production systems (Robertson et al.), which affects air quality. • Higher average temperatures will cause a "climate penalty" on ozone abatement, because NOx emissions must be decreased more to obtain the same ozone abatement when temperatures are higher. In addition, the season for ozone conditions that are harmful for crops and human health will likely become longer (Peel et al., Robertson et al.) • Climate change and nutrient enrichment are likely to have synergistic effects on biodiversity loss in many ecosystems (Porter et al.). • Some connection to the loss of ecosystem services, perhaps using the damage estimates from N provided by Compton et al. (2011), would be useful in framing the economic consequences of altered biogeochemical cycles. (Compton JE, Harrison JA, Dennis RL, et al. 2011. Ecosystem services altered by changes in reactive nitrogen: A new perspective for US decision making. Ecol Lett 14: 804-815).General comments for Chapter 151. The Key Messages could have a little more specificity. In particular, it is stated that there are "major consequences" for biogeochemical cycles and climate change, yet nowhere in the Key Messages are these articulated. For a decision maker, it would be best to know exactly what these consequences are rather than some nebulous mass of bad stuff (i.e., increased changes in climate, loss of terrestrial and aquatic biodiversity, reduced human health and longevity). In our opinion, these MUST be in the Key Messages.2. Consider adding regional effects as summarized (see Table) in Houlton et al. NCA chapter, as regional impacts are largely lacking from the report – yet they could strongly affect overall management and implication of coupled N x climate impacts and interactions. 3. Better use of graphics in several cases is needed. First, it seems that Figure 15.1 and 15.5 are too similar, and we should be more prudent with space. We would suggest moving 15.5 to where figure 15.1 is currently positioned, and adding the small amount of additional information in 15.1 as text. Second, we would have liked to see the relative contributions from N processes in 15.2 as	ons of Climate Change and Biogeochemical Cycles				scope of the National Climate Assessment, a scientific document that provides the basis for decision making, but does not address policy.

		opposed to all processes assumed equal (i.e., different arrow sizes representing processes of differing magnitude). This would be much more informative than the current laundry list. Suddick et al 2012 has such a figure in the Executive Summary. Furthermore, why do we have three figures on C-sinks and sources (15.1, 15.5, 15.6)? We suggest that we would rather see greater expansion on the effects of these changes rather than the changes themselves (see:#1 above – "why should we care?")					
Emma	Suddick	1. Page 519-520: Introduction: improvements to the text could make the material more accessible to policy makers, the media, and the public. The current draft reads as a useful primer to biogeochemical/climate interactions that would be accessible to the general scientific community, but also contains barriers for the non-scientist to interpret. In the least, I think the introduction would benefit from being expanded and written in a more general way to draw in a broader audience.	15. Interactions of Climate Change and Biogeochemical Cycles		519		After consideration of this point, we have made no changes as this report has to appeal to a broad spectrum from the general public to scientists.
Emma	Suddick	2. Page 519, line 19: It seems incorrect to lump sulfur, which has decreased so significantly, with these other pollutants that are still increasing	15. Interactions of Climate Change and Biogeochemical Cycles		519	19	Thank you for your comment; Key Message #1 has been revised to incorporate this suggestion.
Emma	Suddick	3. Page 519, line 21: p. 519 line 21: What fraction of fossil-fuel emissions does net uptake of CO2 in North America account for? The statistics are unclear and I think one number is missing.	15. Interactions of Climate Change and Biogeochemical Cycles		519	21	Thank you for your comment; Key Message #2 has been revised .
Emma	Suddick	Page 519, line 26-27 Style comment: the "on the one hand…on the other" seems a bit weirdly conversational.	15. Interactions of Climate Change and Biogeochemical Cycles		519	26	Thank you for your comment; Key Message #3 has been revised.
Emma	Suddick	Key message #3 is vague. It would not be difficult or add too much length to add specific topics of impacts, such as biodiversity, agricultural productivity, human health, and the other topics shown in Figure 15.2.	15. Interactions of Climate Change		519	25	Thank you; Key Message #3 has been revised.

			and Biogeochemical Cycles				
Melisa	Ongun	There may be a typo in the citation…it seems the name should read “Andersen” instead of “Andresen.”	6. Agriculture		235	32	The current spelling is correct.
Emma	Suddick	Style comment: We assume that this is written for a general audience. So, maybe precision is not exactly of the utmost importance, but it the way that it is written makes it sound like the fluxes go only in the directions mentioned (since it doesn’t say for example). There is nothing that makes it clear that it can be a loop	15. Interactions of Climate Change and Biogeochemical Cycles		519	30	Thank you for your comment; the text has been revised to read more clearly.
Emma	Suddick	Including a statement about the ease or capacity to regulate CO2 emissions versus N, P, and S compounds might add to the message here. Although regulating NOx and SOx emissions is in some ways easier (and has already begun with CAA) than CO¬2, implementing regulations tied to N2O, NH3, NO, etc. may prove more difficult due to the fundamental linkages to agricultural productivity.	15. Interactions of Climate Change and Biogeochemical Cycles		520	1	Thank you for your comment, however policy issues are beyond the defined scope of the National Climate Assessment, a scientific document that provides the basis for decision making, but does not address policy.
Emma	Suddick	Style comment: this is very weak “society’s capacity to cope with coupled changes…”	15. Interactions of Climate Change and Biogeochemical Cycles		520	3	Thank you for your comment; the text has been revised to reflect your suggestion.
Emma	Suddick	phrase 'reduce air pollution' is redundant in the context of the section.	15. Interactions of Climate Change and Biogeochemical Cycles		520	20	Thank you for your comment; the text has been revised in regards to this suggestion.
Emma	Suddick	It’s nice to have the 85% context for the globe, but to round out the context please also add the % globally.	15. Interactions of		520	28	Thank you for your comment; the text has been revised in regards to this suggestion.

			Climate Change and Biogeochemical Cycles				
Emma	Suddick	“disturbances” is too broad, explain that this is not some historical fire or hurricane we’re talking about, it’s from forest re-growth after human clearing for agriculture in the east.	15. Interactions of Climate Change and Biogeochemical Cycles		520	32	Thank you for your comment; the text has been revised in regards to this suggestion.
Emma	Suddick	“especially fertilization” is awkward.	15. Interactions of Climate Change and Biogeochemical Cycles		521	8	Thank you for your comment; the text has been revised in regards to this suggestion.
Emma	Suddick	In a recent publication, we suggest from best available data that human-caused N inputs are currently 8 times greater than current natural inputs (3 times as large as pre-European inputs): (Sobota DJ, Compton JE, Harrison JA. 2013. Reactive nitrogen inputs to US lands and waterways: how certain are we about sources and fluxes. Frontiers in Ecology and the Environment 11:82-90). Additionally, define what natural sources and human sources are.	15. Interactions of Climate Change and Biogeochemical Cycles		521	11	Thank you for your comment; the text has been revised in regards to this suggestion.
Emma	Suddick	explain how the N cycle affects the greenhouse gases	15. Interactions of Climate Change and Biogeochemical Cycles		522	14	Thank you for your comment; the text has been revised in regards to this suggestion.
Emma	Suddick	Two sentences seem a bit short for “P and other elements”; and, no other elements aside from P are mentioned. Later, S makes a surprise appearance. So, in this section, we would suggest: (a) adding 1-2 sentences more about P (nothing is present with respect to aquatic eutrophication), (b) adding 2-3 sentences EACH about S and Fe. Fe is especially noteworthy and missing.	15. Interactions of Climate		522	16	Thank you for your comment. The text has been revised, however, no mention of aquatic eutrophication has been added since it does not have a

			Change and Biogeochemical Cycles				large impact on greenhouse gases at the national level. NB that wetlands are shown in Figure 15.2. Nothing has been added about Fe, since its effect on the carbon cycle largely plays out in the ocean waters outside the borders of the US which is outside the scope of this report.
Emma	Suddick	how much does P fertilization actually contribute to C sinks? We are not fertilizing large areas of forests with P – how much evidence is there? Is there evidence that P fertilization in agriculture creates a substantial carbon sink? Additionally, Eutrophication of aquatic systems related to phosphorus enrichment can also indirectly affect climate change by facilitating the creation of anoxic habitats where N2O and CH4 are produced (Huttunen JT, Hammar T, Alm J, Silvola J, Martikainen J. 1999. Greenhous gases in non-oxygenated and artificially oxygenated eutrophied lakes during winter stratification. Journal of Environmental Quality 30:387-390).	15. Interactions of Climate Change and Biogeochemical Cycles		522	17	Thank you for your comment. The text has been revised, however, no mention of aquatic eutrophication has been added since it does not have a large impact on greenhouse gases at the national level. NB that wetlands are shown in Figure 15.2.In addition , we don't know of any explicit attempt to estimate this for the terrestrial biosphere. Page 464 of the latest edition of Biogeochemistry, points out that the N/P ratio of the industrial/mining of N and P to the global environment is about 14.3, whereas this ratio is about 31.3 in land plants. So N should be the primary limit.Biogeochemistry, 3rd Edition: An Analysis of Global Change Author : W Schlesinger Release Date: 14 Jan 2013 Imprint: Academic Press ISBN: 9780123858757
Emma	Suddick	This sentence is very awkward and needs tightening up (esp. "captures CO2 mass equivalent to only a fraction of fossil-fuel emissions"). It's correct, but it's a mouthful. Additionally, we suggest specifying what the fractions refer to and how much of the CO2 sink the terrestrial biosphere sequesters. What factors contribute to this uncertainty? 18. Page 523, line 6: Change "more CO2 is emitted than can be taken up" to "three times more CO2 is emitted than can be taken up".	15. Interactions of Climate Change and Biogeochemical Cycles		523	2	Thank you for your comment; edits have been made to improve clarity.
Emma	Suddick	and Page 524 line 17: These appear to present contradictory statements about the effects of ozone on the mean residence time of CH4 in the atmosphere. The Pinder et al. 2012 papers in Biogeochemistry and PNAS explain that the net effect is a modest cooling due to shorter lifetimes of CH4. NOx could be removed from this line and then this would give the sentence the correct meaning. Although we are not sure how the feedback of VOC emissions on methane lifetime is relevant in this chapter. I suggest only stating the NOx emissions decrease the CH4 lifetime.	15. Interactions of Climate Change and Biogeochemical		523	21	Thank you for your comment; the text has been edited in regards to your suggestions.

			Cycles				
Emma	Suddick	This would be a good place to emphasize that the climatic effects of ozone and PM are short-lived, whereas CO2 and N2O have much longer impacts.	15. Interactions of Climate Change and Biogeochemical Cycles		523	30	Thank you for your comment. Edits have been made in regards to this suggestion.
Melisa	Ongun	During the discussion of freezing times and the impacts that reduced freezing times or inconsistencies in prolonged periods of freezing time can have on fruit and nut production, would it be appropriate to discuss the economic implications that can have? When fruit yields are affected, whole state economies can suffer. Being in Michigan for the past five years, I felt personally at a loss when the apple crop was destroyed by the warming and freezing during the winter of 2012 and this significantly affected fruit prices in Michigan and I am sure it hurt many of the farmers. If something about the economic implications of reduced freezing times were inserted, it may have more of a compelling message since most politicians are concerned about the economy first and the environment second.	6. Agriculture		235		Thank you for your comment. We added the estimated value for economic loss in Michigan.
Emma	Suddick	(first row of table: New information and remaining uncertainties): I do not agree with the assessment that uncertainties associated with nutrient sources, particularly N, are well documented. We have just completed an assessment of N sources in the US from existing data (Sobota et al. 2013; cited previously), and find that N inputs associated with biological nitrogen fixation in both cultivated and non-cultivated ecosystems, are quite uncertain. Together, cultivated and non-cultivated biological nitrogen fixation is probably at least as large, and probably larger, than N inputs from synthetic N fertilizer (the largest national N source). N inputs from other sources such as rock weathering are also extremely uncertain.	15. Interactions of Climate Change and Biogeochemical Cycles		534	1	Thank you for your suggestion. Edits have been made in regards to this suggestion.
Emma	Suddick	When all direct and indirect links between reactive nitrogen and climate in the U.S. are added up…" This paragraph seems to over-simplify the situation as we understand it. Placement of the Thomas et al. 2010 reference is confusing, as suggests that Thomas et al. found a reduction in CO2 sequestration by forests, while in fact they find conclude that there has been a 40% increase in C sequestration due to N deposition in global forests and make no predictions of a reversal of this trend in the future. See also comment below. We suggest adding two caveats to the N increases carbon storage discussion. First, some species decrease productivity in response to more N deposition, and at very high N deposition levels, most species will have less growth. Second, carbon storage in the forest system is not permanent. Because of wildfire, harvest, and decomposition, the amount of time that carbon is stored in terrestrial ecosystems can be much shorter than the lifetime of CO2 in the atmosphere.	15. Interactions of Climate Change and Biogeochemical Cycles		524	34	Thank you for your comment. Edits to the text have been made, but please note that in the interest of available space, we have not dealt with differential species responses in forests, because it is the overall temporary sink in forests that really matters here.
Emma	Suddick	Delete "a reduction in nitrogen-stimulated CO2 sequestration in forests (for example, Thomas et al 2010). The main reason for the switch is the loss of N-cooling effects (via methane reduction and aerosols), the decrease in CO2 sequestration in forests doesn't change very much. Furthermore, Thomas 2010 is not really an example of a reduction in growth, most of the species in Thomas increase while only a few decreases.	15. Interactions of Climate Change and Biogeochemical Cycles		524	37	Thank you for your comment. Edits to the text have been made, but please note that in the interest of available space, we have not dealt with differential species responses in forests, because it is the overall temporary sink in forests that really matters here.

Emma	Suddick	At the end of the paragraph I wanted a little more information about what I'm call the "tip of the iceberg". Basically, we're increasingly ratcheting down on the "benefits" from nitrogen (NOx/SOx aerosols) because of reasons associated with human health. This is good, and should be continued, but will unearth the reality that our climate problem is really bigger than it appears to be.	15. Interactions of Climate Change and Biogeochemical Cycles		524	5	We agree with the comment and have added a sentence in the revised text. We disagree with the suggested location of the added text, and have instead put the revised text where all the direct and indirect processes are summarized.
Emma	Suddick	"Changes in phosphorus availability due to human activity can therefore have indirect impacts on climate and the emissions of greenhouse gases in a variety of ways. For example in land-based ecosystems…" It's not clear why marine ecosystems are not discussed here. Additionally, contributing quantitative data on phosphorus effects on CO2 sinks would strengthen the article.	15. Interactions of Climate Change and Biogeochemical Cycles		525	2	Thank you for your comment; in response, we note that most effects of P on C uptake are found in marine systems, beyond the borders of the US which is outside the scope of this report. In addition, there is very little quantitative assessment of the effects of land-applied P on carbon uptake in the US.
Emma	Suddick	Suggest citing study by Marklein and Houlton (2012) for N affecting P availability via phosphatase here (Marklein, A., and Houlton, B. Z., Nitrogen inputs accelerate phosphorus cycling rates across a wide variety of terrestrial ecosystems. New Phytologist (2012)).	15. Interactions of Climate Change and Biogeochemical Cycles		525	5	Thank you for your comment; the text has been revised to reflect this suggestion.
Emma	Suddick	Style comment: "height" might be clearer than "length"	15. Interactions of Climate Change and Biogeochemical Cycles		525	10	Thank you for your comment; the text has been revised to reflect this suggestion.
Colleen	Reid	Research goal 6 should recognize that most schools of public health don't have courses on climate change and health and it is not required in the public health curriculum. For state and local public health departments to be preparing for the health impacts of climate change and improving adaptation, people who work in these departments need training to understand the intersection of climate change and health. This is an important point to make related to education on climate change and should be added to this section.	29. Research Agenda for Climate Change Science		1041	16	We are unable to include this level of detail given page limits.
Emma	Suddick	Clarify for the lay audience that positive y-values are warming and negative are cooling.	15. Interactions of	15.3	525		Thank you for your comment; the text has been revised to reflect this suggestion.

			Climate Change and Biogeochemical Cycles				
David	Wert	The public must not be held responsible for local planning guidance, land use laws and building ordinances that do not account for the effects of climate change on regional water resources, sea level change, drought, flood, general ecology, etc. The public shall not insure individual losses (through FEMA and other federal agencies) incurred from climate related damage where it is evident that local policy did not restrict activities such as ignoring sea level change, aquifer depletion, drought condition related to excessive water use, building in flood plains particularly where these regions expand due to climate effects.	10. Water, Energy, and Land use				Thank you for your comment, however policy issues are beyond the defined scope of the National Climate Assessment, a scientific document that provides the basis for decision making, but does not address policy.
Emma	Suddick	Section “Other Effects: Sulfur Aerosols” we suggest adding one sentence (as context) highlighting that we expect this declining trend to strengthen as natural-gas continues to displace coal as an energy source.	15. Interactions of Climate Change and Biogeochemical Cycles		526	1	Thank you for your comment; the text has been revised to reflect this suggestion.
Emma	Suddick	This would be a good place to cite the chapters by Baron et al. and Porter et al. on climate-biogeochemistry interactions for biodiversity loss in both aquatic and terrestrial ecosystems. These are more up to date and include synthesis of those references already cited here. For instance lines 12-14, although biodiversity is often shown to decline when nitrogen deposition is high (Bobbink et al. 2010; Pardo et al. 2011), the compounding effects of multiple stressors are difficult to predict. Unfortunately, very few multi-factorial studies have been done to address this gap.” Suggest changing to “Biodiversity is often shown to decline when nitrogen deposition is high (Bobbink et al. 2010; Pardo et al. 2011). Warming and changes in water availability have been shown to interact with nitrogen in additive or synergistic ways to exacerbate biodiversity loss (Porter et al. 2012).” Suggest adding examples from Porter et al. 2012 – Table 1 summarizes the impacts of nitrogen, climate and nitrogen-climate interactions for major ecosystems in the US. The section “Sensitivity of specific ecosystems to climate–N interactions” includes several excellent examples:Porter, E., W.D. Bowman, C.M. Clark, J.E. Compton, L.H. Pardo, J. Soong (2012). Nitrogen, climate and biodiversity. Biogeochemistry. DOI 10.1007/s10533-012-9803-3Example 1: Grasslands: “ … experimental N additions to grasslands result in substantial reductions in species diversity and greater losses in areas that are not also limited by other resources such as water (Bobbink 1998; Clark et al. 2007; Bobbink et al. 2010). In an experiment in annual Mediterranean grassland in California, where N, temperature, precipitation, and CO2 were altered, the effects of these factors were additive, and the total effect led to a large loss of plant species, especially forbs (Zavaleta et al. 2003c). In an experiment in temperate perennial grassland in northern Minnesota where CO2 and N levels were altered, the reduction in diversity (mostly forbs) due to N addition was partly mitigated by elevated CO2 because elevated CO2 reduced soil N and increased soil moisture (Reich 2009). Thus, grassland diversity is likely to be sensitive to changes in N and climate, but the exact nature of these changes can vary from system to system.”Example 2: Arid/dry lands: “In areas of the Mojave and Sonoran Deserts in southern California, a series of years with higher-than-average rainfall coupled with increased N deposition from the Los Angeles Basin has promoted the growth of invasive	15. Interactions of Climate Change and Biogeochemical Cycles		528	7	Thank you for your comment. The text has been edited.

		Mediterranean grasses, creating a nearly continuous fuel layer in arid shrublands (Brooks and Minnich 2006; Rao et al. 2010). Fire frequency has increased, as has fire occurrence in areas previously unburned and unadapted to fire (Rao et al. 2010). Native shrubs may not be able to re-establish in these areas, as invasive grasses change the hydrology of the area, removing rainwater from the top layers of the soil thereby preventing its percolation into the root zone of young shrubs (Wood et al. 2006). Nitrogen can exacerbate drought stress in drylands. In pinyon-juniper woodland of New Mexico, N fertilization decreased mycorrhizae and increased leaf production in pinyon pine, leading to increased drought-induced mortality (Allen et al. 2010)."					
Emma	Suddick	We recommend that citations of chapters of our technical report should be changed to the following respective citations of the peer reviewed papers that have since been published:Suddick, E.C., P. Whitney, A.R. Townsend, E.A. Davidson (2012). The role of nitrogen in climate change and the impacts of nitrogen-climate interactions in the United States: Foreword to Thematic Issue. Biogeochemistry. DOI 10.1007/s10533-012-9795-zHoulton, B.Z, E. Boyer, A. Finzi, J. Galloway, A. Leach, D. Liptzin, J. Melillo, T.S. Rosenstock, D. Sobota, A.R. Townsend (2012). Intentional vs. unintentional nitrogen use in the United States: Trends, efficiency, and implications. Biogeochemistry. DOI 10.1007/s10533-012-9801-5Pinder, R.W., W.H. Schlesinger, G.B. Bonan, N.D. Bettez, T.L. Greaver, W.R. Wieder, E.A. Davidson (2012). Impacts of human alteration of the nitrogen cycle in the US on radiative forcing. Biogeochemistry, DOI: 10.1007/s10533-012-9787-z. Robertson, G.P., T.W. Bruulsema, R. Gehl, D. Kanter, D. Mauzerall, A. Rotz, C. Williams (2012). Climate-nitrogen interactions in agriculture. Biogeochemistry. DOI 10.1007/s10533-012-9802-4Baron, J.S., E.K. Hall, B.T. Nolan, J.C. Finlay, E.S. Bernhardt, J.A. Harrison, F. Chan, E.W. Boyer (2012) The Interactive Effects of Human-Derived Nitrogen Loading and Climate Change on Aquatic Ecosystems of the United States. Biogeochemistry. DOI 10.1007/s10533-012-9788-yPorter, E., W.D. Bowman, C.M. Clark, J.E. Compton, L.H. Pardo, J. Soong (2012). Nitrogen, climate and biodiversity. Biogeochemistry. DOI 10.1007/s10533-012-9803-3Peel, J., R. Haeuber, V. Garcia, L. Neas, A.G. Russell (2012). Implications of nitrogen-climate interactions for ambient air pollution and human health. Biogeochemistry. DOI 10.1007/s10533-012-9782-4PNAS paper:Pinder, R.W., E.A. Davidson, C.L. Goodale, T.L. Greaver, J.D. Herrick, and L. Liu. 2012. Climate change impacts of US reactive nitrogen. Proceedings of the National Academy of Sciences 109:7671-7675.	15. Interactions of Climate Change and Biogeochemical Cycles				Thank you for your comment. References have been updated.
Danielle	Martinelli	The southern part of the region is under-represented. Can more be said about West Virginia, and Delaware, for example? Perhaps try to give an example from each state in the region.First message includes a change 'more intense precipitation' and a constant 'heat waves'Introduction: mention other iconic weather-related features, like autumn leaves, Nor'easters, etc.P550: The should be a heading for the climate sectionIn general, the chapter needs more references (e.g., 'most built up environment in the world')P551, Caption: 1.2 feet, or 12 inches?Switch to an image that shows sea level throughout the Northeast, not just the Battery!P. 552: Confirm that 'more than a doubling' of days over 95F in the south is correct Line 7: is it regional climate models, as the text says, or CMIP models, as the caption says?End of page: redundant to have a piece on number of days increasing over 95 and a piece saying they'll double. Pick whichever is most compelling and stick to it.P. 553 last two lines: confirm the statement '25 inches… 'much of the Northeast'P.555 top, This information about Sandy could be updated. For example, lives lost during Sandy. Also more is needed on Sandy generally. Are updated references or numbers available for Sandy damages?You might consider talking more about responses to sea level rise and storms: e.g., retreat, buy outs, debate about whether to rebuild, etc. This could be a novel contribution.Lines 10-11: confirmThe NYC response material could be expanded.FEMA maps could be discussed.Line 14: no 'the' before New York CityConsider getting a more compelling, Post-Sandy image/tool where figure 16.5 currently is.Also add images or photos of	16. Northeast				1. We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include, but have expanded our inclusion of more states. 2. The text has been revised to incorporate this suggestion. 3. After consideration of this point, we still feel the existing text is clear and accurate as we focused on climate related features. 4. After consideration of this point, we still feel the existing text is clear and accurate as a consistent approach was used across chapters. 5. The text has been revised to incorporate this suggestion. 6. After consideration of this point, we still feel

		Sandy's destruction.Lines 19-21, as phrased it downplays stakeholder engagement to date, perhaps unfairly.First bullet needs to be rewritten—theme seems to be vulnerable human populations, not 'people' or 'environmental, social, or economic systems'Lines 25-27 require a reference!Line 28: what is meant by 'extreme events' in this context? Heat? Storms?Page 557, line 24: does this FEMA flood zone include coastal flooding? If yes, it confounds the paragraph two down from here, as you seem to be talking coastal flooding here, and inland flooding there/later.Page 558, after line 7: you might to say a little more here about indirect damages. What are the financial implications of lost productivity? What are the insurance and real estate implications? What are the public health effects of flooding?Insurance is not mentioned, and legal issues should be given more attention as wellImprove last paragraph/end of infrastructure section, for example by making it clear what the paragraph/end of section is about (specific infrastructure examples?). Add the important services that infrastructure provides, discussion of cascading infrastructure impacts after Sandy, and the issue of cost of damages/repair/rebuilding.P560 line 20 'than in any'. Line 21. Is this the best reference, or should you use chapter 2 as the reference?P561 line 35, could close with a Sandy mention here. Why no discussion in this section of ecosystem services? Add.Also this section would benefit from a few sentences on fisheries in the Northeast—their value, and how they might change.Add something too on the role of natural vs. engineered solutions in adaptationChesepeake Bay box needs more material—include an iconic photo, with people or wildlife, perhaps. Also, it needs specific impacts of climate change (nitrogen runoff, mention of regional coordination around its protection, as a template for adaptation.Page 562: lines 17-18" confirm facts about REGGIE ('first', 9 states (NJ included in that tally?)Page 563, line 20, might add that climate and NPCC has been built into NYC charter.Some of the adaptation paragraphs towards the end read like a laundry list. Improve the organization.End culvert box after: 'identify funding sources'.General: make sure you have call outs to all figures, table, and boxesIf conclusions/summary are allowed, add.The references need work. Several important recent references are not included. Update with the latest literature.					the existing text is clear and accurate. 7. We thank the reviewer for the helpful suggestion, which has been incorporated into the figure. 8. After consideration of this point, we still feel the existing text is clear and accurate. 9. The text has been revised to incorporate this suggestion. 10. The text has been revised to incorporate this suggestion. 11. The text has been revised to incorporate this suggestion. 12. The text has been revised to incorporate this suggestion. 13. These lines are accurate. 14. Due to the size of the topic, and the page limit for the chapter, we focused on broad trends rather than delving too deeply or providing such a level of specificity. 15. The text has been revised to incorporate this suggestion. 16. We appreciate the suggestion, but after deliberation, kept this graphic since it is an important planning tool. We now add explanatory text. 17. The text has been revised to incorporate this suggestion. 18. After consideration of this point, we still feel the existing text is clear and accurate. 19. We cannot locate this comment within the chapter. 20. The text has been revised to incorporate this suggestion. 21. We have clarified the coastal flood zone, but disagree that there is confounding with later text. 22. For indirect damages, we already point to the next section for details. 23. Due to the size of the topic, and the page limit for the chapter, we focused on broad trends rather than delving too deeply or providing such a level of specificity. 24. The text has been revised to incorporate this suggestion. 25. The text has been revised to incorporate this suggestion. 26. We have modified this section. 27. This is too much to add to this chapter, so a pointer to Ch25 on Coastal Zones was added where this is discussed in detail. 28.

							We appreciate this suggestion, but space is limited. 29. We appreciate this suggestion, but space is limited. 30. We are modifying the figure to be more informative, but space is too limited to add more detail. 31. The facts about REGGI are accurate. 32. We have modified this section about NPCC. 33. This section has been rewritten. 34. The text has been revised to incorporate this suggestion. 35. This suggestion will be implemented in the final report. 36. Conclusions were not permitted in the regional chapters. 37. The text has been revised to incorporate this suggestion.
Emma	Suddick	The topics mentioned in the previous comment above about “impacts” are mentioned briefly here, but there is an opportunity to explain them more clearly with some brief examples, like the ones given in the bullet points above.	15. Interactions of Climate Change and Biogeochemical Cycles		528	24	Thank you for your comment. After consideration of this point, we still feel the existing text is clear and accurate. No changes to the text have been made.
Melisa	Ongun	I am glad to see the mention of the effect that CO2 will have on alfalfa and soybeans since those are two major crops in the U.S. and are heavily subsidized and also the effects that this will have on cattle grazing in lines 1-13. Since so much of the food system in the U.S. is based on animals, the fact that this systems is very vulnerable due to climate change can be a motivating factor for policy makers. Subsidies are going to stop working at some point and it is going to show up in the cost of food.	6. Agriculture		237		We appreciate the comment.
Emma	Suddick	We did not have a grant from the USGS. They hosted our workshop at the Powell Center, as described in line 14. We did have support from NSF as correctly noted and also from the David and Lucille Packard Foundation. Please add Packard to the acknowledgment.	15. Interactions of Climate Change and Biogeochemical Cycles		533	12	Thank you for your suggestion. Edits have been made in regards to this suggestion.
Emma	Suddick	The Biogeochemistry papers have been published on-line and are available as open access. The full citations are given below. I would recommend changing all of the technical report chapter citations (Suddick and Davidson, Houlton et al., Pinder et al., Robertson et al., Baron et al., Porter et al., and Peel et al.) to the Biogeochemistry papers, because they are fully peer reviewed.	15. Interactions of Climate Change and Biogeoch		533	16	Thank you for your comment. References have been updated.

			emical Cycles				
Emma	Suddick	At first I thought that the “Biogeochemistry team” referred to our team of authors who published papers from our technical report in the journal Biogeochemistry (mentioned on line 16 of the preceding paragraph). Then I realized that you probably meant the team that put together chapter 15 of the NCA. Perhaps some other wording would help avoid this confusion.	15. Interactions of Climate Change and Biogeochemical Cycles		533	19	Thank you for your suggestion. Edits have been made in regards to this suggestion.
Emma	Suddick	Regarding the following statement: “We have high confidence that the combination of carbon sink and potential offsets from other trace gases will ultimately result in a net warming effect. This is based primarily on the analysis of Pinder et al. (2012). However, the exact amount of warming or cooling produced by various gases is not yet well constrained, because of the interactions of multiple factors.” I suggest that you refer to the Pinder et al. paper in PNAS, where the supplemental information provides ranges for each of these multiple factors and describes the effects of propagating uncertainties. In my opinion, your use of “not well constrained” is incorrect here. There clearly are significant uncertainties, but I believe that Pinder et al. have done a reasonable job of defining and constraining them.PNAS paper:Pinder, R.W., E.A. Davidson, C.L. Goodale, T.L. Greaver, J.D. Herrick, and L. Liu. 2012. Climate change impacts of US reactive nitrogen. Proceedings of the National Academy of Sciences 109:7671-7675.	15. Interactions of Climate Change and Biogeochemical Cycles		536	1	Thank you for your suggestion. Edits have been made in regards to this suggestion.
Kathy	Lynn	The following comments were developed by Gary Morishima. Questions may be directed to Gary at: MORIKOG@aol.com. Comments on Forestry ChapterThe Forestry Chapter is superficial. Coverage is limited to broad generalities that will be of little value to policy and decision makers. Several omissions that are of particular concern include:The failure to identify specific sources of information and assistance regarding the identification and recommended responses to local manifestations of climate change on forests.The need to establish long-term, multi-jurisdicational monitoring and reporting systems that can provide data suitable for analysis and synthesis at a landscape scale. Implications of forest expansion receive only minimal treatment. Of particular concern is lack of discussion regarding notherly expansion of boreal forests. As these forests develop, absorption of solar radiation will be affected, vegetative patterns altered, peat bogs and methane release will be affected, weather and moisture accumulation, retention, and hydrologic flow regimes will be altered, potentials for threats of prolonged wildfire, insects, and disease could increase carbon sources.References to “science” have a decidedly western bias towards published research. The validity and legitimacy of different ways and values of knowing, doing, and sharing ecological knowledge is notably lacking. There is no acknowledgement or recognition that the pre-European contact forests resulted from thousands of years of stewardship. Whole ecosystems were maintained by management practices of indigenous peoples. Fire was employed to manage fire-dependent forest communities, including trees, wildlife, fish, foods, medicines, water, soils, and fuel.The Chapter is silent as to substantive treatment of implications of climate change on forests for place-dependent human communities. Communities of indigenous peoples still retain vast stores of traditional knowledge accumulated over countless generations of place-based observation and experience. Climate change will impact indigenous peoples in unique ways. Their knowledge, experience, and rights of access and use to lands and resources are place-based. Adaptation or mitigation options are constrained by geographic areas and complexities of ownership and jurisdictional boundaries.	7. Forestry				Thank you for your comment. However, we are not able to cover everything.

Melisa	Ongun	The paragraph from lines 7-13 seems weak. The reason I think this is because in line 8 it states that "uncertainty is high," that there will be an increase in soil loss due to various factors. If the uncertainty is so high, then why not take this portion out? Otherwise, explain more why the conservation of soil and erosion prevention is so important. Has it been happening on farms in Iowa? Obviously, it is something important otherwise it would not have been mentioned, but it needs to be strengthened. There are so many other strong arguments to show that climate change will have a significant impact on agriculture in this chapter that they should not be undermined by other observations that have not been proven. Soil erosion can be very destructive in a farm community, so it should not be downplayed in this paragraph, which I think is happening because of the wording. Also, should we assume that the general public knows what terms like "crop residue" and "non-point-source pollution" mean? If not, I think a brief explanation of those could be included.	6. Agriculture		241		The figure, "Herbicide Loses Effectiveness at Higher CO2" is no longer in the chapter.
Carol	Berzonsky	Climate and Regional Differences Section (including for Figure 25.4 Bamber, J. L., and W. P. Aspinall. 2013. An expert judgment assessment of future sea level rise from the ice sheets. Nature Clim. Change 3 (4):424-427. Biasutti, M., A. Sobel, S. Camargo, and T. Creyts. 2012. Projected changes in the physical climate of the Gulf Coast and Caribbean. Climatic Change 112 (3-4):819-845. Bromwich, D. H., J. P. Nicolas, A. J. Monaghan, M. A. Lazzara, L. M. Keller, G. A. Weidner, and A. B. Wilson. 2013. Central West Antarctica among the most rapidly warming regions on Earth. Nature Geosci 6 (2):139-145. Cooper, H. M., Q. Chen, C. H. Fletcher, and M. M. Barbee.. 2013. Assessing vulnerability due to sea-level rise in Maui, Hawai'i using LiDAR remote sensing and GIS. Climatic Change 116 (3-4):547-563. Foster, G. L., and E. J. Rohling. 2012. Relationship between sea level and climate forcing by CO2 on geological timescales. Proceedings of the National Academy of Sciences online first. Goelzer, H., P. Huybrechts, S. C. B. Raper, M.-F. Loutre, H. Goosse, and T. Fichefet. 2012. Millennial total sea-level commitments projected with the Earth system model of intermediate complexity LOVECLIM. Environmental Research Letters 7 (4):045401. Goncalves, R. M., J. L. Awange, C. P. Krueger, B. Heck, and L. d. S. Coelho. 2012. A comparison between three short-term shoreline prediction models. Ocean & Coastal Management 69 (0):102-110. Goodess, C. M. 2013. How is the frequency, location and severity of extreme events likely to change up to 2060? Environmental Science & Policy (0). Grinsted, A., J. C. Moore, and S. Jevrejeva. 2012. Homogeneous record of Atlantic hurricane surge threat since 1923. Proceedings of the National Academy of Sciences online first. Grinsted, A. J.C. Moore, and S. Jevrejeva (2013). Projected Atlantic hurricane surge threat from rising temperatures. PNAS, online first, March 13, 2013. Hanna, E. 2012. Greenland plays a large role in the gloomy picture painted of probable future sea-level rise. Environmental Research Letters 7 (4):041002.	Introduction to Response Strategies				We believe this comment was meant for the Coastal chapter. We appreciate having been made aware of these newer references or some previously published but not included here. We reviewed them and included those that add new insights to the document and have made small textual edits where necessary to account for these new insights. We did not see anything in this list that fundamentally changes the findings or key message from this section, and space limitations preclude adding them all.

Harig, C., and F. J. Simons. 2012. Mapping Greenland's mass loss in space and time. Proceedings of the National Academy of Sciences online first.

Harper, J., N. Humphrey, W. T. Pfeffer, J. Brown, and X. Fettweis. 2012. Greenland ice-sheet contribution to sea-level rise buffered by meltwater storage in firn. Nature 491 (7423):240-243.

Hay, C. C., E. Morrow, R. E. Kopp, and J. X. Mitrovica. 2013. Estimating the sources of global sea level rise with data assimilation techniques. Proceedings of the National Academy of Sciences 110 (Supplement 1):3692-3699.

Hemer, M. A., Y. Fan, N. Mori, A. Semedo, and X. L. Wang. 2013. Projected changes in wave climate from a multi-model ensemble. Nature Climate Change advance publication.

Holland, G. J. 2012. Hurricanes and rising global temperatures. Proceedings of the National Academy of Sciences online first.

Jongman, B., P. J. Ward, and J. C. J. H. Aerts. 2012. Global exposure to river and coastal flooding: Long term trends and changes. Global Environmental Change 22 (4):823-835.

Joughin, I., R. B. Alley, and D. M. Holland. 2012. Ice-Sheet Response to Oceanic Forcing. Science 338 (6111):1172-1176.

Little, C. M., N. M. Urban, and M. Oppenheimer. 2013. Probabilistic framework for assessing the ice sheet contribution to sea level change. Proceedings of the National Academy of Sciences 110 (9):3264-3269.

Mazi, K., A. D. Koussis, and G. Destouni. 2013. Tipping points for seawater intrusion in coastal aquifers under rising sea level. Environmental Research Letters 8:[014001.

Rahmstorf, S. 2012. Sea-level rise: towards understanding local vulnerability. Environmental Research Letters 7 (2):021001.

Ranasinghe, R., D. Callaghan, and M. F. Stive. 2012. Estimating coastal recession due to sea level rise: beyond the Bruun rule. Climatic Change 110 (3-4):561-574.

Sakakibara, C. 2008. "Our home is drowning": Inupiat storytelling and climate change in Point Hope, Alaska. Geographical Review 98 (4):456-475.

Sallenger, A. H., K. S. Doran, and P. A. Howd. 2012. Hotspot of accelerated sea-level rise on the Atlantic coast of North America. Nature Clim. Change 2 (12):884-888.

Shaw, J., L. Stocker, and C. D. Galano. 2013. Spanning the Boundary between Climate Science and Coastal Communities: Opportunities and Challenges. Ocean & Coastal Management (0).

Shepherd, A., E. R. Ivins, G. A, V. R. Barletta, M. J. Bentley, S. Bettadpur, K. H. Briggs, D. H. Bromwich, R. Forsberg, N. Galin, M. Horwath, S. Jacobs, I. Joughin, M. A. King, J. T. M. Lenaerts, J. Li, S. R. M. Ligtenberg, A. Luckman, S. B. Luthcke, M. McMillan, R. Meister, G. Milne, J. Mouginot, A. Muir, J. P.

		Nicolas, J. Paden, A. J. Payne, H. Pritchard, E. Rignot, H. Rott, L. S. Sørensen, T. A. Scambos, B. Scheuchl, E. J. O. Schrama, B. Smith, A. V. Sundal, J. H. van Angelen, W. J. van de Berg, M. R. van den Broeke, D. G. Vaughan, I. Velicogna, J. Wahr, P. L. Whitehouse, D. J. Wingham, D. Yi, D. Young, and H. J. Zwally. 2012. A Reconciled Estimate of Ice-Sheet Mass Balance. Science 338 (6111):1183-1189. Sriver, R., N. Urban, R. Olson, and K. Keller. 2012. Toward a physically plausible upper bound of sea-level rise projections. Climatic Change 115 (3-4):893-902. Stammer, D., A. Cazenave, R. M. Ponte, and M. E. Tamisiea. 2012. Causes for Contemporary Regional Sea Level Changes. Annual Review of Marine Science 5 (1):21-46. Vermaat, J. E., and M. A. Eleveld. 2013. Divergent options to cope with vulnerability in subsiding deltas. Climatic Change 117 (1-2):31-39. Toomey, M. R., W. B. Curry, J. P. Donnelly, and P. J. van Hengstum. 2013. Reconstructing 7000 years of North Atlantic hurricane variability using deep-sea sediment cores from the western Great Bahama Bank. Paleoceanography online first:n/a-n/a.					
Melisa	Ongun	The figure on this page is an excellent specific example that demonstrates one of the points made above. However, I feel that this figure may be more appropriate on page 238, near the "Weeds" section.	6. Agricultu re		244		The figure, "Herbicide Loses Effectiveness at Higher CO2" is no longer in the chapter.
Jeffrey	Hicke	Change "pest" to "insect". Also here: P 266, 267, 279; occurrences between pages 298-312, between pages 482-507; P 747	1. Executive Summary		13	6	The authors are comfortable with the existing language.
Jeffrey	Hicke	What is mapped? What is "severity"? The legend has "%" as the units; % of what? What time period is this from? I don't see various fires and insect outbreaks that I would expect on such a map. A suggestion is to combine this metric with burned area and area affected by insects, both of which are readily available.	7. Forestry	7.1	265		The text has been revised to incoporate this suggestion. The text has been revised to add the dates over which the disturbance index was estimated (2005-2009) and given the dynamic nature of disturbance in the west, the dates associated with the index contributes to the nature of the disturbance assessment. The text has been revised to add information on the nature of the disturbance index. We appreciate the suggestion of adding the burn index, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include.
Jeffrey	Hicke	This figure seems a little out of place in a climate change report. Also, a reference to a scientific paper that describes the results should be included.	7. Forestry	7.2	268		We use this to show a climate change adaptation to increased disturbance.
Jeffrey	Hicke	I recommend that this figure be deleted. It is very difficult to understand, even for a scientist familiar with the topics.	7. Forestry	7.3	270		The figure has been deleted from the text. This figure is currently in journal review and consequently will not meet the requirements of literature cited for

							the NCA document. We have replaced this figure with Figure 2.17 from Vose et al. 2012.
Jeffrey	Hicke	What is "carbon uptake rate"? The Running et al. paper referenced in the caption is about GPP, yet the figure title says "sink", implying NEPÉ?	7. Forestry	7.4	271		We have clarified this caption.
Jeffrey	Hicke	There is a confidence level assigned to wildfires, but this key message also includes drought and insect and disease outbreaks. Here are my suggestions and references for the western US: a) drought: very high; Allen et al., 2010; Adams (various pubs); Williams (various pubs); Anderegg, Worrall, Hogg pubs on sudden aspen decline; b) insect outbreaks: high; Raffa et al. 2008; Bentz et al. 2010; c) pathogens: medium; Sturrock et al. 2011 (Plant Pathology); Stone et al. 2008 (Can. J. Pl. Pathology)	7. Forestry		279	1	Noted, we are using many of these references.
Jeffrey	Hicke	Wasn't the Westerling et al. (2011) study model projections, not observations? The statement that that study reported a conversion to shrubland may be a little strong. Same comment for P 272, L 14.	7. Forestry		280	1	There is no mention of the Westerling reference on this page. After consideration of this point, we still feel the text is clear.
Jeffrey	Hicke	Better: "Insect and pathogen outbreaks, É"	7. Forestry		266	6	The text has been revised to incorporate this suggestion.
Jeffrey	Hicke	This paragraph discusses drought, yet the last sentence talks about "other interacting factors, such as ÉdroughtÉ". Delete?	7. Forestry		266	35	The text has been revised to clarify the point that the effects of increased temperatures accompanying future droughts will be compounded by other interacting factors, such as more frequent and/or severe drought, biotic disturbances, and land-use change.
Jeffrey	Hicke	Which visitor center (which park)?	8. Ecosystems, Biodiversity, and Ecosystem Services		301	3	We have added text to clarify that the visitor center is at Bandelier National Monument.
Jeffrey	Hicke	The idea that trees killed by bark beetles lead to fire is more nuanced than this text suggests. Multiple studies have shown that fires are not inevitable following outbreaks, and that after needledrop, stands experience reduced fire risk and/or modified fire types. I suggest "The dead trees...MAY make crown fires more likely UNTIL NEEDLES FALL FROM KILLED TREES" or something similar.	8. Ecosystems, Biodiversity, and Ecosystem Services		301	8	Changed as suggested.
Jeffrey	Hicke	Drought has been linked to recent warming (Breshears et al., PNAS, 2005), suggesting that this sentence should be reworded.	20. Southwest		687	20	The text has been revised to incorporate this and other suggestions received.
Jeffrey	Hicke	The climate analysis of Littell et al. (2009) was limited to 1977Ð2003, I believe. Same comment for text on P 704.	20. Southwest		687	11	After consideration of this point, we still feel the existing text is clear and accurate. Littell et al. (2009) analyzed

							data from 1916 to 2003.
Jeffrey	Hicke	The evidence that insect outbreaks lead to more or more severe fires is insufficient to make this statement here. See recent reviews by Jenkins et al., Hicke et al., others.	20. Southwest		687	8	It is true that bark beetles are an additional factor. The text has been revised to incorporate this suggestion and we have added one of the suggested citations in our chapter assessment.
Carol	Berzonsky	The relevant sections of the chapter should be updated with publications that have appeared since July 31, 2012. Some of the relevant papers are listed by Key vulnerability/message/section below, but likely others have been published. The relevant sections should also be harmonized with the Climate chapter and other regional or sectoral chapters, as necessary.Coastal Infrastructure Section Ayyub, B. M., H. G. Braileanu, and N. Qureshi. 2012. Prediction and Impact of Sea Level Rise on Properties and Infrastructure of Washington, DC. Risk Analysis 32 (11):1901-1918. Kirshen, P., S. Merrill, P. Slovinsky, and N. Richardson. 2012. Simplified method for scenario-based risk assessment adaptation planning in the coastal zone. Climatic Change 113 (3-4):919-931. Matonse, A. o., D. Pierson, A. Frei, M. Zion, A. Anandhi, E. Schneiderman, and B. Wright. 2013. Investigating the impact of climate change on New York City's primary water supply. Climatic Change 116 (3-4):437-456. Mazi, K., A. D. Koussis, and G. Destouni. 2013. Tipping points for seawater intrusion in coastal aquifers under rising sea level. Environmental Research Letters 8:[014001. Naylor, L. A., M. A. Coombes, O. Venn, S. D. Roast, and R. C. Thompson. 2012. Facilitating ecological enhancement of coastal infrastructure: The role of policy, people and planning. Environmental Science & Policy 22 (0):36-46. Wright, L., P. Chinowsky, K. Strzepek, R. Jones, R. Streeter, J. Smith, J.-M. Mayotte, A. Powell, L. Jantarasami, and W. Perkins. 2012. Estimated effects of climate change on flood vulnerability of U.S. bridges. Mitigation and Adaptation Strategies for Global Change 17 (8):939-955. van den Hoek, R. E., M. Brugnach, and A. Y. Hoekstra. 2012. Shifting to ecological engineering in flood management: Introducing new uncertainties in the development of a Building with Nature pilot project. Environmental Science & Policy 22 (0):85-99.Economics Section Adam, C. 2013. Coping with adversity: The macroeconomic management of natural disasters. Environmental Science & Policy online first (0). Ayyub, B. M., H. G. Braileanu, and N. Qureshi. 2012. Prediction and Impact of Sea Level Rise on Properties and Infrastructure of Washington, DC. Risk Analysis 32 (11):1901-1918. Forster, J., P. Schuhmann, I. Lake, A. Watkinson, and J. Gill. 2012. The influence of hurricane risk on tourist destination choice in the Caribbean. Climatic Change 114 (3-4):745-768.Graham, S., J. Barnett, R. Fincher, A. Hurlimann, C. Mortreux, and E. Waters. 2013. The social values at risk from sea-level rise. Environmental Impact Assessment Review 41 (1):45-52.	Introduction to Response Strategies				We believe this comment was meant for the Coastal chapter. We appreciate having been made aware of these newer references or some previously published but not included here. We reviewed them and included those that add new insights to the document and have made small textual edits where necessary to account for these new insights. We did not see anything in this list that fundamentally changes the findings or key message from this section, and space limitations preclude adding them all.

Hall, J. W., S. Brown, R. J. Nicholls, N. F. Pidgeon, and R. T. Watson. 2012. Proportionate adaptation. Nature Clim. Change 2 (12):833-834.

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Hans	Schmitz	Plant disease, whether biotic or abiotic in nature, is inferred in this section but not adequately addressed in relation to animal disease or weeds. More information on insect pests would also be warranted.	6. Agriculture		238	10	These are generally accepted statements; however, the information to support this inclusion in the report is not available.
Melisa	Ongun	Key message number 4 seems to me to be extremely scary in its message but I did not see as much discussion of those critical thresholds that we are already reaching. As a student in the School of Natural Resources and Environment at the University of Michigan and a student of Rosina Bierbaum's, I understand what those critical thresholds are, however I am not so sure that that information is inherent in this chapter. Just an expansion on what those critical thresholds are could clear up potential misunderstanding or misinterpretation.	6. Agriculture		250		The critical thresholds are the temperature limits for plants. The Key Messages of the chapter are intended to be succinct summaries of the most significant impacts, but the "critical thresholds" are defined and discussed in greater detail in the main body of text. Thanks for the comment.
Hans	Schmitz	The statement beginning with "This has been coupled..." makes a reference to data that needs a source. This cited source should also define the term "workable day." The period in which the 3 day decrease in workable days exists also needs to be stated.	6. Agriculture		240	6	We added a reference to the technical report where this is described. There is a direct statement in the sentence as to the period (April to May) where this change has occurred, and we added the years: 2001 through 2011.

Hans	Schmitz	The sentence beginning with "The potential for..." is awkwardly worded and needs to be clarified. For example, reference is made to both potential and realized erosion simultaneously.	6. Agriculture		240	12	We revised the sentence to address the comment.
Kathy	Lynn	There is no reference to the tribal forests section of the National Climate Assessment Forest Sector Technical Report in the NCA Forest Chapter. This is a significant omission and should be addressed in the revision to the NCA Forest Chapter. See pgs. 32-35 in: Vose, James M.; Peterson, David L.; Patel-Weynand, Toral, eds. 2012. National Climate Assessment—forest sector technical report. PNW-GTR-870. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.	7. Forestry				We defer you to Chapter 12 on Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources.
Hans	Schmitz	The statement beginning with "In Iowa soils with even modest slopes, ..." makes a reference to data (the 1.25 inch threshold) that needs to be cited.	6. Agriculture		240	20	We added the corresponding figure number for this statement.
David	Gassman	The Y-axis of Figure 5, page 1064, 1700 Hundred Years … is not entirely clear to me. Are they degrees of temperature or of some sort of index number created to make the graph intelligible? Whichever it is, some labeling might help.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z	5	1064		The figure text has been revised to incorporate this suggestion.
David	Gassman	Figure 27, page 1102, Risk Matrix … Tipping Points … If I understand correctly RISK is a combination of both likelihood & impact. You might say so directly, i.e. define the term, even if you have already done so elsewhere.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z	27	1102		This figure has been eliminated.
Kathy	Lynn	p.263 ln 28 - Add "tribal lands" p.263 ln 32 Add "public, tribal and..." p.263 ln 34 Amend to "Forests provide valuable tribal trust resources..." p.263 ln 37 Add "cultural resources..."	7. Forestry		263		The text has been revised to incorporate the suggestions. For line 28 and 32, after consideration we still feel that the existing text is clear and accurate. This is the key message addressing all private lands and to keep the text within the page limit, we did not add the various private owners here. For Line 34 and 37, this paragraph has been extensively revised to broadened the values from forests and the term cultural resources added.

Kathy	Lynn	p.264 line 1 Add "socio-cultural" values p.264 ln 3 Add "sustaining tribal cultural traditions and economies" p.264 ln 17 Add percent of tribal Indian trust lands p.264 ln 21 Amend to “on public, tribal and private land” p.264 ln 23 Amend to “role in sustaining rural and tribal economies”	7. Forestry		264		The text in this section has been revised extensively using this comment and others. We have added tribal where more specific information about the types of private owners is given. However for line 17, after consideration, we feel that the existing text is clear and accurate as we are charaterizing all private land owners. Cultural values are mention on page 263; given the limitation of space, it is not repeated here.
Kathy	Lynn	Amend to “research documents and tribal traditional ecological knowledge”	7. Forestry		266	26	We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information to include.
Kathy	Lynn	Add "cultural use quality"	7. Forestry		267	22	Thank you for your comment. After consideration of this point, we still feel that the examples currently provided are sufficient and reflect the literature cited.
Hans	Schmitz	This sentence makes the statement of a projected increase, the source of which needs to be cited.	6. Agricultu re		241	32	This sentence is the lead to the next sentence complete with references.
Kathy	Lynn	Figure 7.2 Fuels treatment – Ft. Apaches Reservation Fuels Treatment	7. Forestry		268		There is no room to analyze this topic in such detail.
Kathy	Lynn	Add “such shifts in species composition will likely impact tribal valued resources and cultural use quality (Voggesser et al. 2013) . Voggesser, G., K. Lynn, J. Daigle, F. K. Lake, and D. Ranco. “Cultural Impacts to Tribes from Climate Change Influences on Forests.” Climatic Change. DOI: 10.1007/s10584-013-0733-4	7. Forestry		269	18	We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information to include. Here the text is focused on the impacts of climate change on forest productivity. In the introduction text, we identify the broader impacts of climate change on forests, including tribal cultural resources. We have added the suggested citation in our chapter assessment.
Kathy	Lynn	Add “fire suppression exclusion”	7. Forestry		270	14	After consideration of this point, we still feel the existing text is clear and accurate.
Hans	Schmitz	This figure is extremely removed from its text reference on page 238.	6. Agricultu re	6.10	244		The figure, "Herbicide Loses Effectiveness at Higher CO2" is no longer in the chapter.
Kathy	Lynn	p.276 ln 7 Amend to “private and tribal land”	7.		276		Due to the size of the sector, and the

		p.276 ln 8 amend to “private, tribal and federal…” p.276 ln 9 Add “% tribal” p.276 ln 25 Amend to “private and federal forest owners” p.276 ln 28 Add % of tribal lands p.276 ln 31 Add tribal p.276 ln 34 Amend to “Private and tribal forest owners”	Forestry				page limit for the chapter, we focused on a broad characterization of private lands, which includes tribal lands, rather then providing a level of specificity about the diversity of private landowners.
Kathy	Lynn	p.276 ln 18 Add sentence about tribal forest management from Vose et al. 2012 Vose, James M.; Peterson, David L.; Patel-Weynand, Toral, eds. 2012. National Climate Assessment—forest sector technical report. PNW-GTR-870. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.	7. Forestry		276	18	We appreciate this suggestion. We have added a reference to tribal forests in another section of this text.
Kathy	Lynn	Figure 7.7 Add Tribal Lands to map	7. Forestry		277		We appreciate the suggestion, but the resolution and scale of the figure is such that it would be difficult to see the location of tribal lands. Private land includes land held privately by individuals, families, corporations, Native American tribes, and other private groups.
Hans	Schmitz	The part of the key message "...because critical thresholds are already being exceeded" is not examined in the document. What are the thresholds? Why are they critical? How are they currently already being exceeded?	6. Agriculture		250		The critical thresholds are the temperature for biological response. The Key Messages of the chapter are intended to be succinct summaries of the most significant impacts, but the "critical thresholds" are defined and discussed in greater detail in the main body of text. Thanks for the comment.
Kathy	Lynn	Key message #4 Add tribes to this.	7. Forestry		281		We do not see the necessity to call out that landowner category here.
Kathy	Lynn	Include mention of tribal communities at p.598, lines 19-20, 30-31.	17. Southeast and Caribbean		598	19	The text has been revised to incorporate this suggestion.
Kathy	Lynn	Include in-text citations to Chapter 12: Tribal Lands and Resources and Lynn et al. 2013. Lynn K, Daigle J, Hoffman J, Lake F, Michelle N, Ranco D, Viles C, Voggesser G, Williams P (2013) The Impacts of Climate Change on Tribal Traditional Foods. Climatic Change. DOI: 10.1007/s10584-013-0736-1;	17. Southeast and Caribbean				We have added the suggested citation in our chapter assessment.
Kathy	Lynn	This chapter does an excellent job of addressing tribes in the Great Plains and potential impacts from climate change to tribal communities. Our one suggestion is to add an in-text citation to the NCA	19. Great Plains				We greatly appreciate your positive comment about our report and hope

		Chapter 12: Tribal Lands and Resources somewhere in the Great Plains chapter.					that you find the content useful. The link to the Chapter was added as you suggested.
Kathy	Lynn	1. The discussion of impacts to forests includes reference to traditional tribal uses. Suggest including an in-text citation to Chapter 12: Tribal Lands and Resources and to Voggesser et al. 2013 (Climatic Change). 2. Lines 14-16 mentions affects of ocean acidification on marine food webs. Suggest including an in-text citation to Chapter 12: Tribal Lands and Resources and to Dittmer 2013, Grah and Beaulieu 2013 and Lynn et al. 2013 (climatic change). 3. Consider adding a call-out box or a few sentence to reference impacts to tribes in the Northwest, and the forthcoming tribal chapter in the Northwest Climate Assessment (published by Island Press in 2013). cite Lynn et al. in Dalton et al. 2013.a. Suggested Text: The Northwest Climate Assessment (Lynn et al. Dalton et al. 2013) includes a chapter on the impacts of climate change on tribal communities in the Northwest. There are forty-three federally recognized tribes in Oregon, Washington and Idaho, and the tribal chapter synthesizes information on key climate change vulnerabilities for tribes in the Northwest and potential consequences to a range of tribal cultural and natural resources, traditional foods, and economies. Citations: Dittmer K (2013) Changing Streamflow on Columbia Basin Tribal Lands- Climate Change and Salmon. Climatic Change. DOI: 10.1007/s10584-013-0745-0 Grah O, Beaulieu J (2013) The Effect of Climate Change on Glacier Ablation and Baseflow Support in the Nooksack River Basin and Implications on Pacific Salmon Species Protection and Recovery. Climatic Change. DOI: 10.1007/s10584-013-0747-y Lynn K, Daigle J, Hoffman J, Lake F, Michelle N, Ranco D, Viles C, Voggesser G, Williams P (2013) The Impacts of Climate Change on Tribal Traditional Foods. Climatic Change. DOI: 10.1007/s10584-013-0736-1; Lynn, K., O. Grah, P. Hardison, J. Hoffman, E. Knight, A. Rogerson, P. Tillmann, C. Viles, and P. Williams (2013) "Tribal Communities" In Climate Change in the Northwest: Implications for Our Landscapes, Waters, and Communities, edited by M. M. Dalton, P. W. Mote, and A. K. Snover. Washington, DC: Island Press.Voggesser, G., K. Lynn, J. Daigle, F. K. Lake, and D. Ranco. “Cultural Impacts to Tribes from Climate Change Influences on Forests.” Climatic Change. DOI: 10.1007/s10584-013-0733-4	21. Northwest				None of the other reasons for forests' importance in the opening paragraph of the forest section has a citation, but we have added a citation to this paper farther down in the forest section. There is already a pertinent reference on marine food webs; space precludes additional references.Text and references have been added to introductory paragraph
Kathy	Lynn	Suggest adding reference to Cochran et al. 2013 Cochran P, Huntington OH, Pungowiyi C, Tom S, Chapin FS, Huntington HP, Maynard NG, Trainor SF (2013) Indigenous Frameworks for Observing and Responding to Climate Change in Alaska. Climatic Change. DOI: 10.1007/s10584-013-0735-2	22. Alaska and the Arctic				We have added the suggested citations in our chapter assessment.
Kathy	Lynn	In the brief mention of traditional knowledge in introduction in relation to the diversity of people, language and culture, we suggest including in-text citation to NCA Chapter 12: Tribal Lands and Resources	23. Hawaii and U.S. Affiliated Pacific Islands				The text has been revised to incorporate this suggestion, but we felt it more appropriate under KM #5.
Kathy	Lynn	In the Ocean/Marine chapter, it might be useful to note that four tribes (Makah, Quileute, Hoh, Quinault) have ocean treaty rights off the coast of the Olympic Peninsula and, therefore, four voices to join the U.S. voice in discussions of ocean acidification impacts, research and strategies.	24. Oceans and Marine Resources				While the comment suggests a good specific examples, the authors feel the existing examples are appropriate and adequate.
Kathy	Lynn	Box: mention that shellfish have been a traditionally important food source for tribes for centuries.	24.		840		The text has been revised to

			Oceans and Marine Resources				incorporate this suggestion.
Kathy	Lynn	mention impacts to coastal tribes in section titled "Impacts of Marine-related Climate Change".	24. Oceans and Marine Resources		845		After consideration of this point, we still feel the existing text is clear and accurate. Impacts to coastal tribes is covered in Chapter 25 on Coasts.
Kathy	Lynn	mention tribal initiatives in section titled "Initiatives Serve as a Model".	24. Oceans and Marine Resources		846		After consideration of this point, we still feel the existing text is clear and accurate. Impacts to coastal tribes is covered in Chapter 25 on Coasts.
Kathy	Lynn	within section titled "What are the decisions and who are the decision-makers?" mention tribes and include in-text citation to Chapter 12	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		927		Added specific mention of tribal governments.
Kathy	Lynn	add tribal mitigation efforts to the list of "Voluntary Actions" and include in-text citation to Chapter 12.	27. Mitigation		963		A web-site reference to efforts of tribal communities has been added.
Kathy	Lynn	line 36: add "tribal governments". (3) Table 27.1: add list of sample tribal mitigation efforts.	27. Mitigation		966		We have edited the text to incorporate this concern.
Kathy	Lynn	(1) p.991, line 3: add in-text citation to Chapter 12. (2) p.1006, line 4: add "tribes" to list	28. Adaptation				We thank the commenter for these suggestions and have added the cross reference to chapter 12 and added the word "tribes" to sentence in the list.
Kathy	Lynn	(1) p.1037, line 21: include "tribal" in the title of Research Goal 2. (2) p.1037, line 34-35: include tribes in the list	29. Research Agenda for				This has been added to the list.

			Climate Change Science				
David	Williams	It will be extremely useful to either identify the limitations of the projections for more intense precipitation events or identify continued work on the regional/sub-regional implications for these projections. I work on permitting major mine facilities and water management is a critical issue at many minesites. It will be critical to identify the likely parameters a mine will need to design for over the 30 - 50 year life of the mine.	2. Our Changing Climate		47		We have included a box discussion of the uncertainties in extreme precipitation projections. This box discussion shows that there is broad agreement among climate models that extreme precipitation will increase in all regions of the U.S and in fact over nearly all land areas globally. In many ways, confidence in projected future extreme precipitation is greater than for future mean precipitation. This is partly because the mechanism of changes are simpler. Principal among these over the US being the ability of warmer air to contain more water vapor. This is in contrast to the combination of increases and decreases in projected future mean precipitation. However, there is no accepted methodology for how extreme precipitation design values should be adjusted for the potential future increases from climate change.
Stacy	Small-Lorenz	April 11, 2013To Whom It May Concern,Thank you for the opportunity to comment on the National Climate Assessment (NCA), we commend the authors' progress to-date on this critically important document. Environmental Defense Fund (EDF) is a non-partisan environmental organization with more than 750,000 members nationwide, dedicated to working towards innovative, cost-effective solutions to environmental problems, building on a foundation of rigorous science, economics, and law. The Working Lands section of EDF's Land, Water & Wildlife program develops strategies to incentivize biodiversity and ecosystem service provision on private lands that produce food, fuel and fiber, in partnership with landowners, agencies, business and conservation groups. Chapter 8 of the draft National Climate Assessment addresses Ecosystems, Biodiversity, and Ecosystem Services. One of its five key messages states that "climate change impacts on ecosystems reduce their ability to improve water quality and regulate water flows." In support of this key message, the authors cite the Mississippi River Basin as a high profile example of increased nutrient loading and sediment transport that will come with higher precipitation and runoff predicted by climate change models. This is an important but partial reference to the array of threats that climate change poses to freshwater ecosystems on the whole, especially in the Midwestern U.S. Climate change impacts such as heavy spring precipitation, drought, and warmer temperatures will likely interact with other anthropogenic stressors in the Mississippi River Basin such as agricultural expansion, wetland drainage, fertilizer application, water withdrawals, and river regulation to produce severe impacts to freshwater ecosystems and the native fish and wildlife species that depend upon them. We feel that this important message is understated in the Midwest section of the assessment. Furthermore, although chapter 8 highlights the potential loss of iconic species across the U.S. as a result of climate change, far too little attention is paid to the	18. Midwest				We appreciate the multiple suggestions, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include. Some text has been revised to incorporate broadened discussion of biodiversity within the context of the key message.

		matter of native biodiversity loss in the Midwest chapter of the assessment. Climate change vulnerability assessments (CCVAs) are valuable tools for assessing how climate change will likely affect biodiversity, as highlighted in chapter 8 of the draft National Climate Assessment. We would therefore like to draw the authors' attention to CCVAs for native species that have been conducted in the Midwest region and urge that those results be considered for inclusion in the Midwest section of the National Climate Assessment. While CCVAs don't offer absolute certainty about any one species' vulnerability to climate change, they can be particularly useful for identifying patterns of vulnerability and targeting ecosystem management for the greatest climate adaptation benefit.CCVAs conducted by fish and wildlife professionals in the Corn Belt region have found species associated with freshwater ecosystems to be especially vulnerable to climate change. Illinois assessed species of conservation concern and found 70% of aquatic and semi-aquatic species (62 of 88 species assessed) to be climate change vulnerable. Iowa found 60% of aquatic and semi-aquatic species (93 of 156 species assessed) to be climate change vulnerable. Nebraska found 67% of aquatic species (18 of 27 species assessed) to be climate change vulnerable. This pattern was corroborated by EDF's findings in our own independent assessment of all Illinois vertebrates. Other CCVAs have been conducted or are underway throughout the Upper Mississippi River watershed, including the states of Michigan, Minnesota, and Wisconsin, according to a 2012 survey by the Association of Fish and Wildlife Agencies (A. Choudry, pers. comm.), and we urge the authors to avail themselves of expertise in those states to highlight the plight of native biodiversity in the Midwest.Considering these results and given that chapter 8 of the National Climate Assessment calls attention to a) imperiled aquatic ecosystems, with special attention to the Mississippi River Basin, b) climate change threats to iconic plant and animal species, and c) the availability of climate change vulnerability assessment frameworks to evaluate climate change threats to species, we urge the authors of the Midwest section to give more specific attention to the vulnerability of aquatic ecosystems and the native fish and wildlife species that depend upon them, using available CCVA information. While we note that the draft assessment focuses some attention on impacts to commercial and recreational fisheries of the Midwest, climate change impacts to native Midwestern species extend well beyond these sectors.Furthermore, while native Midwestern biodiversity has its own intrinsic value, the region will also serve as a critical central corridor for North American species undergoing climate-driven range shifts from other geographies, if ecosystems are managed as habitat networks that provide landscape permeability. In the agriculture-intensive Corn Belt region, riparian (streamside) systems have some of the highest potential for management as habitat networks. Given the continental-scale implications of this matter, we feel it is one that should be highlighted in the National Climate Assessment.Respectfully,Stacy L. Small-Lorenz, Ph.D. Conservation Scientist Land, Water & Wildlife Program					
James	Tolbert	The FINAL Regional Climate Change Action Plan was issued by the Southeast Florida Compact Counties in October of 2012. Also, the "REGIONAL CLIMATE ACTION FRAMEWORK: IMPLEMENTATION GUIDE" has also been issued by the same group. Both are available at http://southeastfloridaclimatecompact.org/compact-documents/ . Please update your reference for this material as a final document.	28. Adaptation		1031	12	We thank the commentor for this updated reference. We have revised it in the references section.
Brian	Marshall	To expand the usefulness of the National Climate Assessment, add a list of recommendations for action to each chapter. _____Overall, the draft Third National Climate Assessment is an outstanding report, as far as it goes. When completed, it promises to be the most authoritative and wide-ranging					Thank you for your comment. The Research Agenda chapter has synthesized research needs from across the report chapters. Several other chapters also include explicit

		scientific analysis ever prepared about the impacts of climate change facing the United States. This comprehensive assessment is valuable, but still falls short of the type of document that is urgently needed today. The key messages presented in each chapter provide a compelling status summary, but to be truly useful, the report needs to go further to include recommended actions.Climate change encompasses a collection of important issues in need of immediate attention. The magnitude and complexity of these issues have made decision-making and implementation extremely difficult at all levels. To a large degree, the reluctance of the world scientific community to offer anything beyond an assessment of the problems has empowered this inaction. This report could significantly advance local, regional, national and international decision-making processes by including a list of recommended high-level response actions to the problems that have been identified. By outlining more detailed response options and providing recommended solutions, this report would better support decision-making while encouraging a propensity for action.Before completely dismissing this comment because making recommendations is not officially required by the Global Change Research Act of 1990, please consider that the advisory committee has already recognized (especially in Chapter 26) gaps exist in the process between data generation and decision making. However, the gap is not created by a lack of 'science translators' as suggested in Chapter 26. There are plenty of capable decision makers who understand science and plenty of knowledgeable scientists who comprehend policy making.Previously, scientific assessments have not gone far enough, so policy makers have not been able to take the conclusions of the technical experts and convert them into meaningful actions for implementation. Therefore, the 'translation' needed is for the climate scientists to go beyond their problem-identifying conclusions, using their technical expertise to delve into potential solutions. One of the simplest and most effective ways to promote decision-making collaboration is to encourage more overlap among participants throughout the process. A direct way to bridge this gap is to have the experts who draw the important conclusions (i.e., 'key messages') also offer a set of recommendations to address the identified problems. Assuming decision makers agree that policies should be established based on facts and guided by science, then the technical experts who study and understand the issues should play a prominent role in establishing the strategies needed to respond to climate change. They are the ones who have the most direct and substantive knowledge of the causes, effects, and potential solutions to the problems the world faces.The few recommendations that are included in the report are related to research needs presented in Chapter 29. It is appropriate to include this type of recommendation where uncertainties exist about the climate system and dynamics, as well as potential mitigation and adaptation measures. However, equally important is to recommend actions for those issues/problems that are well established or for which there is little uncertainty.There should be no concern that making recommendations might infringe on the territory of policy makers. The type of recommendations suggested here are only those of a broad nature, based on well-established scientific data and principles. If the recommendations effectively describe what actions should be taken and why, then policy makers will have the information needed to accept, reject or modify each recommendation during their decision-making processes. Once policy makers make a decision and choose a general course of action, then they will still need to develop the many details defining how the policies will be implemented. To prepare the Third National Climate Assessment, the advisory committee has convened an eminent group of scientists, experts and policy specialists as authors. Collectively, these teams of authors could undoubtedly offer some sound advice in the form of recommendations for action going forward. Building on the coordinated effort already established among USGCRP agencies and researchers for preparing this assessment, any promising solutions offered would be expected to be high-quality, peer-reviewed and well-grounded in current scientific knowledge. With the addition of some basic recommendations, this report could be transformed into a strong leadership document designed to help drive solutions rather than just highlight the problems.					mention of actions and information needs.
Kizzy	Charles-	Part I: Comments on health impacts	9.				We appreciate these excellent

	Guzman	Air Pollution: It would be interesting to mention how the $6.5 billion in health costs was calculated, even on the most general level, especially considering the importance of economic arguments for adaptation efforts. Temperature extremes: It is important to emphasize the severity of heat events, which may be better represented with quantitative data. - In an average year, heat waves kill more people in the U.S. than any other type of natural disaster - One study found that, nationally, there was on average a 3.74% increase in natural-cause mortality on heat wave days compared with non-heat wave days, with risk increasing 2.49% for every 1°F increase in heat wave intensity and 0.38% for every one-day increase in heat wave duration (Anderson & Bell, 2011)Extreme Events, Injuries, and Illnesses: Not very much was said about extreme storms in general, and therefore its importance seems minimized. - Extreme/heavy precipitation events specifically include sea level rise, intensifying storm surge, increasing frequency of hurricanes and other extreme storms, which then leads to injuries/illnesses/death (NPCC 2009) - The most severe effect of hurricane landfall is death from drowning (as mentioned), but also electrocutions or physical trauma (Brunkard, Namulanda, & Ratard, 2008; Fayard, 2009; Jonkman & Kelman, 2005; Jonkman, Maaskant, Boyd, & Levitan, 2009). - Hurricane landfall can also result in a range of non-fatal injuries, including blunt trauma, puncture wounds, lacerations, sprains/strains, motor vehicle crashes, animal bites, and electrocution (CDC, 2005b, 2006; Shultz, Russell, & Espinel, 2005; Warner, 2010). - Secondary exposure from contaminated water and mold and moisture in housing is also a health threat associated with extreme storms and heavy precipitation- this point was mentioned in the diagram on page 347, but doesn't have written text that explains it in very much detail. - Exposure to sewage-contaminated floodwaters and wastewater may lead to gastrointestinal infections, acute respiratory infections, skin infections, and insect bites (Amaral-Zettler, Rocca, Lamontagne, Dennett, & Gast, 2008; CDC, 2005a, 2005b, 2006). - There is also potential for toxic release of hazardous substances after a storm (Chung et al., 2009; Ruckart et al., 2008). There are additional health effects related to extreme storm events and heat waves that can be included:Power outages were mentioned minimally in some of the boxed examples related to heat waves. The risk of power outage is increased by extreme weather events including heat waves, when increased electric demand from air conditioners strains the system; coastal storms, when high winds can down over-ground power lines and flooding can damage underground cables and low-lying power stations; and ice storms, when accumulated ice can snap power lines and poles directly or by bringing down trees - Studies of the August 14-15, 2003 Northeast blackout that affected NYC found increased mortality from both accidental and natural causes that resulted in approximately 90 excess deaths (an increase of 28%) (Anderson & Bell, 2012). - Studies have shown increases in death from eating spoiled foods, especially meat and seafood, during	Human Health				suggestions, but space is very limited. The chapter focused on broad trends for the climate-health topic, and many of the details raised while excellent are beyond the space constraints of the chapter.

		power outages (Marx et al 2006). - Risks of falls can occur from inadequate lighting in dwellings, hallways, and stairwells (Broder et al., 2005) - Power outages can also effect health facilities, especially when hospitals experience equipment failure related to backup generators; during the 2003 blackout, 4 out of 75 hospitals in NYC lost power, despite having back-up generators (Beatty et al., 2006) - One of the difficulties in assessing the health effects of power outages is lack of published, rigorous studies. In addition, data that does exist looks at effects of power outages during normal hot days rather than during extreme heat waves; public health systems may not be prepared for power outages during intense heat wavesCarbon monoxide poisoning was only briefly mentioned with respect to wildfires, but CO poisoning is a major health hazard with other extreme weather events, such as during heat events or storms/floods - CO poisoning occurs when portable generators, cooking appliances, and other gas-powered equipment are used indoors or improperly, which can occur during storm events and/or after power outages (Broder, Mehrotra, & Tintinalli, 2005; CDC, 1996, 2004; Cox, Amundson, & Brackin, 2008; Cukor & Restuccia, 2007; Daley, Smith, Paz-Argandona, Malilay, & McGeehin, 2000; Gulati et al., 2009; Kile et al., 2005; Klein, Herzog, Smolinske, & White, 2007; Muscatiello, Babcock, Jones, Horn, & Hwang, 2010). - Following Hurricane Sandy through November 9, CO-related emergency department visits were elevated several fold compared to expected counts for the time of year (NYC DOHMH, 2012). Consider highlighting an example from Hurricane Sandy or other major events that occurred more recently Hurricane Katrina: - During Sandy, several hospitals, nursing and long-term care facilities lost power and had to evacuate patients; NYU Langone Medical Center was forced to evacuate patients due to power outages during the peak of the storm; 215 patients had to be transferred to neighboring hospitals and the hospital's basement and lower levels flooded with 10 to 12 feet of water. (Sifferlin, 2012 TIME article) - As of November 1, 2012, Con Edison, New York City's primary electrical provider, still had 650,000 customers out of power. At that time overall, power was out for 4.6 million homes and businesses. (TIME NewsFeed) - As of November 26, 2012, NYC estimated that public and private losses from Superstorm Sandy totaled at least $19 billion (NYC 2012).Part II: Comments on vulnerable populations Besides children, the elderly, the sick, the poor, and some communities of color, there are other vulnerable populations that deserve to be mentioned, despite falling within some of the mentioned categories: - Beyond biological and physiological reasons, the elderly are further susceptible because of: reliance on medication, physical care, life sustaining medical equipment, chronic disease conditions (Rand 2005). (Some medication can specifically interfere with controlling body temperature/hydration.)					

		- A critical vulnerability factor for heat is lack of access to air conditioning - Homebound populations have also shown to be more vulnerable. Poor and minority populations, and elderly nursing home residents, are more likely to lack transportation during disasters, and these populations often have a high prevalence of chronic health problems. (Zoraster, 2010). - Being socially isolated, bed-ridden, or homebound makes it harder to get assistance during extreme weather events (Semenza et al., 1996) (Bouchama et al., 2007) (EPA 2006) - Residents of nursing homes that sheltered in place are among those that can be killed by drowning (D. Dosa et al., 2011) - Residents of nursing homes and other major facilities that must be evacuated are also vulnerable to the range of health impacts related to evacuation - Non-English speakers, the unemployed/uninsured, and those with poor housing quality are also among vulnerable populations (Guatam 2009). - Incarcerated populations may also be more vulnerable in a number of climate events; In New Orleans during Katrina, a lack of basic emergency preparedness and planning led to chaos during the storm. Prisoners locked in cells were abandoned to weather the storm alone without power, food, water, or even sufficient ventilation (ACLU 2006). Despite the vast amount of data around Katrina, consider using examples from other events to increase the generalizability of the point: - During the 2003 northeast blackout, studies in NYC found that seniors aged 65-74 were the most vulnerable (Anderson & Bell, 2012). - During Sandy, providers in the Rockaways identified patients with pre-existing diagnoses of asthma or COPD but that had run out of their regular medication, making them more vulnerable to the effects of those illnesses (NYC DOHMH 2012 Alert #34). Most of Sandy's victims were low income New Yorkers (NYU Furman Center), and communities that were resilient and organized before Sandy were the most resilient after the disaster hit (Sandy Regional Assembly). Part III: Comments on prevention strategies and co-benefitsBeyond early warning systems and other methods mentioned, the following strategies (arranged by specific climate hazard & including some examples) are also preventative measures that offer protection and a wide variety of co-benefits: Heat & Air Pollution Target heat health resilience efforts to the most vulnerable neighborhoods and populations Implement and continue to monitor heat vulnerability measures and health outcomes Increase access to AC for vulnerable people to reduce heat stress and ozone exposure: - Develop funding for subsidies to purchase and install room air conditioning units, analogous to low income heat energy assistance programs, to strengthen the capacity of vulnerable populations during extreme heat events; over 80% of those who died from heat stroke in recent years in NYC were exposed to heat at home (White-Newsome et al., 2012)					

		- The state of Rhode Island has a Low-Income Home Energy Assistance Program to help residents who are 60% below RI median income make payments (State of Rhode Island Office of Energy Resources) - Improve access to and appeal of cooling centers - Ensure that congregate facilities housing vulnerable populations (for instance, long-term care and mental health facilities, single room occupancy residences, and prisons) ensure that residents have access to air conditioned spaces during hot weather, such as in Toronto where community agencies serving vulnerable populations may join a heat registry program so individuals can be checked on during heat events (City of Toronto Heat Registries) Expand urban heat island mitigation & electricity conservation: - Identify and map hot spots of UHI neighborhoods - For example, Chicago publishes urban heat island maps (City of Chicago) - Expand cool roof and greening programs - Examples include programs in New York City (PlaNYC 2030), Chicago (City of Chicago CCAP), and Michigan's Ann Arbor Community Forest Management program (City of Ann Arbor) - Improve measures to reduce wasteful cooling in commercial and residential buildings; (set minimum AC temperatures in commercial establishments & maximum room temperature requirements in certain buildings, building regulations into health codes) Bolster heat emergency response - Maintain effective communication (as mentioned), which should more specifically involve evaluating current communication networks, health messaging, and emergency response systems, to bolster overall prevention systems - For example, Boston's municipal web portal was rated the best city portal in the country in 2010 (Center for Digital Government) - This should also include improved evacuation plans, policies, procedures, and messaging - For example, after a heat alert is issued in Philadelphia, "block captains" are notified and asked to check on elderly neighbors (Streets Philadelphia) Reduce ground level ozone - Identify and map air pollution hot spots using ground-level monitoring - For example, California monitors for "toxic hot spots" related to air pollution (CA Natural Resources Agency) & New York City's Community Air Survey measures street-level pollutant concentration (PlaNYC 2030)					

		- Track trends in hospital use for ozone-sensitive conditions like asthma/respiratory conditions Disseminate findings to provide feedback for improvement of interventions - Create resilient communities through public information and outreach (PlaNYC 2030) Coastal storms Improvement of evacuation plans and behaviors, including community engagement - Improve evacuation plans and behaviors during emergency events with improved communication, clearly defined agency roles, and early identification of facilities and homes occupied by homebound, seniors, and other vulnerable populations - Adequately prepare health and residential care facilities for climate-related weather events, particularly flooding and storms - Ensure that volunteer networks are coordinated and informed, and adequately train volunteers and local CERT teams (Sandy Regional Assembly) - Identify and map hot spots of potential storm surge - Plans should include standardized evacuation and communication protocols, and facilitating the use of FEMA/Red Cross response teams to more clearly determine roles that can more quickly be delegated - Integrate regional building efforts with local resiliency priorities & include organizations that represent vulnerable populations in the planning process (Sandy Regional Assembly) Safeguard hazardous materials to prevent public exposure and related health impacts during flooding events or subsequent clean-up efforts - For example, the Sandy Regional Assembly recommends updating NYC's Waterfront Revitalization Program to include more risk assessments and tougher regulation on the handling of hazardous materials (SRA) Address essential utility outages and risks of sheltering in placePower and Utility Outage Prevent and prepare for extended outages - Improve capacity for door-to-door outreach during extended power outages, with a focus on the most vulnerable - For example, the Kentucky Outreach and Information Network (KOIN) works to build a person-to-person network to communicate with hard-to-reach populations (Kentucky Health Alerts) - Implement and enhance monitoring systems that measure electric power demand - Implement and enhance monitoring systems that look at morbidity/mortality, neighborhood health, built environment, social vulnerability measures, neighborhood level temperature data					

- Coordinate with utilities to address power disruptions in critical health facilities

- Identify homes occupied by persons requiring home medical equipment

- Develop public communication tools for areas affected by power outages (i.e. without TV, internet)

- Prepare for such communication disruptions, such as by providing cell phone charging stations in vulnerable areas prior to severe weather events (Sandy Regional Assembly)

- Track trends in GI/foodborne illness, CO poisoning, cold or heat illness, injury, death, excess hospitalizations/mortality, mental illness, and other health effects related to power outagesReferences

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Thomas	Pease	Overall I am impressed by the quality and balance of the presentation. In this chapter and others it becomes confusing when partsof the discusson refer to historical periods of 10, 50 or 100 yers to support trends. Similarly, the references to future conditions include various numbers of decades. While authros of prior pubnlications have addressed differenttime scale and their resutls need to be accurately portrayed, for the sake of the reader, it is helpful to use consistent interpretations of say the next 20 years and the to the end fo the centrury.	2. Our Changing Climate				A special box has been added to the text to explain the choice of the base periods.
Lawrence	Jones	Add: 12. Rate of change is uncertain, and the possibility of abrupt (sub-decadal) climate change cannot be dismissed. Important indicators (such as the decline in annual minimum Arctic Sea ice volume) are changing more rapidly than forecast by the global climate models which guide policy. If triggered, an abrupt climate change may be difficult to identify with confidence until years after the onset. An unexpectedly rapid transition to a warmer climate may occur without warning from climate models, based on challenges in modeling (i) known abrupt climate changes in the geological record and (ii) identified non-linear positive feedback mechanisms (such as permafrost methane release). (Ch. 22, 29).	1. Executive Summary		10	28	Good points, but the authors have chosen not to add another report finding on these topics…
Simone	Brant	Snowpack and streamflow are not expected to decline in all parts of the Southwest. For example, the following study predicts increases in some parts of California.Pierce, D. W., T. Das, D. R. Cayan, E. P. Maurer, N. L. Miller, Y. Bao, M. Kanamitsu, K. Yoshimura, M. A. Snyder, L. C. Sloan, G. Franco, M. Tyree, 2013: Probabilistic estimates of future changes in California temperature and precipitation using statistical and dynamical downscaling. Climate Dynamics, v. 40, 839-856. doi 10.1007/s00382-012-1337-9.	20. Southwest		687	14	Thank you for your comment The text has been revised to incorporate this suggestion.
Robert	Webb	The opening sentence is a truism. One could make an equally true and scientifically more robust statement "Milankovitch forcing of climate is already effecting the American people." I would suggest "Changes in climate are already effecting the American people", recognizing that some changes are due anthropogenic forcing and some are due to natural variability.	1. Executive Summary		3	2	After consideration of this point, we still feel the existing text is clear and accurate.
Robert	Webb	"Certain types of weather events have become more frequent and/or intense, including heat waves, heavy downpours, and, in some regions, floods and droughts." This is an over statement for climate change induced droughts and floods- see Lubchenco and Karl (2012)	1. Executive Summary		3	2	The existing language is consistent with current knowledge - and describes observed conditions without a direct statement about attribution.
Robert	Webb	rewrite sentence to read "Many climate impacts are important to Americansê health and livelihoods and the ecosystems that sustain us."	1. Executive Summary		3	7	This change has been made.
Robert	Webb	NOAA said 20 times in July 2012 while Hoerling et al 2012 indicated that 0.6 C warming relative to the 1981-2010 mean is estimated to be attributable to human-induced climate change. Suggest rewrite " Äthat human influence on the climate has increased the risk for extreme heat events like the record-breaking summer of 2011 in Texas and Oklahoma Ä –	1. Executive Summary		3	36	After consideration of this point, we but still feel the text is clear and accurate.
Robert	Webb	There is some evidence that this affects weather patterns farther south in the United States'. There are modeling studies that suggest the decrease in Arctic sea ice both will and will not affect US weather patterns. Suggest rewrite "Some modeling studies suggest that a decrease in Arctic sea affects weather patterns farther south in the United States.	1. Executive Summary		4	17	This statement has been removed.

Robert	Webb	Climate change will influence human health in many ways; some existing health threats will intensify, some may be reduced, and new health threats will emerge.	1. Executive Summary		5	8	Language is amended in response to this comment.
Robert	Webb	As climate change and its impacts are becoming more prevalent, Americans face choices.' The sequencing of the opening sentencet is strange and I suggest deleting the phrase and start the paragraph "Americans face choices." The rest of the paragraph provides a powerful state to act whereas the opening phrase could be a distraction on whether the observed climate impacts are solely the result of human induced global climate change.	1. Executive Summary		5	40	The authors are comfortable with the existing language.
Robert	Webb	"Infrastructure across the U.S. is being adversely affected by phenomena associated with climate change, including sea level rise, storm surge, heavy downpours, and extreme heat. Saying 'phenomena associated with climate change" ignores causality. Just because one might expect certain phenomena to increase in frequency or intensity with climate change does not mean that the observed changes and impacts are due to human induced global climate change. Interannual (ENSO) and decadal variability (PDO, AMO) still dominate many of the phenomena. Suggest to rewrite:"Infrastructure across the U.S. is being adversely affected by sea level rise, storm surge, heavy downpours, and extreme heat. The impacts of these types of climate phenomena are projected to increase with climate change"	1. Executive Summary		8	2	This language has been modified in response to the comment.
Robert	Webb	"Reliability of water supplies is being reduced by climate change in a variety of ways that affect ecosystems and livelihoods in many regions, particularly the Southwest, and the islands of the Caribbean and the Pacific, including the state of Hawai`i." I do not believe there are peer-reviewed climate change detection and attribution references to support making this statement for the Great Plains and for the Southeast and thus I suggest deleting these regions from the list	1. Executive Summary		9	16	The Report Finding on water has been revised to indicate that particular stress on water supply is expected in the southern states, Caribbean, and Pacific Islands.
Robert	Webb	In many regions, the temperature effect of climate change increases the likelihood of water shortages and competition for water among agricultural, municipal, and environmental uses.	1. Executive Summary		9	20	Emphasizing that the driver of these changes is temperature alone may not be useful; the authors have chosen to leave this language as originally proposed.
Robert	Webb	change 'climate change' to 'climate variability and change"	1. Executive Summary		10	1	After consideration of this point, we still feel the existing text is clear and accurate.
Robert	Webb	delete "associated with climate change" because the causality is not true for such a blanket statement	1. Executive Summary		10	6	There is literature that connects longer growing seasons associated with climate change and pest outbreaks of various kinds cited in the Agriculture, Ecosystems and Forestry chapters.
Robert	Webb	Change the title of 'Table 1.1: Regional Observations of Climate Impacts' The table includes an impressive inventory but not every observation is of climate or attributable to climate change.	1. Executive Summary	Table 1.1	11		The table has been replaced with an infographic of regional impacts. After consideration of this point, we still feel the caption is clear and accurate. Elsewhere, the Context and Background describes climate change impacts in the context of multiple stressors.
Robert	Webb	Change to read: Peak snowpack amounts are projected to occur earlier and in some basins decline, impacting the timing and amount of streamflow and water supply for cities, agriculture, and ecosystems.	20. Southwest		687	14	Thank you for your comment. We have very tight word limit constraints, but we have incorporated your suggestion

							into a revised key message.
Robert	Webb	Change to read: Droughts combined with climate change warming have increased wildfires and impacts to people and ecosystems in the Southwest. Fire models project more wildfire and increased risks to communities across extensive areas.	20. Southwest		687	20	The text has been revised to incorporate this and other suggestions received.
Robert	Webb	by saying 'is already occuring' this may be misinterpreted to be linked to ongoing global climate change. NRC report suggests the dominant factors remain ENSO state (EL Ni_o), atmospheric pressure, and astromonical tides with the anthropogenic sea level rise a minor additive component. Change to read: Flooding and erosion in coastal areas have occurred in the past, and continus to occur, damaging some areas of the California coast during storms and extreme high tides. Sea level rise is projected to increase, resulting in major damage as wind-driven waves ride upon higher seas and reach further inland.	20. Southwest		687	23	Thank you for your suggestion. The text has been changed to eliminate misinterpretation about causes of flooding and erosion.
Robert	Webb	The Southwest is already experiencing the initial impacts of climate change. It is important to make it clear that there are more impacts to come and only the initial impacts are already being experienced currently.	20. Southwest		688	19	Thank you for your suggestion. After consideration of this point, we still feel the existing text is clear and accurate.
Robert	Webb	"increases in flows of airborne moisture" Dettinger & Ingram (2013) note an increase in projected amount of moisture of about 10 percent and projected number per year. Would be great to add this insight.	20. Southwest		689	17	Thank you for your comment. We feel the current text is sufficiently detailed. The 10 percent increase was reported in Dettinger 2011, which was already cited.
Robert	Webb	Change to read: Peak snowpack amounts are projected to occur earlier and in some basins decline, impacting the timing and amount of streamflow and water supply for cities, agriculture, and ecosystems.	20. Southwest		690	28	Thank you for your comment. We examined the SWE data and, in general, peak SWE amounts do not occur earlier in the year. For this reason, we are not changing the original text.
Robert	Webb	As noted in the caption these figures are for "Percent changes in statewide snow water equivalent (SWE) accumulation compared to the 1971-2000 modeled average for the first of the month during which the 1971-2000 modeled average modeled peak SWE occurred" It is possible for the total amount of snow to stay the same or even increase but the amount relative to the first of the month of the 1971-2000 peak SWE to have increase. A compress snow season with snowpack accumulating earlier and the melting off earlier in response to warmer temperatures.	20. Southwest	Figure 20.2	691		After consideration of this point, we still feel the existing text is clear and accurate. We reviewed the data and confirmed that in the vast majority of the cases, the peak SWE for each state does not occur earlier.
Robert	Webb	Change to read: Droughts combined with climate change warming have increased wildfires and impacts to people and ecosystems in the Southwest. Fire models project more wildfire and increased risks to communities across extensive areas.	20. Southwest		694	18	Thank you for your comment. The section has been modified to accommodate your suggestion and those of other commenters.
Robert	Webb	By saying 'is already occuring' this may be misinterpreted to be linked to ongoing global climate change. NRC report suggests the dominant factors remain ENSO state (EL Ni_o), atmospheric pressure, and astromonical tides with the anthropogenic sea level rise a minor additive component. Change to read: Flooding and erosion in coastal areas have occurred in the past, and continus to occur, damaging some areas of the California coast during storms and extreme high tides. Sea level rise is projected to increase, resulting in major damage as wind-driven waves ride upon higher seas and reach further inland.	20. Southwest		695	35	The text has been revised to incorporate this suggestion.
Robert	Webb	Key message change to: Peak snowpack amounts are projected to occur earlier and in some basins decline, impacting the timing and amount of streamflow and water supply for cities, agriculture, and ecosystems. I think statements using "will" are a bit too certain for confidence at 'high' rather than	20. Southwest	Key message #1/5	701		Thank you for your suggestion. We have modified the traceable account but have elected to retain "projected"

		'very high'. I suggest changing "Future flows in major Southwest rivers will decline as a result of a combination of increased temperatures, increased evaporation, less snow and less persistent snowpack" to "Future flows in the four major Southwest rivers are likely to decline as a result of a combination of increased temperatures, increased evaporation, less snow and less persistent snowpack"					in the language rather than characterize declines as "likely." We have also modified the key message to incorporate this and other suggestions.
Robert	Webb	Key message change to: Drought combined with climate change warming have increased wildfires and impacts to people and ecosystems in the Southwest. Fire models project more wildfire and increased risks to communities across extensive areas.	20. Southwest	Key message #3/5	704		The text has been revised to incorporate this and other suggestions received.
Robert	Webb	Change key statement to read: Flooding and erosion in coastal areas have occurred in the past, and continue to occur, damaging some areas of the California coast during storms and extreme high tides. Sea level rise is projected to increase, resulting in major damage as wind-driven waves ride upon higher seas and reach further inland. If it is virtually certain that sea level will go up then why Assessment of confidence based on evidence only 'High' rather than 'Very High'.	20. Southwest	Key message #4/5	706		The key statement has been modified to incorporate this and other suggestions received. We agree with the reviewer's suggestion of the assessment of confidence in the Traceable Accounts and have changed it to "very high."
Robert	Webb	"Climate Change Impacts on the Water Cycle." The underlying assumption for this section is that there are peer-reviewed climate change detection and attribution references to support the key messages. A simple fix is to change the section title to: "Climate Impacts on the Water Cycle."	3. Water Resources		107	17	After consideration of this point, we still feel the existing text is accurate.
Robert	Webb	"Annual precipitation and runoff increases are observed now in the Midwest and Northeast regions and are projected to continue or develop in northern states; decreases are observed and projected in southern states". This statement is in a section titled "Climate Change Impacts on the Water Cycle" with the implication that information listed are climate change impacts. The descriptions of the observed trends on page 108, lines 29-35 and material in Chapter 2 do not provide a peer-reviewed climate change detection and attribution reference to support such an assessment. Given the absence of causality the observed changes in the first sentence is misleading. The second sentence needs to be corrected for the the south central and south east given the data presented in NCA Figures 2.11 and 2.13	3. Water Resources		107	18	It is true that parts of the contiguous U.S. are regions of the globe where model simulated changes in mean annual precipitation are rather small compared to natural variations. This key message and accompanying text has been rewritten to put the emphasis on changes in extreme precipitation, for which models are in general agreement about increases almost everywhere.
Robert	Webb	"Summer droughts are expected to intensify in most regions of the U.S., with longer term reductions in water availability in the Southwest, Southeast, and Hawai•i in response to both rising temperatures and changes in precipitation." The text on page 113, lines 15-31 does not directly support this statement and changes is precipitation is ambiguous. Suggest a rewrite to: "The impacts of summer droughts are expected to intensify in most regions of the U.S., with longer term reductions in water availability in the Southwest, Southeast, and Hawai•i in response to rising temperatures ."	3. Water Resources		107	21	We have revised the first Key Message, which addresses dry spells, and the second Key Message on droughts, to reflect this and other comments. We now focus on droughts in general, not just summer. We discuss the roles of precipitation, evaporation, and temperature.
Robert	Webb	"Floods are projected to intensify in most regions of the U.S., even in areas where average annual precipitation is projected to decline, but especially in areas that are expected to become wetter, such as the Midwest and the Northeast." This seems to be a rather strong statement given that statement on page 114, lines 6-7 "floods in some cases are expected to increase _ even where precipitation and overall stream flows decline". Furthermore, the one relevant sentence in Chapter 2 (page 55, lines 18-19) talked in generalities "In general, heavier rains lead to a larger fraction of rainfall running off and, depending on the situation, more potential for flooding." Use the text from page 114 since 'most regions' _ 'some cases': "Floods are projected to intensify in some cases, even in areas where average annual precipitation is projected to decline, but especially in areas that are expected to become wetter,	3. Water Resources		107	24	We have revised the Key Message and the supporting text in response to this and other comments. We have edited our statement about flood projections and have noted that strong directional changes have not been documented to date.

		such as the Midwest and the Northeast."					
Robert	Webb	"Climate Change Impacts on Water Resources." The underlying assumption for this section is that there are peer-reviewed climate change detection and attribution references to support the key messages. A simple fix is to change the section title to: "Climate Impacts on on Water Resources."	3. Water Resources		108	1	After consideration of this point, we still feel the existing text is accurate.
Robert	Webb	In the Southwest, parts of the Southeast, the Great Plains, and the islands of the Caribbean and the Pacific, including the state of Hawai•i, surface and groundwater supplies are already affected and are expected to be reduced further by declining runoff and groundwater recharge trends, increasing the likelihood of water shortages for many off-stream and in-stream water uses. It is not obvious which parts of the Southeast are expected to dry from figures 2.12 and 2.13. Replace 'Great Plains' with 'part of the Great Plains" since figures 2.12 or 2.13 do not suggest uniform future reductions in precipitation (alternatively you might say lower Great Plains as noted in the last line of the table on page 133). Delete "are already affected and" since there is no peer-reviewed climate change detection and attribution for these regions to reference.	3. Water Resources		108	2	We have revised the applicable key message.
Robert	Webb	After correcting the language in the 'Key Messages', the corresponding text in the body of the chapter needs to be corrected.	3. Water Resources				Thank you for your comment. We have ensured consistency between the key messages and the corresponding text in the body.
Robert	Webb	After correcting the language in the 'Key Messages', the corresponding text in the traceable accounts needs to be corrected. The 'description of the evidence base' needs to be tightened up. Too often the text as written suggests that if a change in an enviromental condition is currently being observed and has been projected to change in a similar manner in the future, then the observed change can be attributed to global climate change. By not depending on peer-reviewed climate change detection and attribution that formally identifies the role anthropogenic emissions in the observed change, this assessment approach can easily misinterpret multi-year to decadal or multidecadal natural variations (e.g.,PDO and AMO) as climate change impacts.	3. Water Resources				We have added text that notes that natural variations, local human influences and climate change can all contribute to historical observed changes. Indeed, natural variations will be present in all of them, local human influences may be present in many of them, and it remains to be shown for nearly all of the variables documented here whether, and to what extent, climate change is contributing.
Robert	Webb	The construct of this sentence makes the content both true and not true. "Certain types of extreme weather events have become more frequent and intense, including heat waves, floods, and droughts in some regions." Some have become more frequent and some more intense. I would break it into two sentences: "Certain types of extreme weather events have become more frequent and intense. For example, heat waves have become more frequent in the western US and Alaska, flooding more frequent in the northcentral US, and drought intensity has increase under warmer climate conditions, especially in the southwestern US	2. Our Changing Climate		26	14	The Key Message has been revised. Considerable evidence in support of the key message is given in the supporting text.
Robert	Webb	While true for 1980 to present, the open sentence ignores the caution stated in the IPCC SREX assessment (p 159) " Global reanalyses of tropical cyclone intensity using a homogenous satellite record have suggested that changing technology has introduced a non-stationary bias that inflates trends in measures of intensity (Kossin et al., 2007), but a significant upward trend in the intensity of the strongest tropical cyclones remains after this bias is accounted for (Elsner et al., 2008). While these analyses are suggestive of a link between observed global tropical cyclone intensity and climate change, they are necessarily confined to a roughly 30-year period of satellite observations, and cannot provide clear evidence for a longer-term trend." It is worth remembering how the selection of start date, end date, and record length are important in calculating trends. See Liebmann, B, R Dole, C Jones, I Blad_, and Allured, 2010: Influence of Choice of Time Period on Global Surface Temperature Trend Estimates. Bulletin of the American Meteorological Society, 91, 1485-1491.	2. Our Changing Climate		26	20	Thank you for your comment. We agree that a caveat is appropriate here. This was the motivation for the statement about “ocean cycles”. We have modified the text of the Key Message to be more clear about the uncertainty in the anthropogenic vs natural forcing of the observed changes.

Robert	Webb	I believe one of the esteem lead authors on this chapter have a paper coming out that challenges, if not refutes, the statistical approach used in the Hansen et al (2012) paper.	2. Our Changing Climate		52	23	The text has been revised.
Robert	Webb	I discussed with Dr. Hoerling the sentence "So while this Texas heat wave and drought could have occurred naturally, the likelihood of record-breaking temperature extremes has increased and will continue to increase as the global climate warms." Based on my discussion with the lead-author of study being interpreted, I suggest a slight rewrite of the sentence to reflect the actual findings of the study: "The Texas drought and heat wave was primarily a natural occurring event driven by a deficit in precipitation; nonetheless, the chances for record-breaking temperature extremes has increased and will continue to increase as the global climate warms."	2. Our Changing Climate		52	29	We have reworded the sentence to convey the essence of the reviewer's comment.
Felix	Deguilla, Jr.	While existing nuclear power plant designs are inherently unsafe and require voluminous quantities of water for their operation, it should be noted that tomorrow's modern molten-salt nuclear reactors will not require any water to operate.	4. Energy Supply and Use		174	21	Due to page length limitations in the National Climate Assessment, it is not possible to include discussion of advantages and disadvantages of non-commercial technologies.
Garrit	Voggesser	There is no reference to the tribal forest section of the National Climate Assessment Forest Sector Technical Report in the Forest chapter (see pgs 32-35). This is a significant omission and should be addressed in the revision to the NCA Forest Chapter. (Vose, James M.; Peterson, David L.; Patel-Weynand, Toral, eds. 2012. National Climate Assessment—forest sector technical report. PNW-GTR-870. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.)	7. Forestry				We defer you to Chapter 12 on Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources.
Christina	Swanson	Chapter 3 – Water ResourcesAdaptation and Institutional Responses As noted in the draft report, climate change will present severe challenges to water infrastructure in the U.S., much of which is in need of repair and replacement(1). Estimates by the U.S. EPA and others indicate that investments of several hundred billion dollars to more than $1 trillion are needed in the coming decades to replace our country's aging water infrastructure(2). While the report states that "[c]urrent drainage infrastructure may be overwhelmed during heavy precipitation and high runoff events anticipated as a result of climate change(3)," it fails to acknowledge that in light of current deficiencies, existing drainage infrastructure oftentimes is already overwhelmed during these events. In Philadelphia when it rains, combined sewer overflow (CSO) events occur in some places up to 85 times a year(4). In New York City, approximately 30 billion gallons of CSO are discharged annually(5), with overflows in some areas occurring up to 75 times a year(6). Other municipalities with combined sewer systems experience similar CSO occurrences(7). To address these challenges, municipalities across the country are increasingly turning to green infrastructure techniques, which utilize soils and vegetation in the built environment to absorb runoff close to where it falls, limiting flooding and sewer backups. Green infrastructure such as green roofs, rain gardens, roadside plantings, porous pavement, and rainwater harvesting not only reduce flooding and protect water quality – they also transform rainwater from a source of pollution into a valuable resource that helps to literally green the urban landscape, cool and cleanse the air, enhance water supplies, reduce asthma and heat-related illnesses, cut heating and cooling energy costs, create urban oases of open space, and enhance property values(8). Footnotes: (1) Draft NCA at 129. (2) See U.S. EPA, 2009 Drinking Water Infrastructure Needs Survey and Assessment (2009), available at water.epa.gov/infrastructure/drinkingwater/dwns/upload/2009_03_26_needssurvey_2007_report_needssurvey_2007.pdf; U.S. EPA, Clean Water Needs Survey (CWNS), 2008 Report to Congress (2008),	3. Water Resources				The text has been revised to incorporate the suggestion.

		available at water.epa.gov/scitech/datait/databases/cwns/upload/cwns2008rtc.pdf; and American Water Works Association, Buried No Longer: Confronting America's Water Infrastructure Challenge (2012), available at www.awwa.org/Portals/0/files/legreg/documents/BuriedNoLonger.pdf. (3) Draft NCA at 129, lines 15-16. (4) City of Philadelphia Water Department, Green City, Clean Waters—Philadelphia Combined Sewer Overflow Control Long Term Control Plan Update (September 2009), p. 3-91, available at www.phillywatersheds.org/ltcpu/LTCPU_Section03_Characterization.pdf. (5) New York City Department of Environmental Protection, NYC Green Infrastructure Plan: A Sustainable Strategy for Clean Waterways (2010), p. 8, available at www.nyc.gov/html/dep/html/stormwater/nyc_green_infrastructure_plan.shtml. (6) New York City Department of Environmental Protection, Gowanus Canal Waterbody/Watershed Facility Plan Report (2008), www.nyc.gov/html/dep/html/dep_projects/gowanus.shtml. (7) NRDC, Rooftops to Rivers II: Green Strategies for Controlling Stormwater and Combined Sewer Overflows (2011), available at www.nrdc.org/water/pollution/rooftopsii. (8) Id. at 13-16.					
Tyler	Corson-Rikert	Are the 1.2 million people who move to the "coast" each year moving to one of the 672 coastal counties/parishes? If so, given that a significant number of the "672 coastal counties and parishes of the U.S." do not actually border the coast, it is strongly recommended that line 2 on page 869 be reworded to be more precise.	25. Coastal Zone Development and Ecosystems		869	2	The text has been revised to reduce the potential for confusion on this point.
Tyler	Corson-Rikert	Suggested edit: "The amount of flooding ("return level") due to a 100-year storm (that is, a storm that has a 1% chance of [insert: 'being equaled or exceeded'] [delete: 'occurring'] in any given year)"	25. Coastal Zone Development and Ecosystems	25.3	871		We have decided to keep the sentence as is, and revised other sections of the caption to make it more understandable.
Tyler	Corson-Rikert	What are the 20 largest cities located along coastlines? This is probably important enough to list them in the text or in a table. Also, "located along coastlines" is ambiguous and therefore meaningless. Are the 20 cities located in the Low Elevation Coastal Zone (LECZ), or in one-percent annual chance coastal flood hazard areas? At a minimum, recommend replacing "located along coastlines" with "located near coastlines" (or "bordering coastlines" if applicable). But much better still would be to determine how many of the 25 largest U.S. cities are located in the LECZ.	25. Coastal Zone Development and Ecosystems		878	4	This sentence has been struck from the text. NOAA makes a useful distinction of watershed and shoreline coastal counties, which is instructive here. The former reaches farther inland and constitutes the population that affects coastal ecosystems and waters, whereas the latter constitutes the population that is most directly influenced by coastal hazards. For the

							purposes here, BOTH definitions of coastal (and thus, location of cities along the coast) are relevant. Insufficient coastal infrastructure will affect coastal urban areas, ecosystems and waters. Coastal storms will impact coastal infrastructure. Thus the two interpretations are entirely appropriate here.
Tyler	Corson-Rikert	Suggested edit: "… Federal Emergency Management Agency (FEMA) (the 100-year flood zone is the aerial extent of a flood that has a 1% chance of [insert: 'being equaled or exceeded'] [delete: 'occurring'] in any given year).	25. Coastal Zone Development and Ecosystems		880	4	After consideration of this point, we decided against making such a large change because it would make the language less accessible to lay readers (the audience we were asked to assume) – hence only a small revision was made.
Tyler	Corson-Rikert	A citation is needed for the "217,000 individuals." (This number is not in Heberger, et al. 2009).	25. Coastal Zone Development and Ecosystems		883	5	The text has been corrected due to this suggestion. The correct value from Heberger et al. 2009 is 270,000, which was derived by summing the totals from Tables 8 (for Pacific Coast areas) and 9 (for San Francisco Bay-bordering areas) in that report.
Tyler	Corson-Rikert	Neither GAO 2004, nor King 2005 says or alludes to this. Recommend finding a relevant citation or deleting this passage.	25. Coastal Zone Development and Ecosystems		887	32	Convening lead author contacted several experts on this issue: Kunreuther (University of Pennsylvania), King (CRS), and Crowell/Heal/McAfee (FEMA) to see if anyone had analyzed the data. This analysis had not been undertaken to date, but FEMA agreed to analyze their database to answer our question. The result has led to the correction made in the text.In addition, we note that King (2005) states (p. CRS-20): "Appendix D shows that although RLPs exist in all 50 states, five states — Louisiana, Texas, Florida, North Carolina, and New Jersey — accounted for 63% of all repetitive loss payments from 1978 through 2004." Thus, this sentence does indeed allude to our conclusion, as all five are coastal states, frequently exposed to storms and hurricanes, compared to, say,

							Oklahoma or Kentucky. However, the evidence is indirect and inconclusive. A similarly indicative but inconclusive piece of evidence comes from Platt (1999, p.32) who found that coastal communities hold nearly 60% of all NFIP policies, and nearly 50% of all claims, but he does not state conclusively that most repetitive loss properties are coastal. The answer is now given by FEMA as indicated in the text.
Tyler	Corson-Rikert	Regarding the entry on NYC: This text suggests that the FEMA Flood Insurance Rate Maps (FIRMs) for New York City show both current and future risk, when in fact they only address current risk. A close reading of the New York City "PlaNYC Progress Report 2012" cited by the table clarifies that NYC worked with FEMA to update FEMA's FIRMs for the City to reflect, among other things, sea level rise observed to date as of 2012. NYC developed separate maps (not FEMA FIRMs) showing projected sea level rise. Please clarify in the text the distinction in what the different maps depict (current versus future risk).	28. Adaptation	28.3	993		Thank you for the comment. The authors have removed "and future" from the discussion of NYC in Table 28.3.
Gene	Fry	$ Cost of Damages I did not find the topic discussed in the Assessment. It should be a separate chapter. Apparently (4/10/13 e-mail from Moms Clean Air Task Force), the 2009 National Climate Assessment said such an analysis would be included in the 2013 edition. As we think about the costs of mitigation, especially reducing carbon emissions via (1) a carbon tax or (2) a carbon cap and trade system, we need to balance the costs of inaction against the costs of action. The costs of action are reasonably well defined, uncertain by less than one order of magnitude. Many, especially in carbon-intensive industries, say they are too high, while they neglect or trivialize the cost of inaction. They promote small (some tens of billions of $) private interests at the expense of a much larger public interest (many trillions of $). The $ cost of damages from climate change (i.e., inaction) feature much larger error bounds than the costs of action. A basic problem is that uncertain costs are incurred in the future from actions taken today. These future costs are likely to accelerate. For example, US agriculture can cope with warming before mid-century but will be increasingly negatively impacted after mid-century. Another example: sea level rise will accelerate as the Greenland ice sheet melts at an increasing rate, due to warming from permafrost feedbacks and its own albedo change. Sea level rise will inundate high value city real estate and much of the most productive farmland on Earth. To be more specific, we don't know if world food production will fall 20% by 2050, 40% by 2100 and 70% by 2150; or if it will fall 10%, 25%, and 40% by those dates; or 30%, 60%, 80%. We are pretty confident that the Sahara Desert will expand into Spain, Italy, and Greece, but whether that happens more late this century or more next century is up in the air. Similarly, we know New Orleans, Venice, and probably Amsterdam will be flooded this century. But we don't know if Miami, Shanghai, Guangzhou, Calcutta, Saigon, Alexandria, and Norfolk will be mostly flooded late this century, the early part of next century, or the late part of next century. Similarly, we don't know how far and how fast					Thank you for your comment. While the authors attempted to include economic information where possible, for this report, economic information is limited to what could be developed from case studies and reports in particular sectors and regions. The ongoing sustained assessment process developed around this Third NCA report can hopefully contribute to an improved assessment of the valuation of climate impacts, mitigation, and adaptation.

Brazil's Chaco and caatingas will expand into the Amazon rainforest. The discount rate an economist chooses makes huge differences in the present values of the $ value of the damages.

Of course, this interacts with our success at large-scale removal of carbon from the air, even as the permafrost adds very large amounts, in its positive feedback loop. (Permafrost not under ice holds twice as much carbon as the atmosphere.) And then there's methane hydrates and permafrost still under vast ice sheets. This all adds uncertainty. But uncertainty does not mean costs are zero, which a failure to treat the subject implies.

However, there is a rich literature on the subject. In addition, there is a rich set of climate-related disasters over the past decade, to which $ costs have been attached. However, these disasters are far from the only climate change costs we have incurred to date. Small changes that affect very large numbers of people also count.

I have followed literature only somewhat in recent years. Below I touch on a few studies that have come to my attention.

Tol (2004) performed a review of 28 marginal damage cost estimates by many researchers from 1991 thru 2003. Among those researchers were Nordhaus, Cline, Hohmayer, Fankhauser, Downing and many others. Tol gathered103 estimates of the marginal damage costs of carbon dioxide emissions from 28 published studies. The distribution of values is strongly right-skewed. If all studies are combined, the median is $14/ton of carbon, the mean $93/t C, and the 95th percentile $350/t C. Studies with a lower discount rate have higher estimates and much larger uncertainties. Similarly, studies that use equity weighting have higher estimates and larger uncertainties. Tol notes "using a monetary metric to express non-market impacts, such as effects on ecosystems or human health, is more difficult but not impossible."

Cline (1992) is typical in the types of effects valued: damages (or benefits) to (1) agriculture; (2) forests; (3) species (loss / extinction); (4) sea-level rise; (5) space heating and cooling; (6) human amenity; (7) human mortality and morbidity; (8) migration / refugees; (9) hurricanes; (10) water supply; (11) construction; (12) leisure; (13) urban infrastructure; and (14) other pollution.

Drawing on then-recent research from the German Institute for Economic Research, and the PAGE model used for the European Commission's Directorate General-Environment, Ackerman and Stanton (2006) estimated the present value of damages from climate change at $74 trillion (Watkiss 2005). This included an estimate that climate change would cause $20 trillion per year damages in 2100, inflation adjusted (Kemfert 2005). Ackerman and Stanton cited near-term estimates of the cost of damages from CO2 at £70 / ton C (UK Government Economic Service) and £68 from DEFRA (2006).

The Stern Review (2006) estimated value of damages from climate change at $85 / ton of CO2 (about $312 / ton C). Stern thought this would fall to $25-30/ton of CO2 ($92-110 / t C) if we could keep warming to 2°C.

Ackerman (2008) estimated that US inaction on global warming could cost 3.6% of GDP ($3.8 trillion per year by 2100). Half of that was based on just 4 types of impacts: hurricanes, water costs, energy costs, and real estate losses to sea level rise (45 inches by 2100).

Martin Parry et al., for the World Bank / IIED, reviewed studies that estimated climate change already

cost $9-109 billion per year in the developing world. Overall, Parry estimated the global costs of adapting to climate change to be US$49-171 billion each year, for the UN Framework Convention on Climate Change, based on agriculture, water, health, infrastructure, coastal zones, and ecosystems.

McKinsey & Company, in a report for the Climate Adaptation Working Group in 2009, estimated that climate change could cost 19% of GDP by 2030 in some of the areas studied, especially poor nations.

The UN in 2010 (report by Trucost's Mark Trevitt et al.) estimated that environmental damage caused by greenhouse gases emitted by humans in 2008 was $4.5 trillion, or 11% of global GDP (report available at www.unepfi.org/publications/investment), using Stern's $85 / ton of CO2.

Dell in 2012 estimated in the American Economic Journal: Macroeconomics that every 1°C warming in a poor country reduces its economic growth by 1.3%.

In 2012 DARA estimated current damages from climate change at $695 billion per year, growing to 3% of Gross World Product by 2030. It linked climate change to 500,000 deaths per year and said that climate change has already held back development. Besides Cline's categories, DARA also considered (1) drought, (2) floods and landslides, (3) wildfires, (4) biodiversity, (5) labor productivity, (6) permafrost, and (7) fisheries.

Insurance companies have compiled records of losses from weather-related disasters, which they consider to be increasingly climate-related. Munich Re reported a record $265 billion economic losses worldwide from severe natural catastrophes in 2011, if mostly from earthquakes. See www.bostonglobe.com/opinion/2011/11/30/bad-weather-policy-insuring-against-climate-change/knGgWx1IAxB6lp26G1sWtM/story.html. In 2012, global losses from natural and man-made catastrophes totaled $186 billion, according to Swiss Re, including $119 billion in the US. See www.climatecentral.org/news/us-dominated-global-disaster-losses-in-2012-insurer-reports-15814.

Simply dividing $119 billion in US catastrophic losses by 5.3 billion tons of US CO2 emissions in 2012 yields $22.50 in damages per ton of CO2 emitted. Some catastrophic losses would have occurred absent climate change, but not nearly as much. On the other hand, some climate change losses are not catastrophic. Moreover, much of the losses come in the future, from actions taken today. So $22.50/t of CO2 is a reasonable estimate.Ackerman, Frank; E.A. Stantion. October 11, 2006. Climate Change – the Costs of Inaction. Report to Friends of the Earth England, Wales and Northern Ireland Ackerman, Frank; E.A. Stantion; C. Hope; et al. 2008. The Cost of Climate Change

What We'll Pay if Global Warming Continues Unchecked. Natural Resources Defense Council.The Economics of Climate Adaptation Working Group. 2009. Shaping Climate-Resilient Development: a framework for decision-making.Cline, William R. 1992. The economics of Global Warming. Institute for International Economics, Washington. ISBN 0-88132-150-8DARA. 2012. Climate Vulnerability Monitor: A Guide to the Cold Calculus of a Hot Planet.Dell, Melissa, Benjamin F. Jones, and Benjamin A. Olken. 2012. "Temperature Shocks and Economic Growth: Evidence from the Last Half Century." American Economic Journal: Macroeconomics, 4(3): 66-95. doi: 10.1257/mac.4.3.66Parry, Martin; Nigell Arnell, Pam Berry et al. 2009. Assessing the Costs of Adaptation to Climate Change: A review of the UNFCCC and Other Recent Estimates. International Institute for Environment and Development and Grantham Institute for Climate Change. London.Stern, Nicholas, et al. 2006. Stern Review: the Economics of Climate Change. Cambridge University Press, Cambridge, England. ISBN-13 978-0-521-70080-1Tol, Richard S. 2004. "The marginal damage costs of carbon dioxide emissions: an

		assessment of the uncertainties". Energy Policy 33(2005): 2064-2074.Trevitt, Mark et al. of Trucost, for UNEP Finance Initiative. October 2010. Universal Ownership: Why environmental externalities matter to institutional investors.					
Christina	Swanson	Chapter 25 – Coastal Zone Development and EcosystemsClimate-related Drivers of Coastal Change Figure 25.3 should be further clarified in the final NCA report. In part A, the caption should explain that even with a 1.6 foot SLR by 2100 some coastal regions are projected to experience significantly less or more relative sea level rise due to factors including coastal uplift, land subsidence, and changes in ocean circulation. In part B, the caption states that a 3.9 foot SLR by 2100 is shown. Given that amount of sea level rise, it is unclear how all of the coastal areas shown have relative sea level rises of less than 2.3 feet as indicated by the key shared with part A(1). In particular, some of the most rapidly subsiding coastal areas in the U.S. (e.g., the Gulf Coast, Tidewater Virginia) are indicated only to experience relative sea level rises of 2.0 to 2.3 feet. With a 3.9 foot SLR, this would suggest that these areas are in fact experiencing uplift instead of subsidence. This is contrary to recent studies that indicate that the rate of sea level rise in the mid-Atlantic region is substantially greater than global sea level rise rates(2). Part C of the caption would benefit from additional clarification as well. It is not stated what amount of sea level rise is assumed and whether the figure represents the existing 100-year coastal flood return level, the return level in mid-century, or the return level for 2100.The draft report indicates that the four panels in Figure 25.4 will be integrated into a single figure in the final report(3). Considering the level of detail contained in panels (a) and (b) and the amount of text contained in panels (c) and (d), careful consideration should be taken when these panels are integrated so that the data presented in each panel is not obscured. Economic Disruption The draft report mentions beach replenishment as a method of "soft protection" to protect against coastal flooding and erosion, but fails to mention natural infrastructure approaches. Techniques such as the restoration of coastal wetlands and oyster reefs utilize natural features to mitigate storm surge, flooding, and erosion risks. These natural features serve to absorb storm surge and flood waters and dissipate wave energy, providing protection from coastal storms and flooding. They also provide wildlife habitat, enhance fisheries, maintain natural shoreline dynamics, filter water pollutants, and preserve public access to the shoreline(4). Because these natural infrastructure solutions are decentralized and implemented at multiple locations, they are flexible and adaptable—an important characteristic given the likelihood that future hydrologic conditions will become increasingly volatile and unpredictable due to climate change. In contrast to "hard protection" measures, these approaches allow for planning to be incremental, continuous, and easily modified if and when climatic and hydrologic conditions change. Uneven Social Vulnerability The draft report cites Crossett et al. 2004 as a reference for the statement that "almost 24.6 million Americans lived within the 100-year floodplain or in neighborhoods that border the open ocean coast" in 2010(5). However, this particular report, which was completed in 2004, only examines coastal population trends from 1980 to 2008(6). Vulnerable Ecosystems The caption for Figure 25.9 should be corrected to reflect that the panel on the left and not the right "shows land change with SLR of 10.6 inches between 2010 and 2060(7)." Adaptation Planning The draft report states that "[t]here is only limited evidence of more substantial ('transformational') adaptation occurring(8)." However, the definition of "transformational" is not provided, making it unclear what adaptation actions the report is referring to. The final report should include a definition to	25. Coastal Zone Development and Ecosystems				The figure title and caption of Figure 25.3 have been corrected and we thank the reviewer for the helpful suggestion. The confusion about the top end in the upper figures being 2-2.3 ft., for a 3.9 ft. scenario by 2100, has to do with timing – the figure time frame is now correctly identified as 2050 rather than 2100.Figure 25.4 has been revised by the Technical Support Unit. Issues with crowding will be addressed for the final report.The text has been revised to point to the adaptability of natural shoreline features and the additional values they provide. A similar change was made in the earlier section on infrastructure.We thank the reviewer for the helpful suggestion and revisions have been made to this section. The main reference for this sentence is Crowell et al. 2013, so the supporting older reference was deleted. In addition, extensive conversations with Crowell have enabled us to update this information with 2010 population data and an improved methodology to determine coastal high hazard population numbers.The caption for Figure 25.9 has been clarified. We thank the reviewer for the helpful suggestions in the Adaptation Planning section. The definition of transformational was added from the seminal paper defining it. Thank you for that suggestion concerning the text on hazard mitigation. We have adopted it. Thank you for that suggestion concerning the cost estimates associated with sea level rise. We have modified the text to clarify this. The text has been revised to incorporate the suggestion concerning winter storms. Colloquially,

		provide additional clarity. Further, instead of stating that "the cost of preventive hazard mitigation is 4 to 10 times lower than the cost of inaction," it may be clearer for the report to state that the cost of inaction is 4 to 10 times greater than the cost associated with preventive hazard mitigation(9). Additionally, it is unclear what is included in the cost estimates presented in this section. The draft report states that the "cumulative costs to the economy of responding to sea level rise and flooding events alone could be as high as $325 billion by 2100 for 4 feet of sea level rise(10)." However, additional detail should be provided as to whether this estimate only includes the cost of adaptation measures, the cost of damages associated with sea level rise and associated flooding, or some combination thereof. Similarly, additional clarification should be provided on whether the $200 billion cost estimate associated with one foot of sea level rise by 2100 refers to direct damages resulting from sea level rise and associated flooding, the cost of adaptation measures, or a combination of both factors(11). The draft report also refers to the winter storm ("nor'easter") that struck the northeastern U.S. shortly after Superstorm Sandy as "Athena(12)." The National Weather Service currently does not maintain a naming convention for winter storms. Moreover, there is considerable debate within the meteorological community as to whether a naming scheme for winter storms should be utilized without first establishing strict criteria governing its use(13). Until a formal naming system has been established, the final report should refrain from using unofficial terminology to describe severe winter storm systems.Footnotes: (1) Draft NCA at 871. (2) Asbury H. Sallenger, Jr, Kara S. Doran and Peter A. Howd, "Hotspot of accelerated sea-level rise on the Atlantic coast of North America," Nature Climate Change 2 (2012): 884-888. (3) Draft NCA at 872, lines 2-4. (4) "Alternative Shoreline Stabilization Methods," NOAA Office of Ocean and Coastal Resource Management, revised October 2, 2012, coastalmanagement.noaa.gov/initiatives/shoreline_stabilization.html. (5) Draft NCA at 882, lines 22-23. (6) NOAA, Population Trends Along the Coastal United States: 1980-2008 (2004), available at oceanservice.noaa.gov/programs/mb/supp_cstl_population.html. (7) Draft NCA at 885, line 21. (8) Id. at 887, line 16. (9) Id. at 887, line 34. (10) Id. at 887, lines 37-38. (11) Id. at 887, lines 39-42. (12) Id. at 888, line 1. (13) See Brian K. Sullivan, "Weather Channel Plan to Name Snowstorms Greeted Coldly," Bloomberg					many winter storms have been named over the years, but we were not aware that this is hotly debated in the pertinent professional circles. Our point is about sequencing of severe storms, so we removed the name in order to avoid controversy.

		News, October 5, 2012, available at www.businessweek.com/news/2012-10-04/weather-channel-s-plan-to-name-snowstorms-gets-cold-reception and Alana Semuels, "Naming a winter storm? Meteorologists are appalled by Nemo," Los Angeles Times, February 8, 2013, available at articles.latimes.com/2013/feb/08/nation/la-na-nemo-winter-storm-20130208					
Christine	Reimer	• Page 114, line 9, Groundwater Availability: As general background, see Ground Water and Climate Change by Richard G. Taylor et al which appeared recently in Nature Climate Change. The paper provides an extensively referenced article on the influence of climate change on groundwater systems, and groundwater impacts on the climate system, including a discussion of groundwater's role in adapting to climate change and future water supply challenges. See http://www.nature.com/nclimate/index.html	3. Water Resources		114	9	We have added the suggested citation in our chapter assessment.
Christine	Reimer	• Page 114, line 17: After (Hanson et al 2006), please consider adding:The federal Advisory Committee on Water Information's Subcommittee on Ground Water developed a framework for a national groundwater monitoring network, as authorized by the SECURE Water Act, (Public Law 111-11). Among other objectives, the network is designed to provide data to determine: What are the effects of climate variability on groundwater levels across the country? See Public Law 111-11 at http://www.gpo.gov/fdsys/pkg/PLAW-111publ11/pdf/PLAW-111publ11.pdfSee Final National Ground Water Monitoring Network Framework Report at http://acwi.gov/sogw/	3. Water Resources		114	17	The text has been revised to incorporate a reference to the ACWI report.
Christine	Reimer	• Page 115, line 2: After the "drought.", please consider adding:Managed aquifer recharge provides a method to replenish groundwater supplies by capturing available water (during wet periods or during periods of low demand) and storing it in natural underground reservoirs called aquifers. Managed aquifer recharge can be especially helpful in capturing and storing water that can be used later to fulfill demand when availability is under stress. See for example: Prospects for Managed Underground Storage of Recoverable Water, National Research Council, 2008 at http://www.nap.edu/catalog.php?record_id=12057 and also see the National Ground Water Association's Aquifer Storage and Recovery Information Brochure at http://www.ngwa.org/Media-Center/briefs/Documents/info_brief_enhanced_gw_storage.pdf)	3. Water Resources		115	2	The text has been revised to reflect that groundwater can be augmented through recharge strategies.
Christine	Reimer	• Page 115, line 12: For your background information and possible reference, the article Vulnerability Indicators of Sea Water Intrusion by Adrian Werner et al that appeared in the January-February 2012 Ground Water may be of interest. The paper proposes a new/modified way to rapidly characterize the vulnerability of coastal aquifers. The authors note that additional work is needed in order to develop descriptive vulnerability definitions, e.g. high vulnerability, low vulnerability; and, in any case, they recommend that development of quantitative indicators be combined with other methods to determine vulnerability. See http://onlinelibrary.wiley.com/doi/10.1111/j.1745-6584.2011.00817.x/abstract	3. Water Resources		115	12	We have included citation of this reference as suggested.
Christine	Reimer	• Page 126, line 28: Please consider changing the use of the words "off-steam and in-stream" to recognize groundwater is a major water source. Note: The draft document uses the terms off-stream and in-stream elsewhere. Each reference should be reviewed and changed as appropriate.	3. Water Resources		126	28	The text has been revised to imply both surface and groundwater sources.
Christine	Reimer	• Page 130, line 2: Please consider adding the following sentence that also highlights the issues related to conjunctive or integrated management of surface water and groundwater and the current institutional arrangements.Conjunctive management of groundwater and surface water, which can be used to mitigate imbalances between water availability and demand that may occur more frequently under a changing climate, also faces practical limitations within the current water management institutional framework and prior appropriation regime. See Hydrologic Trade-Offs in Conjunctive Use Management by John Bredehoeft, Ground Water, July-August 2011 at http://onlinelibrary.wiley.com/doi/10.1111/j.1745-6584.2010.00762.x/abstract	3. Water Resources		130	2	The text has been revised to incorporate aspects of this suggestion. We did not include the issue of prior appropriation doctrine due to space limitations.
Christin	Reimer	• Page 131: A National Ground Water Association reviewer found the "Traceable Accounts" section not	3. Water		131		Thank you for your comment. The

e		very useful as currently built. He suggested that it be considered as an appendix. In part, the reasoning for the move is that the tabulated arguments represent expert deliberations on the subject with little added value to the scientific debate on uncertainty and magnitude. As another alternative, the suggestion was made to have an entire section dedicated to addressing the skeptics and detractors to climate change.	Resources				inclusion of traceable accounts in chapters is a consistent feature across the entire NCA report so this chapter will not be restructured in this manner.
Gene	Fry	With respect to increasing effects of climate change on agriculture, at lines 31-34, yields of major U.S. crops ... are expected to decline. Indeed they may decline STEEPLY before 2100; the Assessment should note this. This was first (to my knowledge) pointed out by Peart et al. [1989], Ritchie et al. [1989], and Rosenzweig [1989], as summarized in Rind 1990. More recently, Schlenker (2009) has estimated that crop yields for corn and soybeans could fall 75-82% by 2100 in a fast warming scenario, due most of all to heat spikes. I expect there are other supporting studies, of which I am not aware.Rind, D.; R. Goldberg, J. Hansen et al., 1990. "Potential Evapotranspiration and the Likelihood of Future Drought", Journal of Geophysical Research 95(D7),9983-10004. DOI: 10.1029/JD095iD07p09983Schlenker, Wolfram; Michael J. Roberts, 2009. "Nonlinear temperature effects indicate severe damages to U.S. crop yields under climate change", Proceedings of the National Academy of Sciences 106(37):15594–15598. www.pnas.org cgi doi: 10.1073 pnas.0906865106	6. Agriculture		228		Thank you for your comment. After consideration of your suggestion, we have decided to keep the text as is. We believe the current wording and citations are adequate and appropriate.
Christina	Swanson	Chapter 26 – Decision SupportNRDC commends the USGCRP for the inclusion of a chapter on "Decision Support" in the draft NCA report. The attention to this topic strengthens the NCA, giving much-needed attention to the use of climate information in decisions. Overall, the chapter currently reads as a literature review on decision support. While this is an adequate treatment of the topic, the usability of the chapter can be increased by tailoring the information to the audience more specifically. Decision-makers, climate scientists, and scientific institution leaders are three distinct audiences which will benefit from better decision support on climate change issues, and at the same time must work to improve support tools and processes. The current organization of the chapter can be edited to better engage each of these audiences. For example, the key messages(1) can be re-written to identify how each audience can benefit from decision support techniques and tools, or how each can work to improve decision support. The chapter content can then be reorganized by each key message for better comprehension. Include more examples of decision-making processesAs stated in the chapter: "Decision-makers routinely make complex decisions under uncertain conditions; they recognize that even though scientific information may be uncertain, it still provides valuable insights that will lead to better outcomes if incorporated into decision-making(2)." The NCA can support this statement and illustrate that managing decisions under uncertainty is feasible with examples from a variety of fields. Dealing effectively with uncertainty can be overwhelming at any level of decision-making. Using concrete case studies from other fields, such as public health or national security, will show decision-makers that success is possible. For example, a 2013 National Research Council report reviews the decision processes, treatment of uncertainty, and risk management approaches used in a number of public health cases, including secondhand smoke bans and food safety(3). Another example is the national security community, which uses a risk management framework in its decision processes due to uncertainty about threats and the range of outcomes(4). Although not referencing climate change decisions, these cases dovetail with the iterative adaptive risk management framework described in the chapter on page 928: "The National Research Council has concluded that an 'iterative adaptive risk management' framework, in which decisions are adjusted over time to reflect new scientific information and decision-makers learn from experience, is appropriate for decisions about adaptation and ways to reduce future climate change, especially given uncertainties and advances in scientific understanding(5)." The chapter should include a case study specific to climate change that illustrates	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				As suggested, the chapter has been significantly reorganized and additional examples have been included both within the text and as detailed examples in boxes. A coastal community example has been incorporated into the risk management, perception, and assessment section. The section on boundary processes, of which science translation is one such activity, has been revised and expanded. The text now incorporates the role and importance of stakeholders more explicitly. The idea of changeability is included in the iterative risk management framework and the text in the sections describing this framework.

		the utilization of an iterative adaptive risk management framework. One possibility is to highlight the third case study from the “Adaptation” chapter in the draft NCA report. A “Climate Change Framework” initiated by several partners in Northern Wisconsin and neighboring states uses an iterative approach to adjust forest management practices as the climate changes(6). Science translationScience translators serve a critical function to effective decision support. The draft chapter makes mention of the “need for ‘science translators’ who can help decision-makers efficiently access and properly use data and tools that would be helpful in making more informed decisions in the context of climate change(7)." In the chapter, elaboration on basic elements of science communication will help to establish initial best practices for science translators in climate decision-making processes.One principle of good science communication is to reject the “information deficit model,” meaning that scientists should not assume that their audience is simply lacking information, and that providing new information will suffice as effective communication. Instead, engaging values, culture, and predispositions should be recognized as a necessity in science communication. One Texas A&M study discovered that the more information a person has about global warming, the less responsibility and concern he or she feels for it(8). A Yale study shows that, when comparing political conservatives with liberals, opinions about climate change become MORE polarized with more scientific education(9). These counterintuitive results imply that values, culture, politics, and ideology shape how individuals absorb new scientific information. In addition, individuals are more likely to be concerned about climate change if they agree ideologically with a proposed solution. In another Yale study, people whose values align with politically conservative views were more likely to accept climate change as a problem when presented with solutions that they already supported(10). Another key element of science communication is to find ways to accurately use stories and personal experiences to bring data to life. Nonscientists relate to personal experiences and stories much more than statistical evidence. Our associative, emotional processing system is automatic, translating experiences and risks into feelings. On the other hand, our analytic reasoning must be explicitly learned, and requires conscious effort. Nonscientists often rely on associative and emotional reasoning, including when the two systems of perception are in conflict. In other words, if one consciously understands the risks through data but does not "feel" the risks from experience, then the risks will likely be ignored(11). Of course statistical evidence and data should not be ignored in communication, but science translators can look for opportunities to enhance communication of risks with real world examples, stories, and experiences. Lastly, proper framing and messaging is critical to effectively translate climate science to decision-makers and to stakeholders. Frames are “interpretive storylines that set a specific train of thought in motion, communicating why an issue might be a problem(12).” Climate change issues can be framed in a number of ways, and must be tailored to a specific audience’s interests, values, and cultures. Science translators must be familiar with a number of frames for climate change and adept at utilizing them in the correct contexts. Improving communications and stakeholder engagementThe draft National Climate Assessment recognizes the significance of stakeholder inclusion: "An important challenge is identifying the stakeholders in decision-making processes. There are often many categories of stakeholders, including those directly and indirectly affected by the outcomes of decisions as well as the decision-makers themselves, scientists, and elected officials(13)." Because stakeholder engagement is difficult but critical, including additional analysis of effective engagement and communication with stakeholders will improve the Decision Support chapter.Excellent communication and engagement is necessary to convene a wide range of stakeholders who have varying amounts of attention for climate or environment issues. The first step is for the decision-maker to demonstrate commitment to the process and clarify the opportunities for stakeholder input. Secondly, the outreach strategy to find stakeholders can utilize elements from a public communications campaign: defining purpose; targeting audiences; constructing frames and messages; working with credible messengers; and using effective channels(14). Many of the principles outlined above for effective science translation also apply to stakeholder engagement. In the				

		context of a climate change decision-making process, the purpose may be to engage a diverse set of stakeholders in determining decision criteria. In this case, the audiences would be the defined groups of stakeholders, such as public sector employees, small businesses, NGOs, citizen groups, and others. The frames, messages, and messengers must be credible and somewhat consistent across different audiences. The communication channels must be used frequently by the target stakeholders. Reducing uncertainty concerns in decision criteriaThe chapter currently has a limited discussion about decision criteria, referring to criteria as quantitative or qualitative: "Based on the relevant objectives, decision criteria can be established that reflect constraints and values of decision-makers and affected parties. Criteria can be quantitative (for example, obtaining a particular rate of return on investment) or qualitative (for example, maintaining a community's character or culture)(15)." This discussion can be expanded to include a number of criteria to help reduce uncertainty, such as "no regrets" activities, cheap safety margins, changeability, short planning horizons, and planning to variances(16). The concept of changeability is currently reflected in parts of the chapter, such as in the Denver Water Case Study's highlighting of scenario planning(17), but the chapter does not directly address the consideration of "changeability" or other strategies in decision criteria. Considering the uncertainty of future climate impacts, due to unknown future emission paths as well as incomplete understanding of climate sensitivity, designing decision criteria that help to address uncertainty into climate change strategies will be important for decision-making. Footnotes: (1) Draft NCA at 925, lines 21-37. (2) Id. at 926, lines 17-19 (3) National Research Council. Environmental Decisions in the Face of Uncertainty, The National Academies Press, (2013), available at www.nap.edu/catalog.php?record_id=12568. (4) Nick Mabey et al., Third Generation Environmentalism (E3G), Degrees of Risk: Defining a Risk Management Framework for Climate Security (2011), 80, available at www.e3g.org/images/uploads/Degrees%20of%20Risk_Defining%20a%20Risk%20Management%20Framework%20for%20Climate%20Security_Full%20Report.pdf (5) Draft NCA at 928, lines 1-15 (6) Id. at 1011. (7) Id. at 940, lines 33-35. (8) Paul M. Kellstedt, et al., "Personal Efficacy, the Information Environment, and Attitudes Toward Global Warming and Climate Change in the United States," Risk Analysis 28, 1 (2008): 122, available at 128.138.136.233/students/envs_4800/kellstedt_etal_2008.pdf (9) Dan M. Kahan, et al., "The polarizing impact of science literacy and numeracy on perceived climate change risks," Nature Climate Change 2 (2012): 732–735, available at www.climateaccess.org/sites/default/files/Kahan_Polarizing%20Impact%20of%20Science%20Literacy.pdf (10) Dan M. Kahan, "Fixing the Communications Failure," Nature 463 (2010): 297, available at www.climateaccess.org/sites/default/files/Kahan_Fixing%20the%20Communications%20Failures.pdf.					

		(11) American Psychological Association, Psychology and Global Climate Change: Addressing a multifaceted phenomenon and set of challenges (2010), 23, available at www.apa.org/science/about/publications/climate-change.aspx. (12) Matthew C. Nisbet, "Communicating Climate Change: Why Frames Matter for Public Engagement," Environment Magazine, March-April 2009, available at www.environmentmagazine.org/Archives/Back%20Issues/March-April%202009/Nisbet-full.html. (13) Draft NCA at 929, lines 15-18. (14) Susanne C. Moser, Communicating climate change: history, challenges, process and future directions (2012), 37-44, Wiley Interdisciplinary Reviews: Climate Change, available at www.climateaccess.org/sites/default/files/Moser_Communicating%20Climate%20Change.pdf. (15) Draft at 929, lines 33-36. (16) Wisconsin Initiative on Climate Change Impacts, Adaptation Working Group. Adapting to climate change: why adaptation policy is more difficult than we think (and what to do about it) (2010), 10-11, available at worldcat.org/oclc/750398676/viewonline. (17) Draft NCA at 933, lines 1-4.					
Christine	Reimer	• Page 962, line 32: Please insert the word "geothermal" in the parenthetical as an example of renewables.o Reduction of CO2 emissions from energy supply through the promotion of renewables (wind, solar, bioenergy, geothermal), nuclear energy, and coal and natural gas electric generation with carbon capture and storage, and	27. Mitigation		962	32	We have made clear that our choices are illustrative only, and not a complete list.
Christine	Reimer	• Page 965, line 43: A recent issue paper in Ground Water identifies potential barriers to achieving significant CO2 reductions using carbon capture and storage. The issue paper titled CO2 Capture and Geologic Storage: The Possibilities by Hugo A. Loáiciga is available through Wiley On-Line Library. The National Ground Water Association has not taken a position on the article's conclusions, but shares the paper for the Committee's potential review and reference. See http://onlinelibrary.wiley.com/doi/10.1111/gwat.12041/abstract	27. Mitigation		965	43	We have not chosen to include this citation.
Christine	Reimer	• Page 968, line 23: Consider substituting or adding the link below to the current link to maps from the Database of State Incentives for Renewables and Efficiency. This link provides more comprehensive information than the current selected maps. http://www.dsireusa.org/summarymaps/index.cfm?ee=0&RE=0	27. Mitigation		968	23	We have added the suggested link.
Christine	Reimer	• Page 970, Table 27.2, under Financial Incentives for Efficiency and Alternative Fuels and Technology: Consider adding an example of renewable energy technology eligible for the tax credits such as:o Loan guarantees for innovative energy or advanced technology vehicles production and manufacturing; investment and production tax credits for renewable energy, such as geothermal heat pump systems.For additional background information on geothermal heat pump systems, see the National Ground Water Association web site at http://www.ngwa.org/Documents/ga/FINAL_Benefits_of_GHPs_Work_02132013.pdf.	27. Mitigation	27.2	970		We made an edit to clarify the bullet, but are reluctant to add more specific examples.
Christina	Swanson	Chapter 28 – AdaptationWe commend the USGCRP for recognizing the importance of preparing for climate change impacts by including a chapter in the draft NCA report specifically dedicated to	28. Adaptati				We thank the commenter for the suggestion, but space is limited. We

		adaptation. As highlighted by the draft report, changes in precipitation patterns and intensity, runoff and soil moisture, and drought frequency already have been observed, as have increases in evaporation and snowmelt, loss of lake and river ice and rising water temperatures. These changes, along with rising sea levels, are beginning to fundamentally alter our communities and natural resources by affecting all sectors that rely on and are impacted by water, including water supply and quality, public health and safety, transportation networks, energy production and vital ecosystems, among others. Further, increasing variability and uncertainty in water resources and the subsequent impacts on people, communities and ecosystems will only intensify as temperatures rise further. To successfully address these challenges, policymakers, resource managers, and other decision-makers will need to understand relevant climate risks, develop preparedness plans, and implement appropriate adaptive measures. Additionally, the inclusion of case studies at the end of this chapter helps to provide policymakers and practitioners with concrete examples of how planning concepts translate into adaptation practices. Adaptation Activities in the United States – Federal Government In several places throughout this chapter, the draft report refers to many resources as forthcoming or underway. The final report should be updated to reflect that since the draft report was developed, many of these resources have been completed and released. These include the National Fish, Wildlife and Plants Climate Adaptation Strategy, the U.S. EPA's National Water Program 2012 Strategy: Response to Climate Change, and the U.S. EPA's Climate Change Indicators in the United States(1). In addition to the six ways identified in the draft report that the federal government can facilitate climate adaptation(2), federal agencies also have a key opportunity to ensure effective adaptation at the state and local levels by requiring federal funding recipients to consider the possible impacts of climate change. There are several federal funding programs that can be utilized to further climate adaptation: • U.S. EPA's Drinking Water and Clean Water State Revolving Funds (SRFs) provide support for drinking water infrastructure improvements and water quality protection projects, such as wastewater treatment and non-point pollution control. While state agencies ultimately have control over how funds are distributed under the SRF, U.S. EPA can and should ensure that projects funded by the program take climate change into consideration. These criteria could include energy and water efficiency as well as potential climate change impacts to the design and siting of proposed projects. By requiring climate change criteria, U.S. EPA can avoid funding projects that result in the release of additional greenhouse gas emissions and/or projects located in potentially hazardous areas, which contribute to greater climate change vulnerability.• FEMA can and should use its existing authority under the Stafford Act, as amended by the Disaster Mitigation Act of 2000 (42 U.S.C. § 5165), to require that all state hazard mitigation plans consider climate change impacts. In order to be eligible for certain pre-disaster hazard mitigation funding, states must prepare hazard mitigation plans that identify the natural hazards, risks, and vulnerabilities facing the state. These plans must be approved by FEMA. The Agency currently has the statutory authority – in fact, the obligation – to approve only those state plans that comprehensively assess all hazards and risks, including the impacts of climate change. However, FEMA currently does not enforce this requirement, and most state plans do not assess climate-related risks. Because past risk is no longer a good indicator of future risk, FEMA's approval of insufficient plans means that many states will not be prepared for climate-related disasters when they strike. FEMA should enforce the Stafford Act and insist that state plans fully consider and prepare for the impacts that climate change will have on their communities(3). Adaptation Activities in the United States – States We agree that states play a key role in ensuring that local communities are prepared for climate change impacts and also are integral to national adaptation efforts. However, there are many nuances with regard to state climate adaptation planning efforts that are not accurately captured and reflected by the map in Figure28.1. According to the map, there are "at least 15 states [that] have completed climate adaptation plans(4)." Yet the C2ES analysis referenced in the draft report does not establish	on				deliberated and agreed on the most timely and relevant information throughout the chapter, including in the federal table reflecting a diversity of departments and agencies. While the commentors point is a good one, with limited space, all of the suggestions can not be integrated.

		criteria for what qualifies as a state climate adaptation plan. According to our recent analysis of climate adaptation planning in all 50 states, there are fewer than 15 states that have conducted comprehensive climate adaptation planning and even fewer still that are making substantial progress on implementation(5). Several of the states that are deemed to have completed a climate adaptation plan in the C2ES analysis (e.g., Florida and Virginia) merely include a few adaptation measures within their state's climate action plan, which focuses more on climate change mitigation measures(6). Further, in several other states given credit for already completing a plan, including Maine, New Hampshire, and Vermont, the "climate adaptation plan" recommends that each state develop a comprehensive climate adaptation plan(7). Figure 28.1 also neglects to consider the fluid nature of state adaptation planning efforts. Within the last few years, climate action at the federal legislative and state government levels has noticeably diminished in some locations as economic conditions have deteriorated and political interests have shifted. This trend has affected some of the states that have seemingly made much progress on climate change adaptation planning(8). Without a top-down directive and/or sustained support from the executive level, there is unlikely to be sufficient action and continuous progress by all necessary government agencies within a state on climate change issues. Additionally, the map identifies states in which the development of a climate adaptation plan was recommended in the state's climate mitigation planning reports. However, many of these reports were developed five or more years ago during the terms of governors who are no longer in office and by commissions or committees that no longer exist(9). Adaptation recommendations made under such circumstances are not likely to be acted upon. Table 28.2 should list reference citations for all of the examples of state-level adaptation activities identified. The state examples for Kentucky, Montana, and Rhode Island do not have citations(10). Adaptation Activities in the United States – Non-governmental and Private SectorWe appreciate the draft report's inclusion of NRDC as an example of an organization that provides adaptation services(11). In addition to the resources submitted during the USGCRP's technical input solicitation process, we are finalizing a climate preparedness planning guide for states. This guide will identify and detail a six-step process for states to follow to develop and implement a state climate preparedness plan focused around addressing the water-related impacts from climate change. The most unique aspect of this guide is the inclusion of over 600 strategies that have been evaluated by subject matter experts for states to implement to address climate vulnerabilities as they relate to agriculture; energy, transportation and urban infrastructure; fisheries and aquatic ecosystems; oceans and coastal resources; public health and safety; tourism and recreation; and water management(12). The examples of organizations that function as climate information providers in Table 28.4 appear to have been truncated. The last organization listed is only identified as "U.S. Center(13)." Next StepsAs part of the "emerging areas of needed research(14)," methodologies that are developed to evaluate the costs and benefits of adaptation options will need to accurately integrate and consider the value of natural resources, ecosystem services, and other environmental benefits. Often, these benefits are overlooked or not appropriately valued in cost-benefit analyses. Footnotes: (1) See National Fish, Wildlife, and Plants Climate Adaptation Partnership, National Fish, Wildlife and Plants Climate Adaptation Strategy (2013), available at www.wildlifeadaptationstrategy.gov/pdf/NFWPCAS-Final.pdf; U.S. EPA, National Water Program 2012 Strategy: Response to Climate Change (2012), available at water.epa.gov/scitech/climatechange/upload/epa_2012_climate_water_strategy_full_report_final.pdf ; and U.S. EPA, Climate Change Indicators in the United States (2012), available at www.epa.gov/climatechange/pdfs/climateindicators-full-2012.pdf. (2) Draft NCA at 989, lines 1-15.					

		(3) NRDC and National Wildlife Federation, Petition Requesting That the Federal Emergency Management Agency Comply with the Stafford Act and Disaster Mitigation Act of 2000 By Approving Only State Hazard Mitigation Plans That Adequately Address Climate Change; Amend Its Regulations to Confirm that Climate Change Must Be Addressed in Hazard Mitigation Plans; and Provide Agency Guidance to States Regarding How to Address Climate Change in Hazard Mitigation Plans (Oct 2012), available at switchboard.nrdc.org/blogs/rhammer/FEMA%20Petition%20-%20FINAL%20-%2010-2-12.pdf. (4) Draft NCA at 989, line 24. (5) NRDC, Ready or Not: An Evaluation of State Climate and Water Preparedness Planning (2012), available at www.nrdc.org/water/readiness. (6) See Governor's Action Team on Energy and Climate Change, Florida's Energy and Climate Change Action Plan (October 2008), 8-1 to 8-7, available at www.flclimatechange.us/ewebeditpro/items/O12F20127.pdf and Governor's Commission on Climate Change, Final Report: A Climate Change Action Plan (December 2008), 34-39, available at www.deq.state.va.us/export/sites/default/info/documents/climate/CCC_Final_Report-Final_12152008.pdf. (7) See Maine Department of Environmental Protection, People and Nature Adapting to a Changing Climate: Charting Maine's Course (February 2010), 17, available at cci.siteturbine.com/uploaded_files/climatechange.umaine.edu/files/Maine_CC_Adapt_Full_Report_2010.pdf; New Hampshire Climate Change Policy Task Force, The New Hampshire Climate Action Plan: A Plan for New Hampshire's Energy, Environmental and Economic Development Future (March 2009), 59, available at www.des.state.nh.us/organization/divisions/air/tsb/tps/climate/action_plan/documents/nhcap_final.pdf; and Vermont Governor's Commission on Climate Change, "Appendix 2: Plenary Group Recommendations & Appendices," Final Report and Recommendations of the Governor's Commission on Climate Change (October 2007), I-16, available at www.anr.state.vt.us/anr/climatechange/Pubs/GCCC%20Appendix%202_Plenary%20Group%20Recommendations%20&%20Appendices.pdf. (8) See NRDC, "Alaska," Ready or Not: An Evaluation of State Climate and Water Preparedness Planning (2012), available at www.nrdc.org/water/readiness/files/water-readiness-AK.pdf and NRDC, "Pennsylvania," Ready or Not: An Evaluation of State Climate and Water Preparedness Planning (2012), available at www.nrdc.org/water/readiness/files/water-readiness-PA.pdf. (9) NRDC 2012, note 42. (10) Draft NCA at 991. (11) Draft NCA at 994. (12) NRDC, Getting Climate Smart: A Water Preparedness Guide for State Action (anticipated April 2013), www.nrdc.org/water/climatesmart. (13) Draft NCA at 994.					

		(14) Id. at 1007.					
Adam	Carpenter	The American Water Works Association (AWWA) would like to thank NCADAC and USGCRP for the opportunity to comment on the draft of the National Climate Assessment and Development Advisory Committee climate report. This report, once revised and finalized, should be instrumental in furthering the understanding of climate science and climate change with decision makers, the public, and the greater water utility community. AWWA is an international, nonprofit, scientific and educational society dedicated to the improvement of drinking water quality and supply. Founded in 1881, the Association is the largest organization of water supply professionals in the world. Our 50,000 plus members represent the full spectrum of the drinking water community: treatment plant operators and managers, environmental advocates, engineers, scientists, academicians, and others who hold a genuine interest in water supply and public health. Our membership includes about 4,000 utilities that supply roughly 80 percent of the nation's drinking water. Based on this broad membership base, these comments should be considered as representative of the drinking water community in general.AWWA would like to thank USGCRP, NCADAC, and the over 240 lead and contributing authors involved in creating the draft National Climate Assessment. We applaud this effort as an important assessment that spans across nearly every sector. This document includes up to date, credible, and relevant climate science and helps to make it accessible and understandable to decision-makers, professionals, and the general public. This draft document successfully builds upon past research compiled by the Intergovernmental Panel on Climate Change (IPCC) and others. We encourage NCADAC and USGCRP to refine this draft report based upon any additional credible and relevant information obtained during the comment period and then finalize the report as soon as possible thereafter, so the public can begin to benefit from the information contained within. We would also like to thank USGCRP, NCADAC, and the authors in providing excellent information in the regional chapters. These chapters, such as the Southwest chapter, provide vital information about regional issues. However, we believe that there is a great deal of connectivity between the regional chapters and national issues, and that the report could better emphasize these connections. Currently, a reader examining only national issues could miss important information that has national implications contained in regional chapters, and vice versa. Similarly, one reading a regional chapter could miss related information in other nearby regions. Any methods that could help cross-reference issues contained in regional chapters with each other and with relevant national issues would be extremely useful to the readers. Given the expected e-book format of the final report, we believe that such cross-references could easily be included.					Thank you very much for your positive comments. The electronic format of the final report will help readers to discover relevant information in multiple chapters.
Adam	Carpenter	The American Water Works Association (AWWA) would like to thank NCADAC and USGCRP for the opportunity to comment on the draft of the National Climate Assessment and Development Advisory Committee climate report. This report, once revised and finalized, should be instrumental in furthering the understanding of climate science and climate change with decision makers, the public, and the greater water utility community. AWWA is an international, nonprofit, scientific and educational society dedicated to the improvement of drinking water quality and supply. Founded in 1881, the Association is the largest organization of water supply professionals in the world. Our 50,000 plus members represent the full spectrum of the drinking water community: treatment plant operators and managers, environmental advocates, engineers, scientists, academicians, and others who hold a genuine interest in water supply and public health. Our membership includes about 4,000 utilities that supply roughly 80 percent of the nation's drinking water. Based on this broad membership base, these comments should be considered as representative of the drinking water community in general. In general, the information contained in Chapter 3 appears to be accurate and useful to the reader. On line 19 of page 130, several sources are listed suggesting that drinking water and wastewater utilities, associations, alliances, and governments are undertaking more efforts to understand the potential	3. Water Resources				The three suggested references are included in the text; we have specified that drinking water utilities are increasingly using climate information.

		impacts of climate change to their operations. These references include Barsugli et al. 2009, Carpenter 2011, EPA 2011, and Means et al. 2010a. We believe that the possible impacts of climate change to drinking water (as opposed to water resources in general) could be further expanded with material from these references and potentially from others, and we believe that information would be useful to decision makers and the public to further reinforce the importance of understanding climate science and addressing both its the causes and implications.					
Adam	Carpenter	The American Water Works Association (AWWA) would like to thank NCADAC and USGCRP for the opportunity to comment on the draft of the National Climate Assessment and Development Advisory Committee climate report. This report, once revised and finalized, should be instrumental in furthering the understanding of climate science and climate change with decision makers, the public, and the greater water utility community. AWWA is an international, nonprofit, scientific and educational society dedicated to the improvement of drinking water quality and supply. Founded in 1881, the Association is the largest organization of water supply professionals in the world. Our 50,000 plus members represent the full spectrum of the drinking water community: treatment plant operators and managers, environmental advocates, engineers, scientists, academicians, and others who hold a genuine interest in water supply and public health. Our membership includes about 4,000 utilities that supply roughly 80 percent of the nation's drinking water. Based on this broad membership base, these comments should be considered as representative of the drinking water community in general. We believe that the sustained assessment is a vital part of continuing USGCRP's mission. The current sustained assessment chapter is relatively short and although filled with many good ideas, currently lacks details. For example, many federal agencies have offices or departments directly involved in climate change issues and/or advisory committees related to climate change. In addition to the NCAnet process, a greater emphasis on how different portions of the federal government will share information (and importantly, how outside organizations will be part of that process) is warranted. The overall approach of ongoing communication and relatively frequent reports that are smaller in scope than the full Assessment is an excellent way to keep research, outreach, and exchange of information happening continuously. These interim reports combined with the ongoing dialogue will help to enhance the water sector's capacity (and the capacity of other sectors) to adapt and respond appropriately to a changing climate. One particularly important consideration for the near future is how to integrate the new climate models and scenarios that will soon be released in the fifth IPCC assessment report. We recognize that the Assessment must have a cutoff date in order to publish the final report on schedule, but the fifth IPCC assessment is a particularly vital publication to coordinate with, and we encourage USGCRP and the authors to produce a specific plan for aligning the scenarios and models used in the two reports as soon as possible.	30. The NCA Long-term Process: Vision and Future Development				Two main points seem to emerge from the comment: (1) the chapter lacks detail, especially in regard to acknowledging all forms of potential engagement in the sustained assessment process, and (2) integration is needed with the upcoming IPPC assessment report. For the first point, the commenter seems to acknowledge the other mechanisms besides NCAnet that are envisioned for engagement and articulated in the chapter so no further revision seems warranted. The second point is more difficult to address, as alignment with IPCC and moreover CMIP efforts is not limited to the upcoming AR5 effort. To address the general issues, versus the specific reference to AR5, the following was added as a new number 7 under Contributions of a Sustained Assessment Process on page 1048: "Enhance integration with other assessment efforts such as that of the Intergovernmental Panel on Climate Change and climate modeling efforts such as the Coupled Model Intercomparison Project." Specifically reconciling this assessment with AR5 is beyond the scope of this chapter, although it should be noted that other chapters of the assessment do address this issue in part.
Mark	McCaffrey	The American people have a right to know about the causes, effects, risks and responses to climate change. They are being denied that right for a variety of reasons, one of them being the lack of substantial and coordinated efforts to increase literacy and education around the issue. The NCA should not only be a laundry list of what's being observed and projected about climate change, but it should also be clearer about responses. One of the most vital responses is to go beyond shallow communications and information into deeper levels of understanding through education.Education is nearly all together missing from NCA, mentioned almost in passing, even though communication and education are one of the key strategic goals of UCGCRP. The Letter to Americans should state that we	Introduction: Letter to the American People				This is a scientific assessment and is not intended to promote particular policy responses or suggest outcomes. That being said, providing the findings in electronic format will significantly enhance its accessibility.

		as scientists, educators, parents, leaders and citizens have a responsibility to provide not just information but knowledge and know-how to address the changes that are already well underway.					
Beverly	Law	The assumption that bioenergy combustion is carbon neutral ignores emissions due to decreasing forest biomass and contribution to the land carbon sink. The carbon-neutrality notion is based on the assumption that carbon dioxide emissions from bioenergy use are balance by plant growth, but this neglects plant growth and carbon sequestration that would have occurred in the absence of harvest for bioenergy production. It also ignores fossil fuel emissions associated with land management, harvest, bioenergy processing and transportation (Schulze et al. 2012). Thorough bioenergy production studies that consider these factors in life cycle assessments, and include region-specific combinations of forest productivity, biomass longevity, and harvest regimes have shown that in most cases, increased harvest for bioenergy production leads to higher carbon emissions, and creates a carbon debt that takes 100 to 340 years to repay (Mitchell et al. 2012; Hudiburg et al. 2011; Holtsmark, Climate Change 2012). This is much longer than the time required to reduce emissions to meet greenhouse gas targets. Holtsmark (Global Change Biology Bioenergy, 2012b) compared methods and indicated that when realistic assumptions are used and a carbon cycle model is applied for multiple harvests, an increased harvest for bioenergy leads to a permanent increase in atmospheric carbon dioxide. On the other hand, managing forests to maximize carbon storage can yield substantial and highly predictable carbon mitigation during the next century.The global warming effect of atmospheric carbon dioxide does not depend on its source. Per unit of energy, the amount of carbon dioxide released from biomass combustion is about as high as that of coal and substantially larger than that of oil and natural gas (Haberl et al. 2012). The loss of carbon sequestration in forests associated with bioenergy production, as well as the greenhouse gas effects of large-scale sustained bioenergy harvest of forests needs to be assessed within regions to determine the net effect on emissions. There are also concerns about sustainability of harvest for bioenergy. Consideration of impacts of long-term bioenergy harvest on soil fertility, biodiversity and interaction with climate change effects also need to be considered. If harvest or residue removal for bioenergy is repeated over time, it could result in loss of soil fertility, and fertilization with nitrogen would lead to emissions of yet another greenhouse gas, nitrous oxide (N2O). Biogeochemical stoichiometry of forest function should not be overlooked.Citations Haberl, H., D. Sprinz, M. Bonazountas et al. 2012. Correcting a fundamental error in greenhouse gas accounting related to bioenergy. Energy Policy, 45, 18–23.Holtsmark, B. 2012a. Harvesting in boreal forests and the biofuel carbon debt. Climatic Change 112: 415–428.Holtsmark, B. 2012b. The outcome is in the assumptions: Analyzing the effects on atmospheric CO2 levels of increased use of bioenergy from forest biomass. Global Change Biology Bioenergy, doi: 10.1111/gcbb.12015.Hudiburg, T., B.E. Law, C. Wirth, S. Luyssaert. 2011. Regional CO2 implications of forest bioenergy production. Nature Climate Change 1:419-423. DOI: 10.1038/NCLIMATE1264. Schulze, E.-D., C. Körner, B.E. Law, H. Haberl, S. Luyssaert. 2012. Large-scale bioenergy from additional harvest of forest biomass is neither sustainable nor greenhouse gas neutral. Global Change Biology Bioenergy 4: 611-616. DOI: 10.1111/j.1757-1707.2012.01169.x.	7. Forestry		274	23	We appreciate this suggestion, but space is limited. The argument of Schulze et al. (2012) is debated by Bright et al. (2012), and both studies are mentioned in lines 24-25. Certainly the many factors listed in this comment need to be considered [as Bright et al. (2012) also point out] . To date, the data are not available to do thorough anaylses that include all of these factors. But having forests in commercial production for bioenergy (or other purposes) is better for CO2 and other services than not having those forests (e.g., having the land being developed for urban, suburban, or industrial use). As the forest sector declines in the US (Woodell e al. 2012), the loss of forests is a real concern. We have chosen not to add the suggested references because of the chapter's space limitations.
Mark	McCaffrey	Response to the National Climate Assessment Draft and Annotated Bibliography of education and literacy related resources. Mark S. McCaffrey- Programs and Policy Director- National Center for Science EducationThere is a major omission--specifically the lack of education and literacy as a key elements of preparing the nation	1. Executive Summary				Thank you for your comments and the reference material you provided. Since this is an assessment of the state of knowledge related to climate change, an assessment of climate literacy is

		to minimize the risks and respond to climate change--in the draft National Climate Assessment. This omission weakens the overall document and will limit our ability as a nation to "develop and refine approaches that enable decision-making and increase flexibility, robustness, and resilience in the face of ongoing and future impacts." There is deep confusion among the public about the causes, effect, and possible responses to global change in general and climate change in particular. As a result, we are woefully unprepared for addressing the changes that are already well underway. The reasons for his confusion are many and complex, and robust research, which is missing from the draft NCA, has for many years examined the factors relating to manufactured doubt, misconceptions, sociological and psychological factors that have contributed to the general lack of understanding of the essential science of climate change. Some of this literature is included in the attached bibliography, but the research is voluminous and the citations included are the mere tip of the iceberg. To address these omissions, we recommend: 1) that relevant education, integrated with communications and outreach, be emphasized as a key strategy to engage and inform the nation, especially the 56 million Americans now in K12 schools and the 20 million more in higher education and professional programs; 2) that a strong education advocate be added to the NCADAC as soon as possible; and 3) that representatives from the broad education, communications and outreach community be engaged in the development and deployment of the NCA portal to ensure that the final product is accessible and helpful for educators and learners throughout the nation, not just the professional decision-makers and stakeholders that have thus far been involved in the NCA process.As Leiserowitz et al (2010) articulates in the Knowledge across Global Warmings' Six Americas study, which found that the public has a very shallow understanding of climate change: ...very few Americans have ever taken a formal course on climate change, so it is perhaps unsurprising that they lack detailed knowledge about the issue. Instead, these results likely reflect the unorganized and sometimes contradictory fragments of information Americans have absorbed from the mass media and other sources.While the current NCA draft prides itself in having held stakeholder meetings and the work of the communications and engagement workgroup, conspicuously missing from the document are education experts or discussion of how to inform and engage the public beyond the elite decision-makers and stakeholders. While education and broad public communications and outreach to better prepare the nation as a whole and vulnerable communities in particular from the risks of climate change might be considered technically out of scope in terms of the charge of the National Climate Assessment and Development Advisory Committee, the goal of supporting "climate-related decisions by providing an information base" should not be limited to self-selected decision-makers and stakeholders, but the public broadly defined. The membership and designation of the committee was supposed to include educators and other experts to reflect the full scope of issues to be addressed, but there is no explicit education component in the draft NCA, other than in passing, as in Chapter 29 on page 1041 where it is mentioned in the context of workforce development. The lack of a strong expert or advocate for education and literacy efforts in the NCA process risks the final product failing to take advantage of the "teachable moments" that can be unpacked from the findings, perpetuating the shallow and scattered understanding the public is currently mired in.There are precedents and compelling reasons why an integrated education, communications and outreach component be added to the final NCA. One is the United States' largely neglected commitment to Article 6 of the UNFCCC, signed by the US in 1992, requires:(i) The development and implementation of educational and public awareness programmes on climate change and its effects;					one topic that could have been chosen for inclusion. However, it was not possible to cover every topic in this report due to space constraints. Fortunately, many of the topics you suggest have been addressed by many recent publications and programs. The NCA should serve as an excellent foundation for educational efforts in schools, and the electronic delivery format is expected to encourage broad access to the information through web-based capacity and tools. There are many educators and several people who are considered experts in climate communications and climate literacy and the role of education on the NCADAC. The Department of Education was invited to participate in the NCA acativities from the beginning.

		(ii) Public access to information on climate change and its effects; (iii) Public participation in addressing climate change and its effects and developing adequate responses; and (iv) Training of scientific, technical and managerial personnel.There have been many missed opportunities to provide improved public access, participation and to develop and implement programs over the past two decades, in part due to the deliberate manufactured doubt that has been well documented by researchers, but even the National Science Education Standards of 1996 sidestepped whether human activities were altering the climate system, contributing to the confusion of the current generation of adults who never learned the essentials of climate change. Another reason is that USGCRP Strategic Goals include not only helping advance the science, inform decisions, and conduct sustained assessments, but also to "Communicate and Education: Advance communications and education to broaden public understanding of global change and develop the scientific workforce of the future" http://library.globalchange.gov/u-s-global-change-research-program-strategic-plan-2012-2021As stated on the USGCRP website: The NCA aims to incorporate advances in the understanding of climate science into larger social, ecological, and policy systems, and with this provide integrated analyses of impacts and vulnerability. The NCA will help evaluate the effectiveness of our mitigation and adaptation activities and identify economic opportunities that arise as the climate changes. It will also serve to integrate scientific information from multiple sources and highlight key findings and significant gaps in our knowledge. The NCA aims to help the federal government prioritize climate science investments, and in doing so will help to provide the science that can be used by communities around our Nation try to create a more sustainable and environmentally-sound plan for our future.Without an explicit component in NCA that addresses not just the scientific gaps but also the cognitive gaps, cultural, psychological and social frames, misconceptions and misinformation about climate change, the assessment will fall short of its goal of providing useable science for future planning. The primary goal of a national climate strategy outlined in the March 2013 letter to the President from the President's Council of Advisors on Science and Technology--"to help the Nation prepare for impacts from climate change in ways that decrease the damage from extreme weather and other climate-related phenomena (i.e., increase robustness) and ways that speed recover from damage that nonetheless occurs (i.e., increase resilience)"--will require substantially stepping up the USGCRP goal to advance communications and education to broaden public understanding. As Robert Socolow mentions in a recent Science Magazine article (Kintisch, E., (2013). "A More Modest Climate Agenda for Obama's Second Term?" Science. 22 March 2013, Vol. 229, p. 1372), emphasizing adaptation first and mitigation second could help reframe public engagement on the issue and reopen a "completely muffled" national conversation. But even if that approach is the pragmatic one now, the facts remain: Most people lack a background in climate basics (Leiserowitz, Ranney) They are confused about whether human activities are the primary driver of climate change (various polls) If they do learn about climate in school, the topic tends to be skimmed over, taught in a hesitant way, or taught as controversy (NCSE, Meehan) They may respond with literal, interpretive or implicatory denial (Norgaard, Cohen), falling into motivated avoidance and social numbing to cope with the overwhelm and emotions that arise. The					

		NCA draft can be improved by making the authors aware of the importance of education and literacy to foster decisions based on evidence and current science. Another option, should infusing education throughout the document or adding a chapter specifically about an integrated education, communications and outreach component not be deemed feasible, would be a national assessment on improving education, communications and outreach in the nation. There is substantial data on the state of and reasons for confusion and lack of understanding about climate change in the United States, little of it cited in the draft NCA. Nor is there mention of federally funded projects to build capacity around climate education and literacy, including the NSF Climate Change Education Partnership program, the NOAA Climate.gov website, and NASA Innovations in Climate Education program. These programs have through their evaluation programs begun to demonstrate success with diverse sectors of society in increasing understanding and fostering informed decision-making beyond a narrow group of professionals, but funding for such programs is limited or being cut. Privately funded programs of considerable merit, such as the Alliance for Climate Education, have shown that even short "interventions" about the science can have significant impact on the understanding of and concern about climate change, a finding that dovetails with the work of Ranney and colleagues at UC Berkeley. The Climate and Energy Literacy Summit report, issued in March of 2013 by the National Center for Science Education, could help in framing how understanding of climate change can be improved. It contains a number of relevant recommendations on how to substantially and measurably improve education and literacy around climate change related topics in the nation. Key recommendations from the Summit are:Create a national initiative using the Collective Impact approach for effective partnership by developing a common agenda, shared measures, engaging in reinforcing activities and continuous communication, and having a supporting infrastructure; Significantly expand through private funding the availability of existing high-quality climate and energy related education, communication, and outreach programs; Emphasize teaching climate change and energy topics throughout education, which is vital to establishing a strong foundation for future decisions and in fostering resilient communities; Build on existing resources and frameworks, including the U.S. Global Change Research Program's Climate Literacy and Energy Literacy documents; Support the climate and energy-related aspects of the forthcoming Next Generation Science Standards (NGSS); Collaborate with key programs and partners, including the 100K in 10 initiative, which aims to recruit and prepare 100,000 science, technology, engineering, and mathematics teachers in ten years; Maximize the potential for digital learning opportunities, including online courses, educational gaming and the use of digital badges and certification; Identify and address the education, communications, and outreach needs o underserved and vulnerable communities relative to these topics; Conduct a national survey to determine whether, where, and how climate change and energy topics are taught in formal education; and Anticipate and effectively respond to denial and manufactured doubt about climate change.Other steps					

to improve the NCA and the portal site include highlighting and encouraging the use of the Climate Literacy and Energy Literacy documents, neither of which were mentioned in the document and that are available through the USGCP website. Both were reviewed by the USGCRP Principals. There are many related projects such as the CLEAN (Climate Literacy and Energy Awareness Network) catalog of resources and guide for teaching, which have been incorporated into the NOAA climate.gov website, should also be acknowledged as well vetted tools that can be used by professional decision-makers, stakeholders as well as the millions of educators and learners in the United States who are ultimately decision-makers and stakeholders with the ultimate vested interest: concern about safety, security and opportunities now and far into the future. Selected References

There are numerous references that could provide a wider assessment of the Nation's understanding of and ability to respond to climate change. American College and University Presidents' Climate Commitment (2012). ACUPCC Five Year Report. Second Nature. http://www.presidentsclimatecommitment.org/reporting/annual-report

Higher education contributes a small percentage of the nation's carbon footprint, but it represents 100% of the 'educational footprint'—our institutions teach not only our college students but also the teachers who prepare our K-12 students for the new challenges of the 21st century. More than 6 million students attend an ACUPCC institution, representing approximately one-third of all college and university students in the US. ACUPCC institutions are employing a range of innovative approaches to ensure that climate and sustainability issues are incorporated into the educational experience of all students in order to prepare the

next generation of leaders to create and implement solutions for a sustainable society.Anderson, A. (2010). Combating Climate Change through Quality Education. Brookings Institution. http://www.brookings.edu/~/media/research/files/papers/2010/9/climate%20education%20anderson/09_climate_education.pdf

This policy brief presents a framework for the existing communities of practice to mobilize around in order to promote education for sustainable development; and also integrate disaster risk reduction, quality learning, and environmental and climate change education. It explores how education for climate change action can be leveraged through existing international agreements and relevant agendas; and asserts that investing in quality education to combat climate change is an essential tool in achieving the Millennium Development Goals (MDGs). Anderson, A. (2012). Climate Change Education for Mitigation and Adaptation. Journal of Education for Sustainable Development. Despite being threatened by climate change, the education sector offers a currently untapped opportunity to combat climate change. Since the causes of climate change are at least partly linked to human actions, these actions need to be identified and changed. Anderson, A., M. Strecker (2012). Sustainable Development: A Case for Education. Environment Magazine: http://www.environmentmagazine.org/Archives/Back%20Issues/2012/November-December%202012/sustainable-full.html

There is a clear education agenda in this process in terms of providing a foundation for the shift in the global demand away from resource- and energy-intensive commodities and toward green products....While this change will not happen overnight, the education sector has a critical role to play in imparting the knowledge and skills that lead to behavior change for sustainable development. Bord, R. J., O'Connor, R. E., & Fisher, A. (2000). In what sense does the public need to understand global climate change? Public Understanding of Science, 9(3), 205218.

In a survey of 1,218 Americans, the key determinant of behavioral intentions to address global warming is a correct understanding of the causes of global warming. Knowing what causes climate change and what does not is the most powerful predictor of both stated intentions to take voluntary actions and to vote on hypothetical referenda to enact new government policies to reduce greenhouse gas emissions. Identifying bogus causes (e.g., insecticides) correlates with

the belief that the globe will warm but is only weakly related to voluntary actions and not at all related to support for government policies. General proenvironment beliefs and perceptions that global warming poses serious threats to society also help to explain behavioral intentions. The explanatory power of an air pollution framework is substantial in bivariate analyses but has little explanatory power in multivariate analyses that include knowledge, risk perceptions, and

general environmental beliefs. Translating public concern for global warming into effective action requires real knowledge. General environmental concern or concern for the negative effects of air pollution appear not to motivate people to support programs designed to control global warming.Choi, D., Niyogi, D., Shepardson, D. P., & Charusombat U. (2010) Do earth and environmental science textbooks promote middle and high school students' conceptual development about climate change? Bulletin of the American Meteorological Society. 91(7), 889-898.

Misconceptions or a lack of relevant prior concepts can hinder students from developing an understanding of scientific concepts. Science education research suggests that building on students' prior concepts is an effective way to develop students' scientific knowledge. This study reports the results of an analysis of earth and environmental science textbooks' representations of climate change concepts and an examination of these presentations for possible contribution to students' common misconceptions of climate change. A literature review was conducted to identify students' common misconceptions of climate change. Textbooks' conceptual coverage and their ways of presenting scientific conceptions were examined concerning their potential influence on further reinforcing and adding greater confidence to students' misconceptions. Our results indicate that the reviewed textbooks were not designed based on careful consideration of students' common misconceptions of climate change. We made recommendations for improving the conceptual clarity and organization of climate change concepts in Earth and environmental science textbooks.Cohen, S. (2001). States of Denial. Polity Press.

Blocking out, turning a blind eye, shutting off, not wanting to know, wearing blinkers, seeing what we want to see ... these are all expressions of 'denial'. Alcoholics who refuse to recognize their condition, people who brush aside suspicions of their partner's infidelity, the wife who doesn't notice that her husband is abusing their daughter - are supposedly 'in denial'. Governments deny their responsibility for atrocities, and plan them to achieve 'maximum deniability'. Truth Commissions try to overcome the suppression and denial of past horrors. Bystander nations deny their responsibility to intervene. Do these phenomena have anything in common? When we deny, are we aware of what we are doing or is this an unconscious defence mechanism to protect us from unwelcome truths? Can there be cultures of denial? How do organizations like Amnesty and Oxfam try to overcome the public's apparent indifference to distant suffering and cruelty? Is denial always so bad - or do we need positive illusions to retain our sanity?Dunlap, R. E. (1998). Lay perceptions of global risk: Public views of global warming in cross□national context. International Sociology, 13(4), 473□498.

This article reports results from a 1992 Gallup survey conducted in six nations (Canada, USA, Mexico,

Brazil, Portugal and Russia) that explored public perceptions of global warming in some detail. Overall the results tend to support those of the small‐scale but in‐depth studies on which the present study built: Lay publics in these six nations see global warming as a problem, although not as serious as ozone depletion or rain forest destruction. Most people acknowledge that they do not understand global warming very well, and results from questions about the perceived causes and consequences of global warming illustrate their limited understanding. While often confusing global warming with ozone depletion and air pollution, majorities of respondents in all but Russia believe that it is already occurring and large majorities within all

nations believe that it will occur within their lifetimes. Furthermore, as discussions of the 'risk society' suggest, public perceptions of global warming do not vary consistently across differing social strata within the nations. The article ends by discussing implications of the results, and questions whether detailed public understanding of highly complex issues like global warming is feasible or even necessary for effective policy‐making.Dupigny-Giroux, L-A. L. (2008) Introduction – climate science literacy: a state of the knowledge overview. Physical Geography, 29(6), 483-486.Today more than ever, being climate literate is a critical skill and knowledge area that influences our interaction with the environment around us, our understanding of scientific news and the daily decisions that we make. Yet, the term climate literacy can be misunderstood, as are the terms weather, climate and climate variability. This article surveys the existing literature and highlights six challenges to achieving a climate literate citizenry in both formal and informal or lifelong learning. The lessons learned from high school and undergraduate students, teachers and lifelong learners, many of whom are retired, serve as the threads which are woven into a tapestry of strategies for embedding climate science principles across entire school curricula as well as society at largeGautier, C., Deutsch, K., & Rebich, S. (2006) Misconceptions about the greenhouse effect. Journal of Geoscience Education, 54(3), 386-395.

Studies have shown that both students and the general public possess many misconceptions about the processes involved in the greenhouse effect and ozone depletion. This study, conducted in a mock summit class on global climate change, explored the level of understanding and the nature of students' misconceptions about climate. Several times throughout the class, students responded to a set of questions about the greenhouse effect. Through analysis of their responses, we were able to track changes in students' mental models, evaluate the degree to which they were able to overcome misconceptions, and assess the permanence of the newly achieved understanding.Hicks D., & Bord A. (2001) Learning about Global Issues: Why most educators only make things worse. Environmental Education Research, 7(4), 413-425.

Canadian study suggesting there is more going on beneath the surface in teaching global issues that may appear at first glance. Jakobsson, A., Mäkitalo, Å, & Säljö, R. (2009) Conceptions of knowledge in research on students' understanding of the greenhouse effect: Methodological positions and their consequences for representations of knowing. Science Education, 93(6), 978-995.

Much of the research on students' understanding of the greenhouse effect and global warming reports poor results. Students are claimed to hold misconceptions and naıve beliefs, and the impact of teaching on their conceptions is also low. In the present study, these results are called into question, and it is argued that they may to a large extent be seen as artifacts of the research methods deployed, in particular when written questionnaires are used.When following students'project work in school over a long period, many of the misunderstandings reported in the literature do not appear. It is argued that the appropriation and use of scientific language when discussing complex socioscientific issues is a gradual process. When observing the language and mediational means students use over time, it is

obvious that they are able to identify and use central distinctions in their interactions. They are also able to make productive use of texts and other materials that allow them to successively approximate scientific modes of reasoning. Thus, what students know emerges in communicative practices where they interact with others and with cultural tools in a focused activity.Johnson, R. M., Henderson S., Gardiner L., Russell R., Ward D., Foster S., Meymaris K., Hatheway B., Carbone L., Eastburn T. (2008) Lessons learned through our climate change professional development program for middle and high school teachers. Physical Geography, 29(6), 500-511.Kahlor, L., & Rosenthal, S. (2009). If we seek, do we learn? Predicting knowledge of global warming. Science Communication, 30(3), 380-414.

Derived from the risk information seeking and processing model (RISP), this study sought to isolate predictors of the public's knowledge of global warming. Using a national sample (N = 805), multiple regression yielded a number of significant relationships among 13 moderators. Notably, the number of media sources used for information about global warming, information seeking effort, and general education were relatively strong predictors of knowledge. Counter to

expectations, informational subjective norms were inversely related to knowledge.Kempton, W. (1991). Lay perspectives on global climate change. Global Environmental Change, 1(3), 183-208.

Ethnographic interviews were conducted with a small but diverse sample of US residents in order to understand how ordinary citizens conceptualize global climate change and make value judgments about it. Most informants had heard of the greenhouse effect. However, they conceptualized global climate change very differently from scientists because they

interpreted it in terms of four pre-existing categories: stratospheric ozone depletion; plant photosynthesis; tropospheric pollution; and personally experienced temperature variation. The strongest environmental value to emerge was a desire to preserve the environment for one's descendants - it was spontaneously mentioned by 12 of the first 14 informants. Species extinction and range shifts are among the most significant potential effects of global climate change, yet these effects were virtually unknown. Few informants recognized the connection between energy consumption and global warming, and they typically regarded their personal fuel consumption as inelastic.Krosnick, J. A., Holbrook, A. L., Lowe, L., & Visser, P. S. (2006). The origins and consequences of democratic citizens' policy agendas: A study of popular concern about global warming. Climatic Change, 77(1□2), 7□43.

This article proposes and tests a model of the causes and consequences of Americans' judgments of the national seriousness of global warming. The model proposes that seriousness judgments about global warming are a function of beliefs about the existence of global warming, attitudes toward it, the certainty with which these beliefs and attitudes are held, and beliefs about human responsibility for causing global warming and people's ability to remedy it. The model also

proposes that beliefs about whether global warming is a problem are a function of relevant personal experiences (with the weather) and messages from informants (in this case, scientists), that attitudes toward global warming are a function of particular perceived consequences of global warming, and that certainty about these attitudes and beliefs is a function of knowledge and prior thought. Data from two representative sample surveys offer support for all of these propositions, document effects of national seriousness judgments on support for ameliorative efforts generally and specific ameliorative policies, and thereby point to psychological mechanisms that may be responsible for institutional and elite

impact on the public's assessments of national problem importance and on public policy preferences.Leiserowitz, A., Smith, N., & Marlon, J.R. (2011) American Teens' Knowledge of Climate Change.Yale University. New Haven, CT: Yale Project on Climate Change Communication. http://environment.yale.edu/uploads/american-teens-knowledge-of-climate-change.pdf

American Teens' Knowledge of Climate Change reports results from a national study of what American teens in middle and high school understand about how the climate system works, and the causes, impacts and potential solutions to global warming. This report describes how knowledge of climate change varies across both American teens and adults. Using a straight grading scale, 25 percent of teens received a passing grade (A, B, or C), compared to 30 percent of American adults. While knowledge levels vary, these results also indicate that relatively few teens have an in-depth understanding of climate change. Also see: Knowledge of Climate Change Among Science & Technology Museum Visitors reports results from a national study of what the American public understands about how the climate system works, and the causes, impacts and potential solutions to global warming. This report describes how knowledge of climate change varies across Science and Technology Museum visitors. Using a straight grading scale, 38% of both occasional and frequent museum visitors received a passing grade (A, B, or C), compared to 19% of non-visitors. While knowledge levels vary across the groups, these results also indicate that relatively few museum visitors have an in-depth understanding of climate change. http://environment.yale.edu/climate/publications/MuseumReport/ Knowledge of Climate Change Across Global Warming's Six Americas reports results from a national study of what the American public understands about how the climate system works, and the causes, impacts and potential solutions to global warming. http://environment.yale.edu/climate/publications/knowledge-of-climate-change-across-global-warmings-six-americas/ Lombardi, D., & Sinatra, G. M. (2012) College students' perceptions about the plausibility of human-induced climate change. Research in Science Education, 42, 201-217.

Overcoming students' misconceptions may be a challenge when teaching about phenomena such as climate change. Students tend to cite short-term weather effects as evidence to support or refute long-term climate transformations, which displays a fundamental misunderstanding about weather and climate distinctions. Confusion about weather and climate may also reflect student misunderstanding about deep time, a concept that spans several scientific content areas. This study examines the relationships between students' understanding of deep time and their understandings of the distinctions between weather and climate, as well as how these understandings influence students' perceptions about the plausibility of human-induced global climate change. Undergraduate students enrolled in an introductory science class on global climate change completed measures of their (a) understanding of distinctions between weather and climate, (b) knowledge of deep time, and (c) plausibility perceptions of human-induced climate change, both at the beginning and end of the course. The study includes comparison groups of similar students enrolled in introductory physical geography classes. Results revealed that greater knowledge of deep time and increased plausibility perceptions of human-induced climate change provide significant explanation of variance in students' understanding of weather and climate distinctions. Furthermore, students achieve significantly increased understanding of weather and climate, even with brief instructionMadsen, J., Gerhman, E., & Ford, D. (2007) How much of the science of climate change does the public really understand? Evaluation of university students' ideas on the carbon cycle. EOS (Transactions of the American Geophysical Union), 88(52): Fall meeting Abstract.Malka, A., Krosnick, J. A., & Langer, G. (2009). The association of knowledge with concern about global warming: Trusted information sources shape public thinking. Risk Analysis: An International Journal, 29(5), 633□647.

During the last decade, a great deal of news media attention has focused on informing the American public about scientific findings on global warming (GW). Has learning this sort of information led the American public to become more concerned about GW? Using data from two surveys of nationally representative samples of American adults, this article

shows that the relation between self□reported knowledge and concern about GW is more complex than what previous research has suggested. Among people who trust scientists to provide reliable information about the environment and among Democrats and Independents, increased knowledge has been associated with increased concern. But among people who are skeptical about scientists and among Republicans more knowledge was generally not associated with greater concern. The association of knowledge with concern among Democrats and Independents who trust scientists was mediated by perceptions of consensus among scientists about GW's existence and by perceptions that humans are a principal cause of GW. Moreover, additional analyses of panel survey data produced findings consistent with the notion

that more knowledge yields more concern among Democrats and Independents, but not among Republicans. Thus, when studying the relation of knowledge and concern, it is important to take into account the content of the information that different types of people acquire and choose to rely upon.Markowitz, E. M. Is climate change an ethical issue? Examining young adults' beliefs about climate and morality. Climatic Change, 114(3□4), 479□495.

Moral philosophers argue that climate change poses an 'ethical problem' for humanity and thus that humans have moral obligations to respond. Little empirical research has explored whether non□ philosophers agree with these conclusions. This is unfortunate, because non□experts' moral intuitions (or lack thereof) about climate change likely hold important implications for willingness to engage cognitively, emotionally and behaviorally with the issue. After reviewing the moral philosophical position on climate change, I present results of two studies conducted with a total of 922 U.S. undergraduate students that explored beliefs about the 'ethics of climate change.' Forty□five percent of the students sampled stated unequivocally that climate change represents a moral or ethical issue; a full quarter of students said it was not an ethical issue and roughly 30% were unsure. Participants' beliefs regarding the causes of climate change were

predictive of intentions to perform pro□environmental actions, and this relationship was fully mediated by ascriptions of personal moral obligation to respond. Implications and directions for future research are discussed.McCaffrey, M., Buhr, S.M. (2008) Clarifying climate confusion: addressing system holes, cognitive gaps, and misconceptions through climate literacy. Physical Geography, 29(6), 512-528. McNeill, K. L., & Vaughn, M. H. (2012) Urban high school students' critical science agency: conceptual understandings and environmental actions around climate change. Research in Science Education, 42, 373-399.

The challenge of significantly increasing the public's climate literacy is a daunting one. While polling research indicates that most American adults believe climate change is happening, the data also show there is widespread confusion about the causes of the change and the degree of scientific consensus around the human impacts on the climate system. Consumers and corporations, who may lack an understanding of the important role of carbon in the climate system, are encouraged to reduce carbon emissions, purchase carbon offsets, and consider carbon labels that show the amount of embedded greenhouse gases in products and services. Utility companies promoting the use of smart meters find that many consumers do not understand how their electricity is generated or the role played by fossil

fuels, which are in effect concentrated forms of buried solar energy linking energy use today to past and future climates. While aggressive media, corporate, and political forces are often regarded as the primary cause of the public's climate confusion, a review of five decades of science education relating to climate in general and climate change in particular reveals that basic climate science has not been well addressed in national and state education standards or science education curricula. Moreover, key misconceptions and misinformation about basic climate science are strongly held by students, teachers, and public audiences. We review research on these misconceptions and call upon educators and communicators to address systemic holes and pedagogical gaps with high-quality resources and professional development. The recently developed Essential Principles of Climate Literacy provides an authoritative, comprehensive framework for educators and communicators to frame climate science. However, to be effectively used as a tool for increasing broad climate literacy, effective mental models to address misconceptions will need to be integral to the high-quality resources and professional development programs required to significantly increase climate literacy throughout society.Meehan, C. R. (2012). Global warming in schools: An inquiry about the competing conceptions of high school social studies and science curricula and teachers. (The University of Wisconsin - Madison). ProQuest Dissertations and Theses. Dissertation number 3547783. Available online at http://search.proquest.com/docview/1270285038

Findings of the author suggest that climate change is often taught in a hesitant way, that teachers and textbooks may deliberately or unintentionally teach controversy rather than current science, and that teacher professional development and high quality curricular materials are required to address the glaring gaps in current practice of climate science education.

National Research Council (2011). Climate Change Education: Goals, Audiences, and Strategies: A Workshop Summary. Sherrie Forest and Michael A. Feder, Rapporteurs; National Research Council National Research Council (2012). Climate Change Education in Formal Settings- K14: A Workshop Summary. Alexandra Beatty, rapporteur; Steering Committee on, K-14; Board on Science Education; Division of Behavior and Social Sciences and Education.The report points to the importance of formal and informal education in supporting the public's understanding of those challenges climate change will bring, and in preparing current and future generations to act to limit the magnitude of climate change and respond to those challenges. Recognizing both the urgency and the difficulty of climate change education, the National Research Council, with support from the National Science Foundation, formed the Climate Change Education Roundtable. The roundtable brings together federal agency representatives with diverse experts and practitioners in the physical and natural sciences, social sciences, learning sciences, environmental education, education policy, extension education and outreach, resource management, and public policy to engage in discussion and explore educational strategies for addressing climate change. Two workshops were held to survey the landscape of climate change education. The first explored the goals for climate change education for various target audiences. The second workshop, which is the focus of this summary, was held on August 31 and September 1, 2011, and focused on the teaching and learning of climate change and climate science in formal education settings, from kindergarten through the first two years of college (K-14). This workshop, based on an already articulated need to teach climate change education, provided a forum for discussion of the evidence from research and practice. The goal of this workshop was to raise and explore complex questions around climate change education, and to address the current status of climate change education in grade K-14 of the formal education system by facilitating discussion between expert researchers and practitioners in complementary fields, such as education policy, teacher professional development, learning and cognitive science, K-12 and higher education administration, instructional design, curriculum development, and climate science. Climate Change

Education in Formal Settings, K-14: A Workshop Summary summarizes the two workshops.Norgaard, K. (2011). Living in Denial: Climate Change, Emotions, and Everyday Life. MIT Press.

Global warming is the most significant environmental issue of our time, yet public response in Western nations has been meager. Why have so few taken any action? In Living in Denial, sociologist Kari Norgaard searches for answers to this question, drawing on interviews and ethnographic data from her study of "Bygdaby," the fictional name of an actual rural community in western Norway, during the unusually warm winter of 2000-2001. Norgaard traces this denial through multiple levels, from emotions to cultural norms to political economy. Her report from Bygdaby, supplemented by comparisons throughout the book to the United States, tells a larger story behind our paralysis in the face of today's alarming predictions from climate scientists.O'Connor, R. E., Bord, R. J., Yarnal, B., & Wiefek, N. (2002). Who wants to reduce greenhouse gas emissions? Social Science Quarterly, 83(1), 1-17.

We examine cognitive, economic, and partisan heuristic theories of why some people express support for reducing greenhouse gas emissions. Methods. Data come from a mail survey of 623 residents of central Pennsylvania, a region in which mitigation costs exceed potential benefits from slowing the rate of global warming. Results. Ordinary least squares analysis shows that people who can accurately identify the causes of climate change and who expect bad consequences from climate change are likely to support both government anti-fossil fuel initiatives and voluntary actions. Economic circumstances and anxieties are not important predictors, but the belief that environmental protection efforts do not threaten jobs for people like the respondent, limit personal freedoms, and hurt the economy is a strong predictor.

Democrats are more likely than Republicans to support government efforts to reduce emissions. Conclusions. Cognitive explanations of support for reducing greenhouse gas emissions are more powerful than economic or partisan heuristic ones. People want to reduce emissions if they understand the causes of climate change, if they perceive substantial risks from climate change if average surface temperatures increase, and if they think climate change mitigation policies will not cost them their jobs.Ojala, M. (2012) Hope and climate change: the importance of hope for environmental engagement among young people. Environmental Education Outreach, 18(5), 625-642

Although many young people think climate change is an important societal issue, studies indicate that pessimism is quite common. Finding ways to instill hope could therefore be seen as vital. However, is hope positively related to engagement or is it only a sign of illusory optimism? The aim of the study was to explore if hope concerning climate change has a significant relation to pro-environmental behavior as well as an impact on behavior when controlling for already well-known predictors such as values, social influence, knowledge, and gender. Two questionnaire studies were performed, one with a group of Swedish teenagers (n = 723) and one with a group of Swedish young adults (n = 381). 'Constructive' hope had a unique positive influence on pro-environmental behavior. Hope based on denial, however, was negatively correlated with pro-environmental behavior in the two samples and was a significant negative predictor in the teenage group. The conclusion is that hope is not only a pleasant feeling but could also work as a motivational force, if one controls for denial. Implications for education concerning sustainable development are discussed.Pew Research Center for the People and the Press. (2012, October 15) More Say There is Solid Evidence of Global Warming. Retrieved from http://www.people-press.org/files/legacy-pdf/10-15-12%20Global%20Warming%20Release.pdfRanney, M., D. Clark, D. Reinholz, S. Cohen (2012). Improving Americans' Modest Global Warming Knowledge in the Light of RTMD (Reinforced Theistic Manifest

Destiny) Theory. In J. van Aalst, K. Thompson, M. M. Jacobson, & P. Reimann (Eds.), The Future of Learning: Proceedings of the Tenth International Conference of the Learning Sciences, Volume 2 (pp. 2-481 to 2-482). International Society of the Learning Sciences, Inc.
http://hamschank.com/convinceme/downloads/papers/RanneyEtAl-ICLS2012.pdf

Also see: http://hamschank.com/convinceme/downloads/papers/RanneyEtAl-CogSci2012.pdf

The former (2-page ICLS Proceedings) piece includes a 400 word intervention that both (a) dramatically helps people understand the mechanism of climate change and (b) significantly helps people accept climate change. The latter (6-page Cognitive Science Proceedings) piece further explicates the experiment involved, as well as the precursor survey that shows that virtually no Americans (zero out of 270 San Diegans) understand the greenhouse effect mechanism.Rosenau, J. (2012) Science denial: a guide for scientists. Trends in Microbiology, 20(12), 567-569.

Evolution, climate change, and vaccination: in these cases and more, scientists, policymakers, and educators are confronted by organized campaigns to spread doubt, denial, and rejection of the scientific community's consensus on central scientific principles. To overcome these threats, scientists not only need to spread scientific knowledge, but must also address the social drivers of science denial.Roser-Renouf, C., & Nisbet, M. C. (2008). The measurement of key behavioral science constructs in climate change research. International Journal of Sustainability Communication, 3, 37-95.

The growth and integration of social science research on climate change will be facilitated by careful, consistent measurement of its central constructs. In this paper, the relevant psycho-social literature is reviewed, with an eye toward enhancing the quality of measurement. We find that risk perception, a focus of much climate change research, has multiple dimensions that may drive behavior in different ways. Values and norms have been assessed by several indices that overlap conceptually, and study findings could be integrated if these overlaps were clarified and tested. Climate change knowledge has numerous components, only some of may be essential in the formation of risk perceptions and behavior. Efficacy has received little attention by survey researchers, but promises to help explain behaviors and policy

preferences. Climate-relevant behaviors are highly complex variables that will require further explication before we fully understand how they may best be measured. Policy preferences have been asked in terms of trade-offs between action and economic impacts, or in terms of specific regulations or tax incentives.Shepardson, D. P., Niyogi, D., Choi, S., & Charusombat U. (2009) Seventh grade students' conceptions of global warming and climate change. Environmental Education Research, 15(5), 2009.

The purpose of this study was to investigate seventh grade students' conceptions of global warming and climate change. The study was descriptive in nature and involved the collection of qualitative data from 91 seventh grade students from three different schools in the Midwest, USA. An open response and draw and explain assessment instrument was administered to students. These data were analyzed for content in an inductive manner to identify students' concepts. The categories that emerged from the students' responses reflected different degrees of sophistication or conceptualization about global warming and climate change. The students' conceptions of global warming and climate change in this study were similar to previous studies in that they lacked a rich conceptualization of the issue, especially as it pertains to the greenhouse effect and its connection to global warming. At the same time, this study expanded on previous studies by further elucidating students' conceptions of the

		impact of global warming on the Earth's oceans, weather, and plants and animals. Here too, students lacked a rich conceptualization. Based on these findings we make curricular recommendations that build on the students' conceptions and the NRC (1996) science education standards. Sinatra, G. M., Kardash, C. M., Taasoobshirazi, G., & Lombardi, D. (2012). Promoting attitude change and expressed willingness to take action toward climate change in college students. Instructional Science, 40(1), 1□17. This study examined the relationship among cognitive and motivational variables impacting college students' willingness to take mitigative action to reduce the impacts of human□induced climate change. One hundred and forty college students were asked to read a persuasive text about human□ induced climate change and were pre and post tested on their attitudes about climate change and their willingness to take action to mitigate its effects. Students showed statistically significant changes in their attitudes about climate change and their willingness to commit to take action. A path model demonstrated that openness to change and a willingness to think deeply about issues predicted both change in attitudes and expressed willingness to take action. This research demonstrates that a persuasive text has the potential to promote change around complex socio□ scientific issues.Sterman, J. D. (2011). Communicating climate change risks in a skeptical world. Climatic Change, 108(4), 811-826. The Intergovernmental Panel on Climate Change (IPCC) has been extraordinarily successful in the task of knowledge synthesis and risk assessment. However, the strong scientific consensus on the detection, attribution, and risks of climate change stands in stark contrast to widespread confusion, complacency and denial among policymakers and the public. Risk communication is now a major bottleneck preventing science from playing an appropriate role in climate policy. Here I argue that the ability of the IPCC to fulfill its mission can be enhanced through better understanding of the mental models of the audiences it seeks to reach, then altering the presentation and communication of results accordingly. Few policymakers are trained in science, and public understanding of basic facts about climate change is poor. But the problem is deeper. Our mental models lead to persistent errors and biases in complex dynamic systems like the climate and economy. Where the consequences of our actions spill out across space and time, our mental models have narrow boundaries and focus on the short term. Where the dynamics of complex systems are conditioned by multiple feedbacks, time delays, accumulations and nonlinearities, we have difficulty recognizing and understanding feedback processes, underestimate time delays, and do not understand basic principles of accumulation or how nonlinearities can create regime shifts. These problems arise not only among laypeople but also among highly educated elites with significant training in science. They arise not only in complex systems like the climate but also in familiar contexts such as filling a bathtub. Therefore they cannot be remedied merely by providing more information about the climate, but require different modes of communication, including experiential learning environments such as interactive simulations.					
Beverly	Law	This paragraph needs to go away, or be more specific. The statement requires reliable references, because it is questionable whether high quality studies have shown that thinned forests are generally "healthier" than unthinned forests. "Stand improvement" is a nebulous phrase, and in the eye of the beholder, so be more specific. Wood extraction can reduce stand density for climate adaptation in dry regions, but it wouldn't make sense in storm-prone areas, as thinning increases boundary layer roughness and makes stands more susceptible to wind throw the first years following the thinning.	7. Forestry		274	38	The text has been revised to incorporate this suggestion.

Stella	Protopapas	The statistic stating that humans use 40% of renewable supplies of freshwater in more than 25% of all watersheds is very vague. Taking the percentage of a percentage will lose the reader, and doesn't make the concepts easy to grasp. I would either do the math (.4 of 25%) or find more transparent statistics to include here.	8. Ecosystems, Biodiversity, and Ecosystem Services		292	21	No change. It is important to include information on the % of withdrawals and the extent of the watersheds affected.
Stella	Protopapas	Elucidate the differences between the A1B and the A2 scenarios. You could footnote it. What does increases in emissions and slow decline thereafter mean, quantitatively? What percentage of change? Who devised these scenarios?	8. Ecosystems, Biodiversity, and Ecosystem Services		292	30	No change. The scenarios are described in detail elsewhere in the report.
Rachel	Jacobson	In addition to listing key messages, it would be useful to order or categorize their content in some way. For example, you could create a chart that lists the physical change (water temperature increase) in one column and the outcome (reduced BDO) in the next column. Then, a final column could list the region(s) in which the change is expected.	3. Water Resources		107	16	Thank you for your suggestion, but space is limited. The author team has deliberated and agreed on the most important information to include.
Rachel	Jacobson	It doesn't make sense to have a subheading here called, "changing rain, snow, and runoff," since the subsequent text discusses precipitation, runoff, streamflows, snowpack, and soil moisture. It makes more sense to keep the main heading "Climate Change Impacts on the Water Cycle," but then have the only sub-headings be each expected category of change ("precipitation", "snowpack", "soil moisture", etc.) Finally, the Key Message could be placed in a sidebar to aid consistency of the reading experience	3. Water Resources		108	25	We have added considerable material to the chapter and feel that the current structure is appropriate.
Rachel	Jacobson	It would be easier to read/scan this section if the bolded words were turned into headings, creating a discrete subsection for each type element of the water cycle. It would also make sense to break out runoff and stream flow, indicating that they are outcomes of increased precipitation rather than in the same category as increased rain, snowfall, and transpiration.	3. Water Resources		108	25	We appreciate your suggestions and have made changes in the document as chapter length allowed.
Rachel	Jacobson	Mentioning human-induced warming trends here makes it seem like human-induced processes have not contributed to any of the other trends in this section.	3. Water Resources		109	7	We have retained the mention of human-induced warming trends in this section because snowpack is a component of the water cycle where attribution has been clearly established.
Rachel	Jacobson	This section does not explain, as do the sections about snowpack and evapotranspiration, the drivers behind precipitation change. It would be great to have more information on that.	3. Water Resources		108	29	The drivers of precipitation change are discussed in Ch. 2, Climate Science Chapter and not repeated here due to chapter length constraints.
Rachel	Jacobson	It would be more aesthetically pleasing if this figure were oriented horizontally	3. Water Resources	3.1	110		We considered your suggestion, but felt the figure works best as it is.
Rachel	Jacobson	Can you provide a footnote to explain, "an ensemble of emissions scenarios and climate projections"	3. Water Resources	3.2	112		The figure caption has been revised to provide more explanation of the projections and scenarios. The

							Executive Summary and Chapter 2: Our Changing Climate has further information on models used in the NCA.
Rachel	Jacobson	This section does not explain, as do the sections on snowpack and evapotranspiration, the drivers behind runoff and streamflow change. It would be great to have more information on that.	3. Water Resources		111	25	We appreciate the suggestion, but space is limited. The author team has deliberated and agreed on the most important information to include.
Stella	Protopapas	"Hurricanes bring intense rainfall, which reduces the salinity of offshore water and leads to blooms of algae. Photo above shows Pamlico Sound, North Carolina, after Hurricane Floyd. Note light green area off the coast, which is new algae growth…Red arrows indicate Hurricanes Dennis, Floyd, and Irene, which hit sequentially during the 1999 hurricane season. The graph on the right shows a steep rise in the amount of surface chlorophyll after these hurricanes, largely due to increased algae growth. (Figure source: Paerl et al., 2003. Image source NASA SeaWiFS)."Yet from: Spreading Dead Zones and Consequences for Marine Ecosystems -- Science 321, 926 (2008) Robert J. Diaz, et al. -- "… hurricanes influence the duration, distribution, and size of the Gulf of Mexico dead zone in a complex way. In 2005, four hurricanes (Cindy, Dennis, Katrina, and Rita) disrupted stratification and aerated bottom waters. After the first two storms, stratification was reestablished and hypoxia reoccurred, but the total area was a fourth less than predicted … The other two hurricanes occurred later in the season and dissipated hypoxia for the year (30)."Oppositional sources exist. Maybe investigate further.	8. Ecosystems, Biodiversity, and Ecosystem Services		295	8	No change. The point and placement of this figure are to emphasize the links between precipitation, discharge, and nutrient loading to coastal waters.
Rachel	Jacobson	Comparing the California groundwater decrease to something described as, "the largest reservoir in the U.S." makes it sound like the decline was insignificant.	3. Water Resources		114	36	The conceptual reference point we have included may be interpreted differently by different readers but it is technically accurate and is included for illustrative purposes.
Rachel	Jacobson	I don't think the information presented in the "spotlight on groundwater" is unique enough to warrant its own section. All of the text in the groundwater section is presented on pretty much the same plane, so it makes sense to just group it all together.	3. Water Resources		114	9	We have revised the Key Message on groundwater and added additional information to the supporting text.
Rachel	Jacobson	Here, I would rather see a map illustrating what percentage of water use demand in a certain area is met by groundwater.	3. Water Resources	3.3	115		We have constructed and added just such a figure, and appreciate the suggestion.
Rachel	Jacobson	If this section is important enough to warrant its own Key Message, then it should contain more descriptive information about how, why, and where these effects will be felt.	3. Water Resources		115	12	We have some added additional descriptive information about this issue and refer readers to Ch. 25, Coastal Zone.
Rachel	Jacobson	Isn't the definition of consumptive use, "water that is withdrawn and eventually consumed?" It seems like the first part of the sentence lumps together consumptive and non-consumptive uses, but the second part of the sentence breaks out consumptive use.	3. Water Resources		118	20	After consideration of this point, we still feel the existing text is clear and accurate.
Rachel	Jacobson	It would be much easier to read this information if it was in table form, with a column for sector, a column for the driver, and a column for source	3. Water Resources		120	7	We appreciate the suggestion but have kept the structure of this section.
Rachel	Jacobson	It doesn't make sense to me that there would be a section on flooding in a larger section called "water resources." I think it makes more sense to just call this section "instream water uses" and move the	3. Water Resource		122	8	We have revised the text to consolidate some of the flooding

		flooding information to the previous section. Alternatively, you could call this larger section “impacts,” and then it would make sense to keep flooding there. Regardless, it would be more readable if you put all of the flooding information in one place.	s				sections.
Rachel	Jacobson	It would be great to include some metrics on the magnitude of the effects of decreased hydropower on various regions’ abilities to meet electricity demand, or to reference another chapter in which that information is presented.	3. Water Resources		124	1	We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include. See Ch 4, Energy Supply and Use, for a more expansive discussion about energy and climate change.
Stella	Protopapas	“Following the fire, heavy rainstorms led to major flooding and erosion, including at least ten debris flows. Popular recreation areas were evacuated and floods damaged the newly renovated, multimillion dollar U.S. Park Service Visitor Center” Why do campers and the visitor center receive as much coverage when there are such few and vague (lacking data, citation, numerical values) sentences about the impact on plants and animals? The visitor center has nothing to do with ecosystems and biodiversity. This chapter is so slanted to the recreational interest of people.	8. Ecosystems, Biodiversity, and Ecosystem Services		301	1	No change. We wanted to provide both economic and ecological examples of damage.
Rachel	Jacobson	Most of the impacts described are very vague and do not include concrete evidence of current or projected trends. If that information is included in the referenced chapters, then no change to this section is necessary. If that information does not exist, it would be great if you were to, as you do in other sections, include a few sentences describing what additional monitoring/studies are needed in order to be able to make accurate predictions about the nature of inland navigation impacts.	3. Water Resources		124	3	Please see Ch 5, Transportation, for additional discussion about impacts on navigation.
Rachel	Jacobson	This section makes a strong case for the value of water-based recreation, but then glosses over the potential climate change impacts. It would be great to see at least 2-3 concrete examples with associated metrics. For example, by how much are Colorado River levels expected to decrease, and what economic impact might that have due to decreased sale of rafting permits?	3. Water Resources		124	28	We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include.
Rachel	Jacobson	It could be detrimental to include the idea of human effects on riverine ecosystems. I assume that this phrase is referring to invasive species, dams, etc. However, people may see it and conflate it with the idea of human-caused climate change. I think it is most useful to focus on climate change effects on ecosystems, and to discuss in parallel (if warranted/desired) whether those climate changes are human caused, leaving out non-climate human changes.	3. Water Resources		125	10	After consideration of this point, we still feel the existing text is clear and accurate.
Stella	Protopapas	Talk of “iconic landscape” loss as if sentimental human recognition of a landscape was the critical loss, here, rather than the biodiversity itself. “ecosystem-based adaption uses biodiversity and ecosystem services to as part of an overall adaptation strategy to help people adapt to the adverse effects of climate change”Why adapting instead of reversing or mitigating climate change instead? What about other life forms?	8. Ecosystems, Biodiversity, and Ecosystem Services				No change. Discussion of mitigating or reversing climate change is beyond the scope of this chapter.
Rachel	Jacobson	Folding this information into the other section(s) on flooding, or moving the information from the previous sections here, would make for a more a more fluid reading experience.	3. Water Resources		126	1	We have revised the text to incorporate this perspective. We have added a box on floods.

Rachel	Jacobson	The phrase, “by altering water availability and demand, climate change is likely to present new challenges” summarizes the main takeaway message of this chapter well, and it would be great to have it, or something like it, somewhere in the beginning of the chapter.	3. Water Resources		126	29	Language discussing climate change altering the water cycle in multiple ways, and presenting unfamiliar risks and opportunities has been added to the text.
Rachel	Jacobson	The chapter does not list any strategies for or examples of increasing the effectiveness of water management. It would be great to see a discussion of strategies/examples in each of the following areas: -demand management (such as domestic use reduction campaigns) -adaptive operating rules (such as timed shutoffs) -combined surface and groundwater resources management (including increased monitoring of surfacewater withdrawal effects on groundwater) -national, state, and local coordination (including regional partnerships and compacts) -stakeholder engagement -equitable decision-making processes	3. Water Resources		126	23	Within chapter length constraints, this chapter has been revised in regards to this suggestion.
Rachel	Jacobson	This graphic doesn’t add much to a section on management, though it might make sense to include it in the section about water resource impacts. A more appropriate graphic might be one showing change in competing water use demands, or one showing uptake of various management strategies by region.	3. Water Resources	3.8	128		Thank you for your suggestion. We feel the current graphic is appropriate for this section.
Stella	Protopapas	Geared toward human audience, rather than an objective or environmental point of view. Ex) Buried mention of nitrogen run-off from farm land leading to algal blooms or pollution, but no indictment of farmers or call for change in fertilizer policy/useEx) Pg 301, line 16: “forest management practices have also made forests more vulnerable to catastrophic fires” yet no call for change in fire management, instead portrays eco-management as promisingReally obfuscates the connection between human activities and climate change and climate change-related occurrences	8. Ecosystems, Biodiversity, and Ecosystem Services				No change. The focus on a "human audience" is consistent with the focus on ecosystem services.
Rachel	Jacobson	The adaptation section focuses almost exclusively on water infrastructure improvements and institutional framework resilience. It gives no treatment to adaptive strategies addressing water use in its own right, and only mentions use in conjunction with adaptation in the context of water law. This might have made sense if the chapter had referenced the adaptation chapter outside of the discussion of capacity-building activities, but it does not. Some examples of adaptation strategies the could be included here are: -promoting drought-resistant crops -flood insurance reform -shifting high-population development away from water-stressed areas	3. Water Resources		129	8	The text has been revised to incorporate some of the suggested examples, within chapter length limitations.
Rachel	Jacobson	It would make sense to either move this text to the water management section, or at least reference the water management section here. As mentioned in another comment, I think this should be the	3. Water Resource		113	7	After consideration of this point, we still feel the existing text is clear and

		central idea of the water management section, and should be expanded upon when talking about water management.	s				accurate.
Rachel	Jacobson	“Too small” for what? Though I have an idea of what this means, it is an incomplete thought and therefore an incomplete illustration of the effects of glacial melting.	3. Water Resources		113	30	The text has been revised to incorporate this suggestion.
Stella	Protopapas	Box 2, Point #14: “Migratory birds monitored in Minnesota over a 40-year period showed significantly earlier arrival dates, particularly in short-distance migration, due to increasing winter temperatures (Swanson and Palmer, 2009)”So? How does this earlier arrival date adversely effect the birds (i.e. lack of food resources)? Also “increasing” winter temperatures would be clearer if replaced with “higher” winter temperatures. The implication of their migratory change is unclear.	8. Ecosystems, Biodiversity, and Ecosystem Services				The study did not measure how the shifts in arrival time affected bird populations, only the timing and trend of migration shifts. It is unclear whether bird (and other shifting) populations will be affected as there are other factors that are either still unresolved or have not yet been fully realized; these include how their food resources also respond to changing climate (through early emergence or declines), as well as changing and potentially novel trophic interations with competitors and predators. I have added some language to the box text to expand a little and clarify. Also, I think "increasing" is appropriate here since the study was documenting a trend.
Rachel	Jacobson	Though the chapter briefly mentions regulation around thermal pollution later on, there is no comprehensive discussion anywhere in the chapter of the impacts of increased thermal pollution due to coolant water returns into climate-induced low-flow streams and low-level lakes.	3. Water Resources		120	4	We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include. Ch 4, Energy Supply and Use, does discuss aspects of this issue briefly.
Rachel	Jacobson	I think that couching the adaptation Key Message in terms of challenges is limiting. There are opportunities in adaptation as well. I think there is potential to have a more well-rounded key message around adaptation that inspires action rather than distress.	3. Water Resources		129	9	The text has been revised to incorporate this suggestion.
Rachel	Jacobson	There are a lot of sentences in the chapter that span many lines and contain up to four or five important ideas. In order to ensure that the reader can digest each idea, it would be better to break up longer sentences into multiple shorter ones.	3. Water Resources				Thank you for your comment. We have attempted to shorten sentences while retaining their meaning where possible.
Rachel	Jacobson	I cover this in a few of my in-line comments, but the chapter could be better organized. Key information about floods and droughts is dispersed in several different sections of the chapter. The section headings are not always illustrative of the section content. The headings and subheadings do not always make sense in tandem. Reorganization would save a lot of space and allow more room for in-depth discussion of some of the topics that lack detail.	3. Water Resources				We have integrated some of the flooding sections per the suggestion. We have added a box on floods.
Rachel	Jacobson	Overall, the first section of the chapter does an excellent job of explaining the climate change effects on each element of the water cycle.	3. Water Resources				We greatly appreciate your positive comment.

Rachel	Jacobson	This figure and its caption are extremely useful here.	3. Water Resources	3.5	119		We greatly appreciate your positive comment.
Rachel	Jacobson	The chapter references the A2 climate change scenario, but never explains what that scenario is, nor does it reference another part of the report with an explanation.	3. Water Resources				Thank you for the comment. More information has been added clarifying the scenarios used in the chapter. The Executive Summary and Chapter 2: Our Changing Climate has further information on models used in the NCA, including in the Water chapter.
Rachel	Jacobson	The topics discussed in the most depth in the chapter are droughts and floods. However, messages surrounding those topics are associated with only a medium-high confidence level; lower than other the confidence level associated with other messages. This highlights the need for better data and decision support. I am also interested in whether droughts and floods get the most in-depth treatment because they pose the biggest threat to property or health, or because they are the most popularized issues. While it is probably a bit of both, I think it is generally worth thinking about the drivers behind the discrepancy of discussion space devoted to individual topics within chapters.	3. Water Resources				Thank you for your comment. Droughts and floods receive a fair amount of attention in this chapter because it is the authors' opinion that they are some of the greatest vulnerabilities for water resources in the face of climate change.
James	Tolbert	"Key Message 1: Substantial adaptation planning is occurring in the public and private sectors and at all levels of government, however, few measures have been implemented and those that have appear to be incremental changes. " The text and even the "Traceable Account" for this key message on page 1014 of the draft appears to completely avoid a major elements of Key Message 1. While there is substantial adaptation planning, this is mostly focused on incremental change and also is mostly focused on planning, not acting. While Key Message 1 uses the term "incremental change", the term is not defined, and is never used again in the text. Furthermore, the only use of the "transformational change" is in the title of an article in the reference section (Kates et al., 2012). The lack of a further discussion of the need for transformational change is a major gap in the content the draft Chapter 28. I suggest that the authors review again the content of Kates, et al. 2012 (or Pelling M (2010) Adaptation to Climate Change: From Resilience to Transformation; Routledge, London) and incorporate more of a discussion of the transformative adaptation that is required to address the adaptations along the eastern and gulf coasts and other areas. The necessity of "transformative change" should be equally placed in a key message as the fact that currently most adaptation involves only "incremental change". The Global Change Research Act is incorporated in the United States Code, Title 15, Chapter 56A - Global Change Research, defines the purpose and content of the National Climate Assessment report in Section 106 (Scientific Assessment) as follows: "On a periodic basis (not less frequently than every 4 years), the Council, through the Committee, shall prepare and submit to the President and the Congress an assessment which: • "Integrates, evaluates, and interprets the findings of the Program and discusses the scientific uncertainties associated with such findings • "Analyzes the effects of global change on the natural environment, agriculture, energy production	28. Adaptation				Thank you for your comment. The authors already cite one of the seminal pieces noted by the commentor. In regards to the main point, however, the authors feel that this area of research (transformative change) is relatively nascent, and the authors are not allowed to be policy perscriptive and identify what should be done. As such, no change was made.

		and use, land and water resources, transportation, human health and welfare, human social systems, and biological diversity • “Analyzes current trends in global change, both human- induced and natural, and projects major trends for the subsequent 25 to 100 years.” The current draft of Chapter 28 does not have sufficient discussion of the transformational adaptation that will be required in the subsequent 25 to 100 years if we continue down the path we are on with minimal mitigation (or even if we implement significant mitigation to stop the growth in emissions of greenhouse gasses.)					
Jonathan	Doubek	The author’s definition of ecosystem is relatively broad and not fully clear. Maybe they could add a few words about, “an ecosystem is typically defined by dominant types of vegetation, climate, and precipitation, which varies from region to region, hence distinct ecosystems.” It might help to give a few examples of ecosystems (i.e., temperature forest, desert) to familiarize those less familiar with ecosystem.	8. Ecosystems, Biodiversity, and Ecosystem Services		291	29	No change. We have used a broadly applicable, widely accepted definition of ecosystems and would have to add a lot of text to accommodate the range of different ecosystem types.
Jonathan	Doubek	“fisheries” is not an ecosystem service; it is an action to obtain food, which is an ecosystem service. This part is a little confusing for the audience.	8. Ecosystems, Biodiversity, and Ecosystem Services		291	37	We have removed mention of "fisheries" as this is really a subset of 'food."
Jonathan	Doubek	I’m not sure why this sentence is on its own line, it should be a part of the previous paragraph? Also, this sentence is a little misleading. I would argue that “some” ecosystem services “can” translate into these variables, and that different ecosystem services are more important for different regions and cultures.	8. Ecosystems, Biodiversity, and Ecosystem Services		291	39	This sentence is a part of the paragraph that precedes it. Edits have been made in regards to this suggestion.
Jonathan	Doubek	I think this sentence is misleading and parts are vague. I would add the word “can” have direct impacts (i.e., we haven’t directly lost a species directly from climate change yet, maybe talk about reduced populations and population ranges?). Also, can the authors better define what “distorted rhythms of nature” means? This might be a good place of an example or two how climate change is impacting our ecosystems (i.e., reduced ranges for some polar species, and various tree species like the maple expanding its range north in the U.S.).	8. Ecosystems, Biodiversity, and Ecosystem Services		292	3	No change. The subsequent sections provide specific examples of each of these impacts. Due to chapter length constraints, we don't want to add examples here as this unnecessarily adds text that will just be repeated in subsequent sections.
Jonathan	Doubek	I would remove “matters to people” because the sentence reads more clearly without it. Or maybe add “and maintains sufficient ecosystem services for humans” at the end.	8. Ecosystems, Biodivers		292	12	No change. "Matters to people" is key to the ecosystem services approach.

			ity, and Ecosyste m Services				
Jonatha n	Doubek	I would argue that less water would mean less water quantity available, not necessarily lower water “quality”.	8. Ecosyste ms, Biodivers ity, and Ecosyste m Services		292	26	Changed as suggested.
Jonatha n	Doubek	This paragraph might be a nice place to add some information by Postel et al. (1996): “We now consume about 54% of all our freshwater, and 70% of the remaining water is deemed unsuitable for consumption.” This is another way to elevate the importance of our diminishing water resources.	8. Ecosyste ms, Biodivers ity, and Ecosyste m Services		292	28	No change. While the comment suggests a good specific example, the authors feel the existing examples are appropriate.
Jonatha n	Doubek	Change algae to phytoplankton. Some phytoplankton are not actually “algae”, they are protists and bacteria (i.e. cyanobacteria), which are often associated with eutrophication.	8. Ecosyste ms, Biodivers ity, and Ecosyste m Services		292	37	Changed as suggested.
Jonatha n	Doubek	I think it is also appropriate to add a small paragraph on inland lake eutrophication. Many lakes in the U.S. are eutrophicated, and I argue that adding this dimension will reach out to people not just on the coast, but throughout the U.S. A strong paragraph on inland lake eutrophication would add great value to this section.	8. Ecosyste ms, Biodivers ity, and Ecosyste m Services		293	5	No change. We have tight space limitations. Lakes are earlier in this paragraph - "Currently, many U.S. lakes and rivers are polluted (have concentrations above government standards) by excessive nitrogen, phosphorus, or sediment."
Jonatha n	Doubek	I would like to see more examples of how eutrophication leads to reduced ecosystem services of a lake. For example, Dodds et al. (2009) reported that harmful algal and cyanobacterial blooms can have severe consequences for recreational and lakeside property values and are responsible for about $2 billion dollars annually in the U.S. alone. I think including more studies like these for inland lakes will help explain connection between lake water quality and ecosystem services. Authors could also discuss how eutrophication may influence the ecosystem service of water purification (Cardinale et al., Nature 2012). The authors might note some ways eutrophication could reduce cultural services of a lake and how eutrophication might have the potential to reduce the water purification ecosystem service.	8. Ecosyste ms, Biodivers ity, and Ecosyste m Services		293	5	No change. While the comment suggests a good specific example, the authors feel the existing examples are appropriate and adequate.
Jonatha n	Doubek	The authors should elaborate on how an increase in these parasites affecting Daphnia might affect the rest of the food web. For example, if there are more parasites, there could be less Daphnia by	8. Ecosyste		293	26	No change. While the comment suggests a good specific example, the

		mortality, or Daphnia of a lower food quality, which could result in lower fish populations, and lower human recreation and money from fishing. Authors should scale this up for more large-scale effect.	ms, Biodiversity, and Ecosystem Services				authors feel the existing examples are appropriate.
Jonathan	Doubek	Change algae to phytoplankton	8. Ecosystems, Biodiversity, and Ecosystem Services		293	38	Changed in response to comment #39136.
Jonathan	Doubek	It is important to note that this is in the U.S. alone!	8. Ecosystems, Biodiversity, and Ecosystem Services		294	8	Changed as suggested.
Jonathan	Doubek	This would be a nice area to add more information on the nexus between climate change and cyanobacterial dominance.	8. Ecosystems, Biodiversity, and Ecosystem Services		294	3	No change. While the comment suggests a good specific example, the authors feel the existing examples are appropriate.
Jonathan	Doubek	But see Cardinale et al. (2012). There is currently very little evidence for flood control and erosion control on the preservation of biodiversity. Very few studies have been conducted directly looking at these topics.	8. Ecosystems, Biodiversity, and Ecosystem Services		296	3	No change. There is no mention of preservation of biodiversity here. The focus here is catastrophic damage.
Jonathan	Doubek	It might be nice to have a baseline here of what a typical year of fire damage brings to the U.S. Was this more damage than usual? If so, how unusual is this? Some context here would be nice.	8. Ecosystems, Biodiversity, and Ecosystem Services		296	18	No change. The dollar values are useful, even without historical context. And the importance of "some forest management" practices as a contributing factor other than climate has been mention in response to comment #5901.

Jonathan	Doubek	I would argue that these sentences should be in the prior paragraph. These are talking more about fires, fire damages, and changes in fire frequency, and less on how fires will change plant and animal distributions. Some of this could be left where it is to set the stage for future discussion, but most is more detail for the previous paragraph.	8. Ecosystems, Biodiversity, and Ecosystem Services		296	28	No change. In the extreme events section the focus is on really big (extreme) fires. Here the focus is on more "normal" fires, or the introduction of fire to places that have not had fires before.
Jonathan	Doubek	reference? It would be influential here to have one example of a species that will be unable to move and adapt with a drastic increase in climate. For example, the authors could talk about specialist species in various regions.	8. Ecosystems, Biodiversity, and Ecosystem Services		297	1	No change. Multiple references are provided in the following sentence - "As climates continue to change, models and long-term studies project even greater shifts in species ranges. However, many species may not be able to keep pace with climate change, either because their seeds do not disperse widely or because they have limited mobility, thus leading, in some places, to local extinctions of both plants and animals. Both range shifts and local extinctions will, in many places, lead to large changes in the composition of plants and animals, resulting in new communities that bear little resemblance to those of today (Cheung et al. 2009; Lawler et al. 2009; Stralberg et al. 2009; USGS 2012; Wenger et al. 2011)."
Jonathan	Doubek	This is great information, but it would also be nice to have one specific example. The authors could discuss one of these systems in depth and draw conclusions about how the species composition of the boundary might change.	8. Ecosystems, Biodiversity, and Ecosystem Services		297	8	No change. Multiple specific examples are provided in the paragraph and we are severely space limited and cannot develop one in depth.
Jonathan	Doubek	omit “so”	8. Ecosystems, Biodiversity, and Ecosystem Services		298	13	No change. The "so" is necessary to set up the second clause of the sentence - "This can cause plants and animals to be so out of phase with their natural phenology that outbreaks of pests occur, or species cannot find food at the time they emerge."
Jonathan	Doubek	The authors might comment briefly on any potential weaknesses these options face. For example, will some of these options be more feasible than others for financial, practical or political reasons.	8. Ecosystems,		300	7	No change. Detailed examples are provided by the citations. We do not have space to elaborate on them here.

			Biodiversity, and Ecosystem Services				
Jonathan	Doubek	Can the authors explain in biological terms what “devastated” refers to.	8. Ecosystems, Biodiversity, and Ecosystem Services		301	1	"Devastated" has been replaced with "negatively affected." We do not have room to provide details.
Jonathan	Doubek	What are the main conclusions from this paragraph? The closing sentence doesn’t give the reader as much attention as it could. Some of this paragraph seems redundant from earlier paragraphs (i.e., re-discussion of bark beetles and wild fires). I’d like to see the reconnection again back to ecosystem services and human use.	8. Ecosystems, Biodiversity, and Ecosystem Services		301	8	No change. The point of the paragraph is to show how the fires provide an example of how forest ecosystems, biodiversity, and ecosystem services are affected by the impacts of climate change, other environmental stresses, and past management practices.
Jonathan	Doubek	Box 2: A general comment here: having more number values in the messages might better grab the reader’s attention. For example, the authors state: “Quaking aspen-dominated systems are experiencing declines in the western U.S.” Yes, but how great is the decline? I feel that including these values (i.e, percentage) would really grab a reader’s attention and make the argument more powerful.	8. Ecosystems, Biodiversity, and Ecosystem Services		302	2	Many studies document trends on species responses to climate change and their (in)ability to respond to changing environmental conditions. In many cases, the full range of impacts on a population due to climate change are not known. Even if a species or population can adjust their phenology, food resources many not change at a similar rate; there may also be unknown trophic interactions with competitors or predators that could effect population success. We have added text to examples in box where studies were able to show a postiive, negative, or neutral trend, but this was not always possible. Studies such as Kascher et al., 2011 show or predict how species or groups of species are or are predicted to respond to climate change across different regions. We have left this study in but added more detail to make the full breadth of the results more impactful. Same with Ibáñez et al. (2008) example.
Christin	Cutrone	From reading this chapter, and looking at this table in particular, I do get a sense of how the presence	16.	Table	559		The text has been revised to

a		of salt from saltwater can have detrimental and damaging effects on buildings and other parts of the Northeast cities' infrastructures. However, I think that for the reader to be able to really understand why the presence of salt is such a significant issue having to do with climate change in the Northeast, that the effects of salt should be expanded and explained further. For example, why does salt have a corrosive effect on city structures, and what happens when saltwater gets mixed with salt water through storms or rising sea levels. Also why does it have an effect on subways, wastewater treatment, and electrical stations? If the salt issue could be explained more and given a case as to why people should it into account, I think that would really add to this chapter in this publication. People will then clearly know the alarming affects of unwanted salt water, and therefore will make more efforts to try to keep the salt water at bay and under control, including trying to mitigate the effects of climate change and therefore reducing their environmental impacts.	Northeast	6.1			incorporate this suggestion.
Kirsten	Schwind	Dear Authors,I am glad to see mention of rising food prices in this assessment. The economic impact of rising US food prices (and prices of other basic goods) driven by climate change is likely to affect far more Americans than sea level rise. It will especially impact low and moderate income families. Yet this topic receives only cursory treatment in the national assessment. I encourage you to significantly expand this section in the next draft, including mention of:1. Current food insecurity rates in the US 2. How many additional households rising prices food prices may place at risk of food insecurity 3. How rising food prices may impact households that are already struggling to survive on food stamps, which have a significant lag time in their inflation adjustmentsFood stamp benefits currently do not keep up with food price spikes, a situation which is likely to lead to more severe hunger in the richest country in the worldI was recently commissioned by the San Francisco Bay Area's Joint Policy Committee (our version of regional government) to survey vulnerable populations in the Bay Area about what climate impacts they are most concerned about. Rising prices of food, water, energy, and other basic goods was the impact of greatest concern, of about 13 options, rating much higher than heat waves, flooding, sea level rise, etc. You can access this report at http://www.baylocalize.org/mappingourfuturereport. This topic needs more research at the national level, but in the meanwhile we can certainly use currently available USDA data on food security and participation in nutrition programs compared to historical food inflation to explore this topic much further in our National Climate Assessment.Please feel free to contact me for further discussion.Best, Kirsten Schwind Director, Bay Localize Oakland, CA 510-834-0420 kirsten@baylocalize.org	6. Agriculture		243	1	Thanks for the comment.
Claudia	Langford	Changes in Tick Habitat references (Ogden et al. 2008). This is an incorrect reference. The reprinted figure is actually from Brownstein et al. 2005.(Health Author Comment - CA Beard)	9. Human Health		345	8	We have changed the reference for this figure. We are using maps of changes in tick habitat adapted from the maps found in Brownstein, John S., Theodore R. Holford, and Durland Fish, 2005: Effect of Climate Change on

							Lyme Disease Risk in North America. EcoHealth, vol 2, p. 38-46. DOI 10.1007/s10393-004-0139-x.
Claudia	Langford	“Insect” should be changed to “arthropod” and “insect-borne” to “arthropod-borne” when referring to that group of diseases because ticks are arthropods, not insects.(Health Author Comment - CA Ostfeld)	9. Human Health		343	29	The text has been revised to address this comment. Where applicable, we have deleted "insect" and used another term such as “vector” to provide accurate representation of arthropod-borne diseases.
Claudia	Langford	Should read, “Health-related costs of the current effects of ozone air pollution exceeding health-based standards have been estimated at $6.5 billion nationwide (Knowlton et al. 2011; Ostblom and Samakovlis 2007).” This is because we cannot exclusively blame the current effects of ozone air pollution on climate change.(Health Author Comment - LA Balbus)	9. Human Health		334	31	The text has been revised to incorporate this suggestion. The sentence now reads, "...current effects of ozone air pollution exceeding national standards…"
Claudia	Langford	Change to “Mary Hayden, National Center for Atmospheric Research.” That is the correct affiliation.(Author Team Comment - LA Hayden)	9. Human Health		333	10	The text has been revised to incorporate this suggestion. Mary Hayden's affiliation was changed to "National Center for Atmospheric Research."
Claudia	Langford	Change to “Vector-borne Diseases”. Justification: using the word ‘insects’ is limiting, as ticks are not insects. The broader, more encompassing terminology should be vector-borne diseases. Additionally, we do not explicitly discuss diseases borne by rodents, so it’s better to eliminate the word.(Health Author Comment - LA Hayden)	9. Human Health		343	29	The text has been revised to incorporate this suggestion. We have changed "insect-borne" to "vector-borne" and taken out rodents.
Claudia	Langford	Change to “…diseases borne by vectors such as fleas, ticks and mosquitoes…” Justification: This provides more accurate representation of arthropod borne diseases.(Health Author Comment - LA Hayden)	9. Human Health		343	30	We have revised the text per your suggestion.
Claudia	Langford	Key message #1/4– Change insects to vectors.(Health Author Comment - LA Hayden)	9. Human Health		356		Thank you for your comment. The text has been revised to incorporate this suggestion wherever Key Message 1 appears.
James	Tolbert	The report is missing an important adaptation that is currently being used: increasing federal emergency aid with increased federal deficit spending. Emergency federal aid to areas after a weather related emergency (e.g. draught, hurricane, or flood relief or crop insurance payments) is an adjustment in a human systems to a new or changing environment that moderates negative effects. Therefore, increased federal aid is an adaptation that should be listed in this chapter. This adaptation practice transfers the cost of the current event caused by a changing environment to future generations that will be required to also pay for mitigation and adaptations at that time. Please add increasing federal emergency aid through deficit spending to your list of current adaptation strategies that are being used.	28. Adaptation	28.1	987		We thank the commenter for the suggestion, but space is limited. We deliberated and agreed on the most timely and relevant information to include in this table of federal actions, reflecting a diversity of departments and agencies. While the commenter's point is a good one, with limited space, this concept has been omitted. However, we did add a clause in the last section on the role of the Federal Gov't in disaster response.
Claudia	Langfor	Diseases from Insects and Rodents: (Change to read “Vector-borne Diseases”)	9.		357		Thank you for your comment. The text

	d	The effects of climate change on vector-borne diseases have been documented in a number of publications. Studies have explored the effects climate change have on location and adaptation of insects (Lafferty 2009; McGregor 2011; Tabachnick 2010), which can alter their interaction and effect with human health (Epstein 2010; Reiter 2008; Rosenthal 2009; Russell 2009), and have documented a number of insect-borne diseases affect the U.S. (Centers for Disease Control and Prevention 2010; Degallier et al. 2010; Diuk-Wasser et al. 2010; Gong et al. 2011; Johansson et al. 2009; Jury 2008; Keesing et al. 2009; Kolivras 2010; Lambrechts et al. 2011; Mills et al. 2010; Morin and Comrie 2010; Ogden et al. 2008; Ramos et al. 2008). Observational studies are already underway and confidence is high based on scientific literature that climate change has contributed to the expanded range of certain disease vectors, including Ixodes ticks which are vectors for Lyme disease in the U.S.(Health Author Team Comment - LA Hayden)	Human Health				has been revised to incorporate this suggestion.
James	Tolbert	I suggest expanding some of the text on the Southeast Florida Climate Compact to discuss some of the changes that are more transformative -- having the ability to eliminate development in areas that will be projected to be below future sea levels after storm damage, or even prohibiting new building. “Work with appropriate local, regional and state authorities to revise building codes and land development regulations to discourage new development or post-disaster redevelopment in vulnerable areas to reduce future risk and economic losses associated with sea level rise and flooding. In these areas, require vulnerability reduction measures for all new construction, redevelopment and infrastructure such as additional hardening, higher floor elevations or incorporation of natural infrastructure for increased resilience.” (Southeast Florida Regional Climate Change Compact Counties. 2012. “Regional Climate Action Plan Implementation Guide”: Action #SP-10). “Develop new community flood maps reflective of a 100-year storm event under future sea level rise scenarios and use this information, in conjunction with similarly updated storm surge models for revising required elevations for new and redevelopment, and in the permitting/licensing of transportation projects, water management systems, and public infrastructure.” (Southeast Florida Regional Climate Change Compact Counties. 2012. “Regional Climate Action Plan Implementation Guide”: Action #SP-12)	28. Adaptation	28.3	993		Thank you for your comments. The authors have added text mentioning the sectors addressed in the referenced report and provided one example highlighted by the commenter.
James	Tolbert	"Despite some early successes, the pace and extent of adaptation activities are not proportional to the risks to people, property, infrastructure, and ecosystems from climate change; important opportunities are also being overlooked. " This conclusion should be a Key Message when communicating the status of adaptation efforts and being asked to project forward 25 to 100 years. The National Climate Assessment is directed to "analyzes current trends in global change, both human induced and natural, and projects major trends for the subsequent 25 to 100 years.” (Global Change Research Act, incorporated in the USC, Title 15 Chapter 56A - Global Change Research; Section 106)	28. Adaptation		1006	28	Thank you for your comment. The authors agree that this is an important point - that the current pace and extent of adaptation is insufficent. But, upon reflection, we don't feel that we can really say that there are early "successess" since we don't have much to evaluate. So we are changing the phrasing to refect that the "despite emerging efforts..."
James	Tolbert	"A Compendium of Adaptation Practices. A central and streamlined database of adaptation options implemented at different spatial and temporal scales is needed. Information on the adaptation actions, how effective they were, what they cost, and how monitoring and evaluation were conducted should be part of the aggregated information. (National Climate Adaptation Summit Committee 2010; NRC 2010a)." A similar compendium of "aid related to climate events" should be created to track all aid given in	28. Adaptation		1007	4	Thank you for your comment. The authors have added language highlighting the opportunity to coordinate with the private sector on related efforts. However, no specific reference was made to the Compendium mentioned by the

		response to climate related events such as floods, droughts, storm surges, hurricanes, and crop failures. As the central tendencies of temperature and sea level increase, we expect the extreme values which create the need for aid to also increase. This financial burden on future tax payers (since aid is typically funded through national debt) should also be tracked. This tracking system should attempt to evaluate the impacts of any mitigation that has occurred. This will also provide data that can be evaluated in discussions about the cost of climate change abatement or mitigation.					reviewer as we were unable to locate it.
James	Tolbert	A second key role of the federal government is providing aid after the climate extreme event (flood, hurricane, crop failure, or drought) to compensate people and populations which had not adequately planned for the extreme event. This unplanned compensation meets the definition of adaptation presented earlier in the chapter as it is an adjustment in a human systems to a new or changing environment that moderates negative effects. Either federal aid in response to these weather related events should be considered an adaptation, or you should consider changing the definition of adaptation and move away from the current, commonly accepted definition.	28. Adaptation		1007	22	Thank you for your comment. We have added a sentence on role of the Feds in emergency relief and also drawn attention to the national response strategy to Hurriance Sandy.
Laurence	Fishtahler	Item #1 Fishtahler(L.E.&C.R.): Chapter 22 – Alaska: Disappearing Sea Ice, pg. 759, line 14 Title: Summer sea ice disappears in the 2030s (pg. 759) Issue: consistency, accuracy, currency Change: “Summer sea ice is receding rapidly and is projected to disappear by mid-century.” To: “Summer sea ice is receding rapidly and is projected to disappear in the 2030s.” (see also pg. 762, line 8) Rationale: Page 762 Line 15: “Models that best match historical trends project seasonally ice-free northern waters by the 2030s.” Wang & Overland (2012) conclude: “For the seven selected CMIP5 models based on observed mean and magnitude of seasonal cycle and our extrapolation approach (Figure 4), the interval range for a nearly sea ice free Arctic is 14 to 36 years, with a median value of 28 years, i.e. relative to 2007 a loss in the 2030s, consistent with the previous estimate we obtained … .” Further, they write “While CMIP5 model mean sea ice extents are closer to observations than CMIP3, the rates of sea ice reduction in most model runs are slow relative to recent observations.” “Recent observations” does not include the 2012 minimum; Wang & Overland (2012) was written before the 2012 summer minimum, and their “climatology period for observation/model comparisons was 1981–2005.” The 2012 summer minimum falls below the range of model projections from Wang & Overland (2012) “The observed decline in annual sea ice minimum extent (September) has occurred more rapidly than was predicted by climate models … .” (Markon et al. 2012) pg. 1 This aspect of sea ice loss is more advanced in the Alaskan Beaufort and Chukchi Seas than the Arctic generally.	22. Alaska and the Arctic		759	14	This comment is inconsistent with the author team’s thorough assessment of the science. The statement in the key message of sea-ice disappearence by mid-century is deliberately conservative since there is considerable disagreement among models as to the rate of future sea-ice loss (traceable accounts). The mid-2030s is stated as a date estimated by models that best reconstruct the historical sea-ice trend. Although September of 2012 set a new record low in the satellite record, it is inappropriate to place too much emphasis on a single year given that the overall downward trend in September sea ice extent is superimposed upon strong interannual variability.
James	Tolbert	Thank you for the good case studies. I suggest making a fourth case study to point out the more common current adaptive strategy used in	28. Adaptation		1008	1	Thank you for your comment. The authors have added some short material about Hurricance Sandy and

		the United States. (Either the Texas drought, or hurricane Sandy could be used as examples.) After an extreme weather event occurs (or as it is occurring), the affected population calls on the Federal and State government to provide financial relief and the elected bodies readily provide financial payments to impacted individuals or low cost loans or emergency supplies. These are typically funded by increased national debt that must be paid for by future tax payers who will be bearing the costs of other adaptive and mitigation activities. This is clearly in the definition of adaptation which was provided in the early section of this chapter, and appears to be a dominant strategy as communities, states, and or county have not taken adequate proactive adaptive measures at this time. Currenlty, I suggest that this is the dominant form of "adaptation" that is being practiced.					the national response. Unfortunately, due to space limitations, more information could not be added. In addition, the authors have encouraged the Executive Committee for the NCA to include a box in the Executive Summary on extreme events.
Laurence	Fishtahler	Item #2 Fishtahler(L.E.&C.R.): Chapter 22 – Alaska: Disappearing Sea Ice, pg. 762, line 8 Title: Summer sea ice disappears in the 2030s (pg. 762) Issue: consistency, accuracy, currency Change: “Summer sea ice is receding rapidly and is projected to disappear by mid-century.” To: “Summer sea ice is receding rapidly and is projected to disappear in the 2030s.” (see also pg. 759, line 14) Rationale: Page 762 Line 15: “Models that best match historical trends project seasonally ice-free northern waters by the 2030s.” Wang & Overland (2012) conclude: “For the seven selected CMIP5 models based on observed mean and magnitude of seasonal cycle and our extrapolation approach (Figure 4), the interval range for a nearly sea ice free Arctic is 14 to 36 years, with a median value of 28 years, i.e. relative to 2007 a loss in the 2030s, consistent with the previous estimate we obtained … .” Further, they write “While CMIP5 model mean sea ice extents are closer to observations than CMIP3, the rates of sea ice reduction in most model runs are slow relative to recent observations.” “Recent observations” does not include the 2012 minimum; Wang & Overland (2012) was written before the 2012 summer minimum, and their “climatology period for observation/model comparisons was 1981–2005.” The 2012 summer minimum falls below the range of model projections from Wang & Overland (2012) “The observed decline in annual sea ice minimum extent (September) has occurred more rapidly than was predicted by climate models … .” (Markon et al. 2012) pg. 1 This aspect of sea ice loss is more advanced in the Alaskan Beaufort and Chukchi Seas than the Arctic generally.	22. Alaska and the Arctic		762	8	The text has been revised to incorporate this suggestion.
Laurence	Fishtahler	Item #3 Fishtahler(L.E.&C.R.): Chapter 22 – Alaska: Disappearing Sea Ice, pg. 762, line 13 Title: Beaufort & Chukchi ice free in 2007 & 2012 Issue: missing – Alaskan region specific information After: “The six Septembers with the lowest ice extent all occurred in the past six years.”	22. Alaska and the Arctic		762	13	While the comment suggests a good specific example, the authors feel the existing examples are appropriate and adequate.

		Add: “From the perspective of the Alaskan region it is important to note that in 2007 and 2012 both the Alaskan Beaufort and Chukchi Seas were completely ice free in early September and nearly so in the years between.” Rationale: NSIDC data sets and analyses. See also: www.arctic.noaa.gov/detect/ice-seaice.shtml “nearly” – one exception occurred when in 2009 there was ice cover in the eastern Beaufort Sea. Provide Alaskan region specific information as well as pan-Arctic context. This aspect of sea ice loss is more advanced in the Alaskan Beaufort and Chukchi Seas than the Arctic generally.					
James	Tolbert	"Brunner, R., 2012: Climate Adaptation and the Drunkard’s Search" First, this is an incomplete reference. Please include sufficient information to identify the paper. At a minimum, add Prepared for the 2012 Spring Workshop on Public Policy Process (WOPPR) series on “Digging Theories in Environmental Policy and Management”, School of Public Affairs, University of Colorado-Denver. 11th of April, 2012. Retired Professor, University of Colorado. http://www.ucdenver.edu/academics/colleges/SPA/BuechnerInstitute/Centers/WOPPR/diggingblog/Documents/Brunner%20WOPPR%20Blog.pdf Second, I am not sure this reference meets the standard for inclusion in the NCA.	28. Adaptation		1021	14	Thank you for your comment. Unfortunately, the reference is incomplete, so we have asked for the article. However, since it was not in press by April 2013, we cannot cite as part of the 2013 NCA.
Laurence	Fishtahler	Item #4 Fishtahler(L.E.&C.R.): Chapter 22 – Alaska: Disappearing Sea Ice, pg. 762, line 13 Title: Decline in ice mass & thickness Issues: (1) missing – Alaskan region specific information (2) missing – important aspect of sea ice loss: thickness (mass) Before: “As sea ice declines, … .” Add: “Updated observational data clearly show rapid decline in not only extent but also thickness (mass) of multi-year ice (Markon et al. 2012).” Rationale: “The observed decline in annual sea ice minimum extent … and has been accompanied by decreases in ice thickness and in the presence of multi-year ice.” (Markon et al. 2012) pg. 1 “The rate of decline of Arctic sea ice thickness and September sea-ice extent has increased considerably during the first decade of the 21st century (Maslanik and others, 2007; Nghiem and others, 2007; Comiso and Nishio, 2008; Deser and Teng, 2008; Alekseev and others, 2009). By September 2007, the area of sea ice had declined to 37 percent of its extent during the period 1979–2000. Although at the time, it was unclear whether the record minimum extent of ice in 2007 was an	22. Alaska and the Arctic		762	13	Due to the size of the topic, and the page limit for the chapter, we focused on broad trends rather than delving too deeply or providing such a level of specificity. The general issues are addressed in the traceable accounts and the cited references.

		extreme outlier, every year since then (2008-2011) has had a smaller September sea ice extent than the years before 2007, with 2011 being second lowest compared with 2007 (fig. 44). In addition, the amount of old, thick multi-year sea ice in the Arctic also has decreased by 42 percent from 2004 through 2008 (Giles and others, 2008; Kwok and Untersteiner, 2011) and the sea ice has become more mobile (Gascard and others, 2008). Thus, the Arctic may be moving toward a new state in which it is dominated by first year sea ice processes, and will lose some of the long term, more stable dynamics associated with old, thick sea ice." (Markon et al. 2012) pg. 74 "On a pan-Arctic basis, the ice coverage at the time of the September minimum is now about 50% less than in the 1980s, and the ice is younger and thinner than at any time in the period of satellite coverage." (Stewart et al. 2013 Sec 2.4.7 Sea Ice pg. 20) See also: "CryoSat-2 estimates of Arctic sea ice thickness and volume" Laxon et al. 2013 DOI: 10.1002/grl.50193 Provide Alaskan region specific information as well as pan-Arctic context. This aspect of sea ice loss is more advanced in the Alaskan Beaufort and Chukchi Seas than the Arctic generally.					
Laurence	Fishtahler	Item #5 Fishtahler(L.E.&C.R.): Chapter 22 – Alaska: Disappearing Sea Ice, pg. 762, line 15 Title: Beaufort & Chukchi predominantly first year ice Issues: (1) missing – Alaskan region specific information; (2) missing – implication for ice loss processes After: "As sea ice declines, it becomes younger and thinner, and therefore more vulnerable to further melting (Stroeve et al. 2011)." Add: "Almost all ice in the Alaskan Beaufort and Chukchi Seas is thin first year ice, and it is expected to disappear relatively early in the next melt season." Rationale: First year ice cover: NSIDC data sets and analyses. See also: www.arctic.noaa.gov/detect/ice-seaice.shtml "In addition, the amount of old, thick multi-year sea ice in the Arctic also has decreased by 42 percent from 2004 through 2008 (Giles and others, 2008; Kwok and Untersteiner, 2011) and the sea ice has become more mobile (Gascard and others, 2008). Thus, the Arctic may be moving toward a new state in which it is dominated by first year sea ice processes, and will lose some of the long term, more stable dynamics associated with old, thick sea ice." (Markon et al. 2012) pg. 74 See: "CryoSat-2 estimates of Arctic sea ice thickness and volume" Laxon et al. 2013 DOI: 10.1002/grl.50193 The Alaskan Beaufort and Chukchi Seas exhibit ice processes analogous to what has been observed in the Being Sea: "The seasonal winter ice is relatively thin, more easily deformable, and vulnerable to	22. Alaska and the Arctic		762	15	Due to the size of the topic, and the page limit for the chapter, we focused on broad trends rather than delving too deeply or providing such a level of specificity. The general issues are addressed in the traceable accounts and the cited references.

		rapid melt in the spring, as has been characteristic of the past six years." "Even in the central Arctic, the ice is much younger and thinner than in past decades (Stroeve et al. 2011)." (Stewart et al. 2013 Sec 2.4.7 Sea Ice pg. 21)					
Laurence	Fishtahler	Item #6 Fishtahler(L.E.&C.R.): Chapter 22 – Alaska: Disappearing Sea Ice, pg. 762, line 15 Title: Models match observations for 1981–2005 Issue: "historical trends" is vague and misleading Change: "Models that best match historical trends project … ." To: "Models that best match observations for the period 1981–2005 project seasonally ice-free northern waters by the 2030s (Stroeve et al. 2007; Wang and Overland 2009, 2012)." Rationale: Wang & Overland (2012) wrote: "our climatology period for observation/model comparisons was 1981–2005." The phrase "historical trends" in this context would be read as 1980–2012, for example Figure 22.2: "Declining Sea Ice Extent" which includes 1980–2012. (Figure 22.2 appears to be Figure 6 pg 21 of NOAA Technical Report NESDIS 142-7 Stewart et al. 2013.)	22. Alaska and the Arctic		762	15	Due to the size of the topic, and the page limit for the chapter, we focused on broad trends rather than delving too deeply or providing such a level of specificity. The general issues are addressed in the traceable accounts and the cited references.
Jan	Dash, PhD	Emphasize Risk Management as the preferred framework, and use the language "Risk Management". This is accurate, neutral, and persuasive.	1. Executive Summary				The authors of this report did use a risk management framework, but did not use this term exclusively when referring to response strategies.
Jan	Dash, PhD	Emphasize Risk Management as the preferred framework, and use the language "Risk Management". This is accurate, neutral, and persuasive.	Introduction: Letter to the American People				The authors appreciate the importance of risk management framing, in fact it is an important component of the NCA approach. However, it is not appropriate to repeat this language every time response strategie are mentioned.
Laurence	Fishtahler	Item #7 Fishtahler(L.E.&C.R.): Chapter 22 – Alaska: Disappearing Sea Ice, pg. 762, line 16 Title: Expected variability in sea ice extent Issues: (1) missing – important aspect of downward trend: steepening (2) inaccurate rendition of referenced material (3) clarity Change: "Within the general downward trend in sea ice there will be periods of a decade or more with both rapid ice loss and temporary recovery (Tietsche et al. 2011), making it challenging to predict short-term changes in ice conditions." To: "As shown in the inset of Figure 22.2, there is significant year to year variation in sea ice extent minima within the general downward trend; this year to year variability is expected (Tietsche et al.	22. Alaska and the Arctic		762	16	The text has been revised to incorporate this suggestion.

		2011), but makes it challenging to predict next year's minimum, as well as estimate the degree of the steepening of the downward trend (Stroeve et al. 2011)." Rationale: "there will be periods of a decade or more with both rapid ice loss and temporary recovery" could be misread as: "there will be decades with rapid ice loss and decades of temporary recovery". Tietsche et al. (2011) intend: annual variability (loss and recovery) over a period of a decade. Tietsche et al. (2011) is a study of model behavior, not observations. It addresses the question of whether their model exhibits "tipping point" behavior. They show their model when forced to run from an "ice free" state does not exhibit "tipping point" behavior. The "tipping point" topic is not mentioned here. See Stroeve et al. (2011) Section 3 "Accelerating decline in September ice extent?" "The rate of decline of Arctic sea ice thickness and September sea-ice extent has increased considerably during the first decade of the 21st century (Maslanik and others, 2007; Nghiem and others, 2007; Comiso and Nishio, 2008; Deser and Teng, 2008; Alekseev and others, 2009)." (Markon et al. 2012) pg. 74					
James	Tolbert	Edstrom et al 2011 is an incomplete reference. Please add clarity by defining that the document was prepared by Lawrence Berkeley National Laboratory for the California Energy Commission. I also suggest adding the web site where it is available: http://www.energy.ca.gov/2011publications/CEC-500-2011-004/CEC-500-2011-004.pdf	28. Adaptation		1023	21	We thank the commenter for completing the full reference and have incorporated the correct full reference into the chapter.
Laurence	Fishtahler	Item #8 Fishtahler(L.E.&C.R.): Chapter 22 – Alaska: Disappearing Sea Ice, pg. 763, line 1 Title: Linear fit for years 1979 – 2012 is invalid Issue: invalid data analysis Figure 22.2: "Declining Sea Ice Extent" includes an inset with a linear fit for years 1979 through 2012 ("Inset is the complete time series of average September sea ice extent (Source: NSIDC 2012)"). Change: This inset should be replaced by one similar to Fig. 3 in Stroeve et al. (2011) updated with the 2011 and 2012 data. Rationale: It is the current understanding that the rate of ice loss is accelerating. See Stroeve et al. (2011) Section 3 "Accelerating decline in September ice extent?" The discussion there, together with the addition of the observations for 2011 and 2012, show a "steepening of the downward trend." A simple linear fit does not accurately represent the acceleration of ice loss in the observed record.	22. Alaska and the Arctic	22.2	763		Due to the size of the topic, and the page limit for the chapter, we focused on broad trends rather than delving too deeply or providing such a level of specificity. The general issues are addressed in the traceable accounts and the cited references.

		Statistically 2012 (and 2007) are far below estimates from this simple linear fit; so far below in fact to show that statistically a simple linear fit over this range of observations is not valid. Significantly, given 2012, 2007's characterization as an "outlier" is not tenable. ("Source: NSIDC 2012" is a web page news release, not a scientific study.) "The rate of decline of Arctic sea ice thickness and September sea-ice extent has increased considerably during the first decade of the 21st century (Maslanik and others, 2007; Nghiem and others, 2007; Comiso and Nishio, 2008; Deser and Teng, 2008; Alekseev and others, 2009)." (Markon et al. 2012) pg. 74					
Laurence	Fishtahler	Item #9 Fishtahler(L.E.&C.R.): Chapter 22 – Alaska: Disappearing Sea Ice, pg. 763, line 11 Title: Longer durations of open waters in Beaufort & Chukchi Issues: (1) missing – Alaskan region specific information (2) missing – important aspect of sea ice loss: duration After" "This leads to a self-reinforcing climate cycle, because the warmer ocean melts more ice, leaving more dark open water that gains even more heat." Add: "Observations for the Beaufort and Chukchi Seas show longer durations of open waters due to earlier melt-out and later freeze-up (Stroeve et al. 2011)." Rationale: "Open water areas are exposed earlier in the melt season and become more extensive throughout summer, further accentuating summer ice melt." "Note that the growing ice-albedo feedback as discussed here is directly related to the coverage of more thin, first-year ice that allows for a longer duration of exposed open water areas … ." "Positive anomalies in absorbed solar radiation grow in magnitude and spatial extent through the melt season, strongly expressed in the Beaufort, Chukchi, E. Siberian, Laptev, Kara and Barents seas by August." Etc. (Stroeve et al. 2011 Sec 4.2) Provide Alaskan region specific information as well as pan-Arctic context. This aspect of sea ice loss is more advanced in the Alaskan Beaufort and Chukchi Seas than the Arctic generally.	22. Alaska and the Arctic		763	11	Due to the size of the topic, and the page limit for the chapter, we focused on broad trends rather than delving too deeply or providing such a level of specificity. The general issues are addressed in the traceable accounts and the cited references.
Claudia	Langford	Citation in line 14 is currently: (McMichael et al. 2007; Parker 2011). Needs to be changed to (Parker 2011; Friel et al. 2009; McMichael et al. 2007)The citation in line 16 (Parker 2011) should be removed and combined with the citation at the end of line 17 and beginning of line 18 (Friel 2010; Friel et al. 2010) so that it reads: (Friel 2010; Parker 2010; Friel et al. 2009).Note: No articles have been added to or deleted from the paragraph the citations have just been moved around.(Health Author Comment - LA Sheats)	9. Human Health		355	11	Thank you for your comment. The text has been revised to incorporate the suggested changes to the citations.
Laurence	Fishtahler	Item #10 Fishtahler(L.E.&C.R.): Chapter 22 – Alaska: Disappearing Sea Ice, pg. 763, line 11 Title: Melting ice transported into warm waters	22. Alaska and the Arctic		763	11	We appreciate this suggestion, but space is limited. We did clarify the text to specify that the ice was thinner due largely to melting in place.

		Issue: missing – ice loss mechanism: transport to warm waters Before: "In autumn and winter, there is a strong release of this extra ocean heat back to the atmosphere." Add: "Warmed by longer exposure to solar energy relatively warm waters further contribute to ice loss by melting ice transported there by winds and currents." Rationale: "The overall downward trend of Arctic sea ice can be explained from increasing air and ocean temperatures and changing atmospheric and ocean circulation (Stroeve and others, 2011). … These two attributes allow the anti-cyclonic regime to transport more sea ice across the Arctic during summer months, which results in faster melt and significantly reduced sea ice extent in the Chukchi Sea (Ogi and others, 2010; Overland and Wang, 2010)." (Markon et al. 2012) pg. 39					
Claudia	Langford	Citation beginning at line 22 and ending at line 23 (Ash et al. 2009; Pastor et al. 2004; Pellizzari et al. 1999; Perlin et al.1995; Wernette and Nieves 1992) should be changed to read: (California EPA 2010; Ash et al. 2009; Pastor et al. 2005; Pastor et al. 2004; Wernette and Nieves 1991).Citations deleted from this paragraph: Pellizzari, E.D., Perritt, R.L. and C.A. Clayton (1999). "National human exposure assessment survey (NHEXAS): exploratory survey of exposure among population subgroups in EPA Region V." J Expo Anal Environ Epidemiol 9(1):49-55.Perlin, S.A., Setzer, R.W., Creason, J. and K. Sexton (1995). "Distribution of industrial air emissions by income and race in the United States: an approach using the Toxic Release Inventory." Environ Sci Technol 29(1):69-80.Citations added to this paragraph:Pastor, M.J., Sadd, J.L. and R. Morello-Frosch. (2005). "The Air is Always Cleaner on the Other Side: Race, Space and Air Toxics Exposures in California." Journal of Urban Affairs 27(2):127-148.California Environmental Protection Agency. (2010). "Cumulative Impacts: Building a Scientific Foundation", December, 2010.(Health Author Team Comment - LA Sheats)	9. Human Health		355	19	Thank you for your comment. The text has been revised to incorporate the suggested changes to the citations.
Laurence	Fishtahler	Item #11 Fishtahler(L.E.&C.R.): Chapter 22 – Alaska: Disappearing Sea Ice, pg. 764, line 2 Title: Ecosystems, food web impacted by changed physical & chemical environments Issues: (1) consistency; (2) missing – information on ecological impact to base of food web After: "There is growing evidence that this has already occurred … autumn cloud cover west and north of Alaska (Wu and Lee 2012)." Add: "Marine ecosystems are impacted by changes to their physical and chemical environments causing changes from the base to the top of the food web. In addition to ice loss, important physical changes include warmer waters and more sunlight penetrating to greater depth over longer periods of time. Chemical changes include changes to salinity, acidity (due to increased absorption of atmospheric CO2), and organic and inorganic nutrients from altered precipitation patterns and increased permafrost thaw (Markon et al. 2012 and Stewart et al. 2013) (see "Changing Ocean Temperatures and Chemistry" below)." Rationale:	22. Alaska and the Arctic		764	2	We appreciate this suggestion, but space is limited. To the extent that space permits, this is discussed under key message 4.

		pg. 762, line 8: “This is altering marine ecosystems … .” but nothing more is presented to describe or substantiate this important point. “Sea ice decline causes problematic changes in the marine ecosystem food chain, resulting in drastic changes to marine species composition and population (Karl et al. 2009).” (Section 2.3.4 “Sea Ice Decline” Stewart et al. 2013: NOAA Technical Report NESDIS 142-7) “Changes in the seasonal sea ice distribution, the oceanic heat flux, and nutrient loads will likely lead to changes in biological production on this shelf. For example, warmer shelf waters may provide more optimal thermal habitats for some species, a reduction in ice cover may increase pelagic phytoplankton production … .” (Markon et al. 2012) See “Ocean Acidification” on pg. 40 of Markon et al. (2012). See http://www.polartrec.com/member/deborah-bronk and http://oceanscience.wordpress.com/tag/chukchi-sea/ about ongoing research on nutrients.					
Claudia	Langford	Citation beginning at line 29 and ending at line 30 (Pastor et al. 2009) should be changed to read: (Bullard and Wright 2009a; Pastor et al. 2006).Citation deleted:Pastor, M., R.D. Bullard, J.K. Boyce, A. Fothergill, R. Morello-Frosch. and B. Wright. (2009). “Environment, Disaster, and Race After Katrina”, Race, Poverty and the Environment, Summer 2006: 21-26.Citation added:Bullard, R. and B. Wright, (2009a). Introduction and chapter 1: “Race, Place, And The Environment In Post-Katrina New Orleans” in Race, Place and Environmental Justice After Hurricane Katrina, Struggles to Reclaim Rebuild, and Revitalize New Orleans and the Gulf Coast, Bullard, R. and B. Wright, (eds.), pp. 1-47, Westview Press.Pastor, M., R.D. Bullard, J.K. Boyce, A. Fothergill, R. Morello-Frosch. and B. Wright. (2006). “In the Wake of the Storm: Environment, Disaster, and Race After Katrina”, Russell Sage Foundation, New York.(Health Author Team Comment - LA Sheats)	9. Human Health		355	26	Thank you for your comment. The text has been revised to incorporate the suggested changes to the citations.
Claudia	Langford	The citation that runs from line 10 to 13 has all the correct articles except Bullard and Wright 2009b should be Bullard and Wright 2009a and I guess they should be ordered from most recent to least recent so the citation should read: (Martinez 2011; Shonkoff et al. 2011; Balbus and Molina 2009; Bullard and Wright 2009a; Frumkin et al. 2008; O’Neil et al. 2008; Pastor et al. 2006; Harlan et al. 2006; O’Neil et al. 2005, 2003).At the end of the citation at line 13 the following phrase and citation should be added to the sentence: and some communities of color (Martinez 2011; Shonkoff et al. 2011; Uejio et al. 2011; Bullard and Wright 2009a; Frumkin et al. 2008; Pastor et al. 2006; O’Neil et al 2005, 2003), …So the text of the first line of the paragraph without the citations should read: Climate change will disproportionately affect low-income communities and some communities of color, raising environmental justice concerns.The citation that runs from line 13 to 15 should be ordered from most recent to least recent but all the citations are correct. The citation on lines 20 and 21 is missing Bullard et al. 2011 and O'Neill et al. 2003. It should read: (Bullard et al. 2011; Martinez 2011; Shonkell et al. 2011; O’Neil et al. 2008; Harlan et al. 2006; O’Neil et al 2005, 2003).Citation added:Uejio, C.K., Wilhelmi, O.V., Golden, J.S., Mills, D.M., Gulino, S.P. and J.P. Samenow. (2011). “Intra-urban societal vulnerability to extreme heat: the role of heat exposure and the built environment, socioeconomics, and neighborhood stability”, Health Place 17(2):298-507Distinguishing Bullard and Wright 2009a and 2009b:Bullard, R. and B. Wright, (2009a). Introduction and chapter 1: “Race, Place, And The Environment In Post-Katrina New Orleans” in Race, Place and	9. Human Health		352	10	We have added the suggested citations in our chapter assessment and reordered the citations.

		Environmental Justice After Hurricane Katrina, Struggles to Reclaim Rebuild, and Revitalize New Orleans and the Gulf Coast, Bullard, R. and B. Wright, (eds.), pp. 1-47, Westview Press.Bullard, R. and B. Wright, (2009b). "Race, Place and Environmental Justice After Hurricane Katrina, Struggles to Reclaim Rebuild, and Revitalize New Orleans and the Gulf Coast, Bullard, R. and B. Wright, (eds.), pp. 1-47, Westview Press.(Health Author Team Comment - LA Sheats)					
Claudia	Langford	Consider changing the wording and citation, Prudent and Luber 2009.(Health Author Team Comment - LA Sheats)	9. Human Health		355	19	We have reworded the sentence and revised the citation to address this comment.
Claudia	Langford	Consider updating the sentence wording and verifying the relevant citations, for the sentence that begins on line 30 and ends on line 31 on page 334. The citation for the sentence currently reads: (Russell et al. 2010; Tagaris et al. 2009).(Health Author Comment - LA Sheats)	9. Human Health		334	30	We have changed the sentence and updated the citations.
Jonathan	Doubek	Overall, I think the authors for Chapter 8: Ecosystems, Biodiversity, and Ecosystem Services do a great job of attempting to bring these broad (and sometimes vague) concepts together across disciplines into one chapter. The authors, for the most part, do a fine job explaining ways in which climate change is and will influence various ecosystems and organisms on our planet. The authors do an especially great job on three of their five main messages: 1) impacts on water quantity and quality, 2) coupling of climate change with other factors to increase extreme events like droughts and floods, and 4) the miscuing of various organisms to their environment with climate change. I argue that two sections could be stronger: 3) shifting population ranges of species and species extinction, and 5) tying together how biodiversity loss could influence ecosystem services. Also, I argue that although the authors do a great job overall explaining how climate change can influence water quantity and quality, they leave out a significant discussion on inland lake eutrophication, and how climate change can increase cyanobacterial dominance in our lakes and what this means for ecosystem services.Major comment 1: The authors discuss thoroughly how climate change could influence water quantity and the quality in coastal environments and freshwater streams. The authors do not, however, give enough attention to water quality in in-land lakes due to climate change. I argue this is a significant part of the section that needs to be included. Eutrophication is prevalent in the U.S. (and the world) and excess nutrients often coincide with increases in cyanobacteria. Cyanobacteria, although often an integral component of a phytoplankton community, can have severe consequences to the surrounding ecosystem at high concentrations. For example, many species of cyanobacteria can excrete hepatotoxins and neurotoxins into the water column, which at high doses can be fatal to animals, including humans. Climate change, in combination with lakeside land use changes and eutrophication, is expected to further increase lake cyanobacterial dominance in the future because different cyanobacteria have specific eco-physiological traits that can allow them to out-compete other phytoplankton, such as greater temperature tolerance, buoyancy and the ability to fix nitrogen (Paerl and Huisman, 2009; Carey et al., 2012). I think this is a novel and important discussion to make: climate change will be a stressor that increases cyanobacteria in our lakes, which could then have drastic consequences to the human use and consumption of our lakes.Major comment 2: I would like to see more discussion about the link between biodiversity and ecosystem services for humans (i.e., Millennium Ecosystem Assessment, 2005; Cardinale et al., 2012). If we lose iconic species, if biodiversity decreases, or if species population ranges shift, how will this affect ecosystem services for humans? Why do we ultimately care and which services should we try best to protect? For example, there is ample evidence that an increase in biodiversity leads to greater provisioning services like wood production and crop yield. However, there is mixed evidence that biodiversity increases ecosystem services such as: pollination, carbon sequestration, and animal disease. Also, some services that have insufficient data for how biodiversity influences them are flood control and soil erosion (Cardinale et al., 2012). Overall, I think that the authors should more thoroughly discuss the connection between biodiversity and ecosystem services. Does a loss in	8. Ecosystems, Biodiversity, and Ecosystem Services				No change. Hopefully our responses to the individual detailed comments of this reviewer address the major concerns listed here.

		biodiversity lead to less ecosystem services, and why? How much biodiversity can we lose without losing substantial ecosystem services? These are important questions to touch upon briefly.Major comment 3: The authors do a good job explaining how organism ranges can change with climate change in a general sense, but this section can be made stronger with more specific examples of species that have experienced recent range shifts, or population declines. Also, the authors could talk about which areas of the world may have populations that are most affected by climate change (i.e., tropical rainforests, coral reefs, and Polar Regions). The authors do not discuss ocean acidification at all, which is an extremely important topic, as calcium producing oceanic organisms like coral are projected to be extinct at the end of this century.Overall, I think the authors do an excellent job tying these concepts together, but the section could be made stronger with more detail and specific evidence added.					
Cassia	Patel	Hi I'm Cassia Patel and I am a senior at Choate Rosemary Hall and a member of the inaugural class of the environmental immersion program at the Kohler Environmental Center. I appreciate the way that this section starts off by supporting both an anthropocentric and ecocentric view by including water's value as a resource for humanity and as habitat for flora and fauna. It is a valid point that climate change causes an increase in precipitation, creating more discharge, which causes erosion. However, I think that the process through which discharge causes erosion could be more directly outlined. The way that it is stated now is vague and ambiguous, unless it is addressed in another section. Furthermore, I think that in a discussion of the effect climate change has on water quality, it is important to address the fact that both increased discharge and the melting of glaciers contributes to a change in the ocean's salinity. This concept is briefly mentioned in the figure of a hurricane; however this is only a specific case. The fact that the salinity of the ocean as a whole has the potential of decreasing is a significant factor with the power to influence many components of the global ecosystem including algae growth and subsequently eutrophication. Therefore should be mentioned alongside rising temperatures and nutrient imbalance.	8. Ecosystems, Biodiversity, and Ecosystem Services		292	14	No change. Space is limited. References point the reader to the specifics of how discharge influences erosion. Glaciers and ocean salinity are covered in other chapters.
Jalonne	White-Newsome	Chapter 1: Executive Summary • Overall, the conversation about vulnerability on page 5 and page 8 (finding #4) is appreciated and much needed. However, the words 'environmental justice' does not appear in any of this discussion. It is important that the term environmental justice be used in this document, because vulnerability can add to the disproportionate impact on low income, communities of color. • Pg. 16: It would be useful to know how the stakeholders that contributed to this process were identified, and what specific sectors – mainstream environmental groups, engineers, environmental justice groups, etc. – were a part of this group that attended the 70 workshops and other expert groups.	1. Executive Summary			Not all possible topics have been covered in this report. The sustained assessment process should provide for opportunities to further explore this topic.
Jalonne	White-Newsome	Chapter 4: Energy• Prioritize Solutions to Shift Beyond from Fossil Fuels The Assessment needs to better evaluate and prioritize solutions that facilitate a paradigm shift in U.S. energy use and move the U.S. beyond fossil fuels. This is an essential component of comprehensively addressing climate change. • Prioritize Clean Demand-Side Management Solutions and Clean Distributed GenerationThe chart describing possible Actions to Address Key Challenges (pp178-180) must emphasize shifting away from fossil fuels by integrating renewable energy (utility-scale and distributed generation), energy storage, micro grids, & building efficiency and conservation. Demand-side management solutions should be prioritized over building new generation capacity to meet potential rising demand from a hotter climate. In the New Equipment section, storage should be the technology for 'add backup supply' action rather	4. Energy Supply and Use			The charter for this chapter is an assessment of the potential physical impacts of climate change to U.S. Energy Systems. Carbon emission reduction (mitigation) opportunities are primarily addressed in Chapter 27 - Mitigation. Improvements in efficiencies (which will result in reduced carbon emissions) in energy, cooling, manufacturing, irrigation and water distribution/reuse are identified

		than new fossil fuel generation. Distributed renewable energy generation should be the source prioritized in the 'add peak generation' action. Smart long-term energy policy must include a shift away from large-scale, centralized generation and long-distance transmission to networks of micro grids that balance distributed renewables, storage, DR, and efficiency • Prioritize Demand Reduction and Improving Existing Building EfficiencyRegarding the Reduce Energy Demand section, we recommend demand reduction be made the highest priority in addressing energy. As a part of this, we support the action to improve building efficiency, cooling system and manufacturing systems, and demand response. To make these "actions" more actionable, we recommend more specifics be added to the assessment. For example, we must ensure new and existing buildings are near net zero energy with highly efficient insulation, efficient HVAC systems, efficient appliances, passive energy designs, and renewable energy. Retrofitting existing buildings is even more important than new buildings in the near term, as buildings are one largest energy uses in the U.S. and the turnover of new building construction is not happening fast enough to achieve the vast and fast energy & GHGs reductions needed to tackle climate change. The assessment should acknowledge this and recommend actions to promote and facilitate retrofits, such as making building energy use a part of the everyday language through requiring building energy ratings and disclosure at point of sale or lease. In addition, cities & states can require building energy standards for new buildings as well as existing buildings.					in Table 4.2 of this chapter as Adaptation Actions in the Energy Sector.
Claudia	Langford	Figure may not adequately portray the health elements discussed in the text. Consider changing the figure to better portray the health-relevant effects of extreme heat in US regions and/or nationally. Consider substituting the graphic and associated caption. The temperatures are being averaged over entire regions, rather than highlighting urban population centers where more people live and where health studies traditionally focus. So readers in New York City, for example, may look at the graphic and ask themselves “Where are the over-100 °F days that I know we are already experiencing in a summer?” This figure makes it look like there aren’t any in 1971-2000.Possibly retain the current graphic, but color the cities in red, with either deeper red or a larger blob of red to signal those cities with the most intense heat wave experience. Then, in the caption, explain that the temps shown are regional averages, but the cities are expected to be hotter (and in many cases already are), as indicated by the red.Also look into publications from Noah Diffenbaugh. He published a global map of return periods of temperatures that currently occur once every 20 years; he used CMIP5 and the SSPs. It might be worth finding out if he has done something similar for the US.Please consider mentioning in caption or elsewhere that during 1971-2000, which was the designated baseline period used as reference when applying outputs from future climate model simulations for Author Teams, there was significant warming. Thus, using that period as the baseline ignores the temperature changes that already occurred by then, relative to earlier decades. (Health Author Team Comment)	9. Human Health	9.7	342		We are using a new graphic for this figure: two maps from the updated Ch.2: Our Changing Climate.
Jalonne	White-Newsome	Chapter 5: TransportationGoal of Chapter: Highlight economic and service-related impacts of climate change on the transportation system and identify adaptation measures.♣ Pg. 195 Key Messages: Bullet 4 addresses adaptive measures such as rerouting and mode change. Consideration should be given to the impacts on those populations dependent on fixed route transportation, including access to rerouted transportation. (See also pg. 196, paragraph 5 and pg. 205.)♣ Pg. 207 Role of Adaptive Strategies in Reducing Impacts and Consequences: Travel information systems should be designed assist various populations. (See also pg. 211, paragraph 3.)	5. Transportation				We appreciate your comment. We have revised the text to address some of your suggestions. We agree that transportation in general should be responsive to the needs you raised. Given chapter space limitations however, we are not able to provide the level of detail proposed by the comment.
Jalonne	White-Newsome	Chapter 9: Human HealthGoal of chapter: To better understand how human health in impacted by climate change. While we appreciate that the assessment acknowledges that “limited resources and an already high	9. Human Health				Thank you for your thoughtful comments. Chapter does highlight cumulative impacts in the "Multiple Climate Stressors and Health" box in

		burden of chronic health conditions, including heart disease, obesity and diabetes will place the poor at higher risk of health impacts from climate change than higher income groups," (p351), it misses a key point around the cumulative impacts of pollution faced by environmental justice communities. These communities are most often low-income communities of color. In fact, race/ethnicity is more correlative with pollution than is income.The Assessment needs to acknowledge that low-income communities of color face disproportionately high cumulative impacts of pollution, which will make these communities more susceptible to climate change. These communities have long been struggling with poor air quality and water quality, high asthma rates, and old, poorly-maintained building stock and infrastructure. The combination of all of these setbacks will the impacts of climate change like hotter temperatures and impaired air quality even tough on environmental justice communities. • Pg. 343: It would be important to mention cardiovascular deaths can result from extreme cold as well. • Pg. 349: Mentioning the mental stress and multiple climate stressors is important. Adding a note about Parkinson's and other disorders is critical as a condition that can increase the vulnerability of certain populations. • Pg. 350: Add in 'rural' risks • Pg. 351: Additional risks can come from housing structures; occupational risks, especially migrant or outdoor workers; • Pg. 352: Information addressing information about Sandy impacts in conjunction with Katrina should be provided. The additional health implications of 'climate refugees', people that have been displaced due to extreme weather events, should be noted as well. • Pg. 355: How power outages can impact human health, specifically in an extreme heat event, is important to add to this discussion. • Pg. 355: Rural communities have some special concerns that should be addressed as it relates to the impact of climate change. Specifically, in some cases, rural communities lack of access to resources, general preparedness and response measures to address human risks. • Pg. 357: Need to find if there has been any research on how climate change impacts hazardous air pollutants and the health effects? o Also, we need to address storm surges and impacts on waste sites, landfills, etc. in EJ communities • Pg. 361: do we need to have a definition of 'communities of color' somewhere in the document? • Pg. 361: An important characteristic of most environmental justice communities is that the baseline health of our communities is not like other communities. Because this baseline is different, we need to account for this difference and the overwhelming disproportionate impacts from climate change. • Pg. 363: The extreme weather events of 2012 should be mentioned.					Key Message 1. Some of the other detailed comments provided are beyond the scope of what the chapter could incorporate, given the space limitations. The National Climate Assessment report has a chapter on Rural Communities (Ch.14); and Ch.11 on Urban Systems, Infrastructure and Vulnerability has incorporated some information on Hurricane Sandy.
Jalonne	White-Newsome	Chapter 10: Water, Energy, Land Use • Prioritize Solutions to Shift Beyond from Fossil Fuels Once again, the Assessment needs to evaluate how to facilitate moving beyond fossil fuels. Switching from one dirty energy source (coal/oil) to another (natural gas)—as proposed in the Assessment (p399)	10. Water, Energy, and Land				We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and

		— cannot be an option. There are numerous well-documented and alarming health and safety impacts associated with drilling techniques like fracking. In addition, more and more information is coming out about high rates of methane leaks during natural gas drilling, transmission, & distribution, which is a problem because methane has a global warming potential of around 30 times greater than CO2. This is why the Assessment needs to look at CO2-equivalent, not CO2 alone, when comparing power sources (p399, Line35). Natural gas should in no way be promoted as a clean energy source by the Assessment. The Assessment needs to prioritize solutions that will sustain drastic GHG reductions over the long term and move the U.S. into a modern, clean energy future, not investments in a technology that will be outdated before it is done being built. • Prioritize Distributed Clean Generation Over Utility ScaleIn evaluating clean energy options, the assessment only discusses utility-scale solar (p402-403). We recommend it also analyze and prioritize distributed generation (DG) in already "disturbed" (developed) areas, such on as rooftops and in parking lots. This is a huge untapped resource even in our nation's 'solar capitol' San Diego County, where the rooftop Solar PV technical potential is enough to meet peak demand, yet the installed potential is around just 3% of the technical potential. Low-income communities of color represent much of this untapped potential, as these communities have very little installed renewable energy get have large areas of commercial and industrial rooftops and parking lots that are prime for renewable energy infrastructure investment.	use				illustrations to include. The discussion of energy technology options has been revised to incorporate this perspective, but policy issues are beyond the scope of the report.
Claudia	Langford	Not completely satisfied that this figure includes the strongest individual graphs available to portray each element of health vulnerability being discussed. Consider changing the figure and caption to better describe and portray vulnerability indicators, and if possible their interaction with climate change. Consider allergy rates or geographic maps of the factors, if appropriate graphics are available.(Health Author Team Comment)	9. Human Health	9.12	350		One of the important activities in the NCA is developing such vulnerability indicators. It is hoped the health vulnerability indicators under development will be able to provide the suggested information.
Jalonne	White-Newsome	Chapter 11: Urban Systems, Infrastructure and VulnerabilityGoal of Chapter: To discuss the vulnerability of urban areas • Pg. 420: lines 13-18. It would be important to mention environmental justice and cumulative impacts as a consideration on how urban dwellers are disproportionately impacted by climate change. "cumulative impacts" could replace or be further described by the text, 'when the effects of climate change interact with pre-existing urban stressors….' • Pg. 424, line 2: We appreciated the recognition of urban residents being stranded in their high-rise apartments without air conditioning. Again, amplifying the fact that risks/threats within the home are just as pronounced as the more visible outside damage from other extreme weather events. • Pg. 425: A reference should be added that addresses the unfairness in the lack of resources to aid in recovery, post extreme weather events, like Hurricane Katrina and Sandy. Typically, the majority of resources (both financial, as well as human capital) are not evenly distributed into environmental justice communities. The larger and some of the smaller urban areas are neglected and recovery does not happen because they don't have the resources to move forward. There are many articles/news stories about this phenomenon, in addition to the article attached below. Environmental Justice Through the Eye of Hurricane Katrina http://www.jointcenter.org/hpi/sites/all/files/EnvironmentalJustice.pdf• Pg. 430 or best place to add this information (pull out box, etc.)One step to engage the broader environmental justice community and multiple stakeholders was a convening over 400 environmental justice advocates, community leaders and stakeholders from New York City and other parts of the nation around issues of climate change at a groundbreaking 2-day conference. Speakers presented findings on several topics related to	11. Urban Systems, Infrastructure, and Vulnerability				Environmental/climate justice is a different concept than social vulnerability--the former necessitating some type of remedial action to address the injustice. We relied primarily on the peer-reviewed literature for our findings, but we appreciate the references provided by the reviewer.

		climate change and its environmental, public health and economic impacts, discussed the multi-faceted impact of climate change on communities of color and low-income, advanced and promoted the concept of climate justice and jointly developed policy recommendations designed to secure climate justice in communities of color and low income. This might be an example to include of how a community based organization, WE ACT for Environmental Justice, is leading, like many other community based organizations across the county, efforts to include low income, communities of color, into the climate change adaptation, conversation, across multiple sectors. (see website for reference: http://www.weact.org/Programs/MovementBuilding/TheWEACTforClimateJusticeProject/AdvancingClimateJusticeConference/tabid/330/Default.aspx)Link to conference proceedings: http://www.weact.org/Portals/7/Program%20Docs/Movt_%20Bldg_/ClimateJusticeConferenceReport.pdf					
Jalonne	White-Newsome	Chapter 12: Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources. Goal of Chapter: To share the impacts of climate change on Tribal, Indigenous Peoples.• Pg. 453: In the discussion of relocation, there is a need to develop institutional frameworks for relocating communities and tribes that these frameworks must start from a place of recognition of the sovereignty of tribal councils and governments. Any institutional development must begin with substantial engagements of representatives from tribal governments. Failing to include this in the report demonstrates ignorance to the tragic history of forced relocation for native and Tribal peoples throughout the United States. Additionally, relocation of tribal communities must be funded by other parties than the communities themselves as they should not have to pay and may not be able to pay for the cumulative impacts of industry.	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources				The text has been revised to incorporate this suggestion.
Jalonne	White-Newsome	Chapter 13: Land Use and Land Cover ChangeGoal of Chapter: Identify land use choices contributing to climate change vulnerabilities and propose alternate planning measures.♣ Pg. 472, paragraph 3: Attempts to alter current development trends must identify options for vulnerable populations. (See also Pg.478 Effects on Communities and Ecosystems)♣ Pg.476 Projections: In paragraph 3, it is projected that higher population density results in increased impervious surfaces; however, consideration should be given to the loss of population in urban centers over the last 50 years and the resultant potential for infill development to absorb some portion of the population increases. Furthermore, opportunities for transit-oriented development in urban centers, and projected reductions in greenhouse gas emissions, should anchor the argument for more public transit funding.♣ Pg. 482: Reducing Greenhouse Gas Levels: Paragraph 3 should include food security for vulnerable populations in the discussion on the conversion of farms to forests or grasslands. (See also pg. 483, paragraph 1.)	11. Urban Systems, Infrastructure, and Vulnerability				Vulnerable communities: We appreciate the suggestion, but space is limited. Vulnerable communities are addressed in the first Key Message. Projections: We appreciate the suggestion, but space is limited. The Health chapter addresses transit and co-benefits. Reducing Greenhouse Gas Levels: We appreciate the suggestion, but space is limited. The Agriculture chapter includes discussion of food security.
Jalonne	White-Newsome	Goal of Chapter: To discuss climate change impacts on the Midwest.• Overall, this chapter highlights some of the important impacts of climate change in the Midwest, on agriculture, flooding, and on the Great Lakes. More emphasis on building a sustainable energy grid – recognizing the Blackout of 2003 and many of cascading health impacts that resulted - is a key issue that was felt across this region. Highlighting the largest urban areas in the Midwest, providing the costs due to a 'blackout' of that proportion and the potential health risks should be discussed or mentioned briefly. o Department of Energy Study ♣ http://energy.gov/oe/services/electricity-policy-coordination-and-implementation/august-2003-blackout	11. Urban Systems, Infrastructure, and Vulnerability				Thank you for the comment. The text has been revised to incorporate this perspective.

		o Impact on Michigan and infectious diseases ♣ http://www.ajicjournal.org/article/S0196-6553(04)00239-1/abstracto Impacts in Midwest ♣ http://www.ncbi.nlm.nih.gov/pubmed/15898487					
Jalonne	White-Newsome	Chapter 26: Decision Support Goal of Chapter: To share collaborative decision making processes to prepare for climate change. • Pg. 929: Where the text discussed how decisions about adaptation and ways to reduce future climate change rest on non-scientific aspects, 'affected communities' could be changed to mention or include 'environmental justice communities'. • Pg. 929 Problem Framing and Establishing Decision Criteria: Another important issue that should be explored to have successful decision outcomes is making sure that all voices are heard in the decision pathway. For instance, adding a statement such as, "Recognizing the current risks and added risks on disproportionately impacted communities in the context of those decisions", or something of this nature, should be added to the list of factors. • Pg. 937: As an addition to the items listed in the 'decision-makers toolkit', there are two additional assessments tools that could be useful: Health Impact Analysis and using a Cumulative Risk Assessment platform. A Health Impact Analysis (HIA) is typically used in the public health world to understand the impact of decisions – policy or programmatic – on the health of a particular community. The cumulative risk assessment platform – which is being used in some sense by the Agency for Toxic Substances Disease Registry (ASTDR) to better understand the total 'exposure' in particular communities, that can be used to better protect and/or make decisions about minimizing risk.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				Discussion of environmental justice has been added to the chapter. Additional examples of decision support tools and processes that may be useful to a range of communities affected by climate change have also been added to the chapter.
Jalonne	White-Newsome	Chapter 27: Mitigation Goal of the chapter: Discuss different strategies and scenarios for GHG reduction strategies, voluntary and involuntary. • Pg. 964: Could add some discussion of the sometimes disproportionate impacts of certain mitigation efforts on EJ communities vs. others. This could be added to the "city, state & regional actions" section, or be a pull out box comparing both strategies. • Pg. 967: Need to possibly add under the 'research needs' section something about the ramifications of different strategies on EJ communities to reduce GHG, or quantify these benefits, etc. • Add environmental justice to the key messages.	27. Mitigation				A section on costs has been added. Distributional issues and unintended consequences are addressed in the chapter, including in the box on interactions between adaptation and mitigation.
Jalonne	White-Newsome	Chapter 28: Adaptation Goal of chapter: Highlights different efforts at various levels of government and the community to build community resilience. • Pg. 985: Please add "mental & environmental stress" to the multiple stressors pull out box.	11. Urban Systems, Infrastructure, and Vulnerab				Pg. 985: After consideration of this point, we feel the existing text is clear and accurate. pg. 989: Thank you for your comment, however policy issues are beyond the defined scope of the National Climate Assessment, a scientific document that provides the

		• Pg. 989: Proving a list of tasks federal agencies can work on to create a process to hold them accountable include the following: create a process to hold partner agencies accountable for their adaptation plans, etc.; In trying to build public awareness, better engage with affected communities, on a national level. • Pg. 993: An example of preparing for climate change by a diverse group of stakeholders was a 2009 environmental justice conference hosted by WE ACT for Environmental Justice in New York. Link to conference proceedings: http://www.weact.org/Portals/7/Program%20Docs/Movt_%20Bldg_/ClimateJusticeConferenceReport.pdf • Pg. 1005: Overall the chart is good. However, please add for Barrier #1, "engaging the most vulnerable communities in the solution" • Pg. 1007: There is a need for an additional area of research: focus on most critical areas, vulnerable populations, 5th bullet • Pg. 1008: Could the authors potentially investigate an urban case study that would be applicable. • Adapt key messages to include environmental justice.	ility				basis for decision making, but does not address policy. pg. 993; pg. 1005; pg. 1007; environmental justice: We appreciate the suggestion, but space is limited. The author team has deliberated and agreed on the most important information/illustrations to include. Please see the Urban chapter for further information on urban adaptation. Environmental justice is discussed in other chapters, including Health, Urban, and Decision Support.
Jalonne	White-Newsome	April 12, 2013Dear Dr. Melillo and members of the National Climate Assessment and Development Advisory Committee: We would like to thank you for the opportunity to review the draft of the 3rd National Climate Assessment. I am submitting comments on behalf of the Environmental Justice Leadership Forum on Climate Change, a national coalition of environmental justice leaders, scientists, public health practitioners and advocates that work to at the local, state and federal level to impute an environmental justice perspective into federal policy. It's not hard to understand that climate change exacerbates many of the conditions that the communities we work and serve in deal with on a daily basis. Consequently, we felt it was very important that we make the time to provide our comments and suggestions for this very important report. While we did not comment on every chapter of the NCA, we did provide some thoughts on several key chapters. One of the main concerns from our standpoint is that in the chapters we reviewed, and we assume it to be the case with the other chapters, there was no mention of the term 'environmental justice'. While the document mentioned vulnerability in several spaces, it is important to us that environmental justice and/or climate justice be used in this document. We would be happy to share with you, at any time, the definition and examples of both terms that could be useful to the NCA. For this 3rd Assessment, I believe the USGCRP staff has made a concerted effort to build partnerships that can communicate as well as expand the utility of this document, beyond the same audiences it has reached in the past. It is our hope that this will not be the only engagement that NCADAC has with the broader environmental justice community, but we can work together to figure out how the NCA can enhance our advocacy, inform our campaigns and ultimately help us protect the communities we serve by enhancing adaptation and resilience. Again, thank you for this opportunity and let us know if you have any questions regarding our	11. Urban Systems, Infrastructure, and Vulnerability				Thank you for your comment, however policy issues are beyond the defined scope of the National Climate Assessment, a scientific document that provides the basis for decision making, but does not address policy.

		comments.Center on Race, Poverty and the Environment (Huntington Park, California) Laureen Boles (Independent Environmental Justice Advocate, Philadelphia, Pennsylvania) Environmental Health Coalition (National City, California) WE ACT for Environmental Justice (Harlem, New York; Washington DC)					
Mary	Stuever	Comments that submitted under my name are taken from a paper that was written by two authors. For this section (whole report) we have included the abstract, overview and final comments. My co-author's name is Maire Claire Voorhees. Abstract: This paper has been prepared with a dual purpose. The primary purpose is to explore several key sections of the National Climate Assessment Development Advisory Committees draft report that is available for public comment, and to provide useful, substantive input to the committee. The second purpose of this paper is to complete an assignment addressing climate change in a graduate course on Sustainability Theory and Practice in Education as part of a PhD program in Sustainability Education at Prescott College, Prescott, Arizona. Both authors of this paper live in New Mexico and have backgrounds in several of the areas discussed in the report including forestry, water, energy, and the Southwest. Three chapters from the National Climate Assessment are reviewed: chapter 3 – water, chapter 4 – energy use and supply, and chapter 7 – forestry. In addition comments are provided on chapter 12 – Tribal and chapter 20 – the Southwest. The authors found the chapters on water and forestry to be thorough and pertinent, but found the chapter on energy use and supply lacking a thorough treatment. The overall comments on the National Climate Assessment are that the document summarizes vast amounts of important information from reputable sources, but lacks cohesion and vision. Overview: Climate change is an issue that touches every aspect of life – with ecological, social and economic considerations. The impending impacts of our changing climates are and will be seriously transforming our world and our society. The opportunities to respond proactively and guide this transformation through meaningful and responsive actions are the core challenges that have launched the field of sustainability. This response requires deep thinking, dedicated actions, and a transformational shift in how humanity lives on the earth. Globally, many scientists, leaders, and scholars have spent decades developing our understanding of climate change, its implications, and recommended responses to mitigate impacts. On an international scale, the Intergovernmental Panel on Climate Change has published four assessment reports (IPCC, 1990, IPCC, 1995, IPCC, 2001, IPCC, 2007)) and is currently in the process of developing the fifth assessment which is scheduled to be published in 2014. In the United States, the Global Climate Research Act of 1990 established the U. S. Global Climate Research Program (USGCRP) which is required to produce a report to the President and Congress every four years. The first National Climate Assessment was published in 2000 (USGCRP, 2000), followed by the second National Climate Assessment in 2009 (USGCRP, 2009). Each report represents an effort to grapple with this serious situation; as our knowledge and understanding continues to develop, a clearer picture of the interrelated aspects of climate change emerges. The most recent collaboration of thinking on climate change for the United States has been captured in a draft of the third National Climate Assessment by the National Climate Assessment Development Advisory Committee. The					Thank you for your comments. The underlying chapters have been revised in many ways that you may find useful. The report is a scientific document that does not make policy recommendations. While the report does not provide a systems analysis perspective, it takes a risk-based approach to framing information that will be useful to decision making.

purpose of this paper is to supply comments on the draft version of this report in response to the request for public input by the Advisory Committee.

The draft report is over 1300 pages long and includes thirty chapters that discuss climate change both regionally and by topics. The authors of this paper have chosen to concentrate their comments in five categories – overall comments on the report, water (chapter 3), energy (chapter 4), forestry (chapter 7), and a final section with minimal comments on other related chapters.

These comments have been compiled with a dual purpose—in addition to providing input on the National Climate Assessment Development Advisory Committees draft report, this paper is an assignment addressing climate change in a graduate course on Sustainability Theory and Practice in Education at Prescott College, Prescott, Arizona. Both authors of this feedback live in New Mexico and are pursuing a Ph.D. in Sustainability Education. Mary Stuever is a district forester in northern New Mexico for state forestry. Prior to working for the State of New Mexico, Stuever was the post fire rehabilitation coordinator for five years for the White Mountain Apache Tribe following the Rodeo-Chediski Fire in east central Arizona. She has authored or edited nine books including the habitat typing guides of the American Southwest forests and woodlands. She has a master's degree in fire ecology and a bachelor's in forest management. Maire Claire Voorhees, formerly the Green building Coordinator for the State of New Mexico, has worked in the area of renewable energy and energy efficiency policy since 2006. She earned a master's degree in Environmental Studies and Sustainable Community Development from Prescott College and a bachelor's of science in Interior Design from Drexel University.

Overall Comments on the Report

As described above, the foundational literature on Climate Change continues to grow and expand. Comprehensive reports have expanded from hundreds of pages to thousands of pages. With the primary goal of the National Climate Assessment to inform key political leaders of important details of changing climates and the possible responses involved, it is likely that these reports will either become too extensive to provide meaningful value, or will need to shift the focus to highlighting critical, rather than comprehensive information. From our reading of this report, it seems that most of the chapters are summarizing more comprehensive works that are published elsewhere. In this format, there is a wide disparity between the chapters on the depth, breadth, and usefulness of the information presented. For example, while we found Chapter 3 on Water to be concisely written, it provided meaningful background information that addressed the discussed adaptation needs. In contrast, Chapter 4 on Energy avoided addressing adaptation and provided a poor summary of the serious energy issues facing our country. The writers seemed to reflect an industry-guided convention that fossil fuels should remain the central backbone of our energy programs with alternative energy providing supplements. However, reducing the use of fossil fuels are the central opportunities for mitigating the impacts of climate change, and yet the energy chapter fails to outline how to eliminate the country's reliance on fossil fuels.

The lack of cohesion within this extensive report is symptomatic for an absence in utilizing a systems thinking approach. Climate change presents a challenge that clearly involves complex systems operating at global, regional and local scales. This report involves an impressive collection of authors who are clearly brilliant and leaders in their perspective fields, but the process needs to cross pollinate to identify impacts between systems and solutions.

		For example, the current focus on primarily producing ethanol from corn is leading to serious food issues throughout the world. Meanwhile western forests are brimming with biomass that is causing extreme fire behavior during wildfires, increasing carbon in the atmosphere, but more seriously, leading to serious erosion issues and reduction in forest productivity. Although this solution is clearly addressed Chapter 7 on Forestry, it is lacking mention in Chapter 4 on Energy. This report has the potential opportunity to show key political leaders how supporting ethanol production from excess forest biomass will solve many problems, including decreasing extreme fire behavior, decreasing severe erosion issues following fire, and decreasing carbon input from wildfire smoke while reducing the nation's dependence on fossil fuels. From a system standpoint, if ethanol produced from forest biomass can replace ethanol produced from corn; increased corn availability could be used to address world hunger issues. The role of the political system is to develop the policies and programs that address meaningful responses to challenges presented by climate change. It is important this report consider not only what is currently the status quo, but what technologies and opportunities exist to do things differently that may be more effective responses. Final Remarks The Third National Climate Assessment is a wieldy document that contains pertinent and important summaries of information and concerns regarding changing climates in the United States. Overall, the information presented is well-researched and compiled by well-respected and informed authors. The weakest aspects of the report are the lack of integration between areas of expertise and lack of clear action plans for aggressively mitigating future climate change by both reducing emissions and increasing storage of carbon.					
Mary	Stuever	Chapter 3: Water The water resources chapter adeptly works through ten key messages defined through an extensive literature review and a series of team discussion from March to June 2011 to identify critical vulnerabilities of current water resources in the face of climate change. The first message reviews the shifts in annual precipitation. The second key message focuses on the potential of increased Summer droughts. The third message discusses the projected intensification of floods. The fourth considers the precipitation and land use impacts on ground water. The fifth message addresses the sea level rise impact on coastal fresh water supplies. The sixth message reviews how water and lakes will be affected. The seventh message focuses on the water shortages in specific areas. The eighth message discusses increase flooding in river basins. The ninth message considers new risk, vulnerabilities and opportunities. The tenth and final message addresses resilience and adaptive capacity. The Water Resources chapter of this document is detailed and well rounded. It provides appropriate and meaningful background information about soil moisture, evapotranspiration and the impacts of climate change on the water cycle. This information arms the reader with the ability to contextualize the impacts of climate change on area hydrology across the United States. This chapter includes a section discussing adaptation which greatly adds to the chapter. Additionally, the concerns and impacts of climate change are considered in terms of stream flow projects for River Basins. However, adaption is not approached in the same manner. What would a river basin approach consist to resilience and adaptation encompass? As discussed early in the chapter, the condition of soil moisture is the largest factor impacting the hydrologic cycle after precipitation. Soil moisture affects the runoff, weather and recharge to groundwater stores. The top	3. Water Resources				The text has been revised to incorporate the suggestion.

		two feet of soil is most susceptible to short term impacts versus deeper soils. (Western, Grayson & Bloschl, 2002). One adaptation and resilience strategy not considered in this chapter is that of watershed protections and restoration. “Healthy watersheds and wetlands provide a host of ecological services, including water purification, ground water and surface flow regulation, wildlife habitat, flood and surge impact reduction, water temperature mod¬eration, erosion control, and stream bank stabilization (EPA, 2012, p.38).” The EPA recognition of critical watershed functions as a means to support healthy hydro-ecology and integrity of our national water resources has inspired the use of the collaborative, systems watershed approach to address and mitigate damaged water resources.					
Laurence	Fishtahler	Item #12 Fishtahler(L.E.&C.R.): Chapter 22 – Alaska: Disappearing Sea Ice, pg. 762, line 18 Title: It’s hard to make predictions, especially about the future (Arctic Sea Ice) Issue: missing – guidance on interpretation and use of GCM projections of Arctic Sea ice variables Supply: guidance on interpretation and use of GCM projections of Arctic Sea ice variables Rationale: “making it challenging to predict” – Obtaining GCM results that reasonably correspond to the observed record and make “reasonable” projections of Arctic Sea ice variables is notoriously difficult. Because modeling of the Arctic (particularly ice related variables) is uniquely difficult, some guidance should be provided somewhere in this section. Guidance should include a description of the difficulties, the state of the art, prospects for the future, and criteria for assessing the credibility, reliability, and proper use of the model results related to Arctic Sea ice.	22. Alaska and the Arctic		762	18	Due to the size of the topic, and the page limit for the chapter, we focused on broad trends rather than delving too deeply or providing such a level of specificity. The general issues are addressed in the traceable accounts and the cited references.
Channing	Corbett	The fact that climate change is causing more extreme temperatures, specifically warming temperatures, is extremely present throughout the Assessment Report. I think hard numbers in degrees for expected change are important and well implemented, but to maximize the readers ability to understand the piece clearly and be motivated to act upon their understanding, I think it would be very beneficial to comparatively match a state's changing temperatures to that of another state that it is moving toward replicating. This comparative match can be extended to any hard numbers that climate change are moving a region toward. For example the average rainfall of Region X in the year 2050 will mirror the current average rainfall of Region Y. This comparison enables the reader to have a real look into what climate change at current rates will produce. It provides clarity and relatability.	16. Northeast				We appreciate this suggestion, but a choice was made not to replicate a very similar figure from the 2009 report in the 2013 version.
Claudia	Langford	Consider adding articles to the citation. It now reads: (Bullard et al. 2011; National Urban League 2009).(Health Author Comment - LA Sheats)	9. Human Health		352	15	We have added the following citation to the other two: Blank, R.M. 2001. “An Overview of Trends in Social and Economic Well-Being, by Race”, in America Becoming: Racial Trends and Their Consequences, Volume I, Smelsen, N.J., Wilson, W.J. and F. Mitchell, (eds.), pp. 21-39, Commission on Behavioral and Social Sciences and Education, National Research Council, National Academy Press, Washington, D.C.

Mary	Stuever	This chapter is follows the five key messages that emerged from author bi weekly meetings and the DOE sponsored workshop of December 2011. The first message reviews the impacts of climate change on energy production and delivery facilities. The second key message focuses on climate change trigger increased summer peak electrical loads. The third message discusses changing water availability constraining energy production. The fourth message considers the impact of sea level rise on facilities and infrastructure. The final message addresses new investment in energy technologies. Since the chapter focused so heavily of the five key messages many key issues were not addressed and here in lies the greatest deficit of this chapter. This chapter discusses Energy Supply and Use which is a critical area impacted by Climate Change. Energy Supply supports all other built infrastructure that our society relies upon: transportation, production and communication. These aspects are intricately woven in a complex, interrelated grid to supply power that is often vulnerable to shifting environmental conditions. With this significance in mind, this chapter seems to broadly brush over the areas impacted by climate change. In the executive summary of this report on page 12 the idea is put forth that: "… climate change and its impacts cannot be adequately assessed in isolation. Rather, they are part of a broader context including many other factors such as: land –use change, local economies air and water pollution, and rates of consumption of resources." This concept from the Executive Summary seems to be lacking in this Energy Supply and Use Chapter. Considering the complexity of this subject, one strategy would be to carefully follow and describe the current status and potential limits of our energy resources and current systems from extraction through delivery and use then onto to release into the atmosphere. Energy supply and use is a complex system that when perturbed in one area may respond idiosyncratically in another. One strategy could be to understand the system by considering the interactions of each of the contributing components. For example, one would look at the system of fuels extraction and processing, then energy generation, moving on to distribution system, then energy use and finally waste products from use and generation. Armed with this information, an analysis could consider the interactions of the components, identify the impacts of changes in one part of the system to other processes, and then analyze the opportunities for change that lead to improvements throughout the system. The Executive Summary of this report states "These impacts [climate change] are the subject of this report (pg 3)." The discussion regarding mitigation is fully contained within a later chapter of the report. This is problematic as response to climate change must come from a systems orientation. The content of the report is maintained in silos limiting the necessary cross reference of information to address the global issues of climate change. Two areas that need additional attention in this chapter are Adaptive Change and Resilience Activities in the face of climate change. Most importantly, these discussions should include adaptive and resilience strategies that mitigate greenhouse gases. There are adaptive practices that can support energy supply diversity and greenhouse gas mitigation simultaneously. Adaptive Change: The thin review of adaptive suggestions seems to focus on ideas related specifically to the current	4. Energy Supply and Use				Due to the page limitations of National Climate Assessment ("NCA"), the authors strove to find an appropriate coverage of important issues, recognizing that in the end it would not be possible to describe every impact of climate change on energy supply and use. Other chapters of the NCA address some of the topics mentioned in this comment, including Chapter Water, Energy, and Land (Chapter 10), the Mitigation chapter (Chapter 27), and the Adaptation chapter (Chapter 28).

		energy infrastructure and not to new technologies. In this broader document, the chapter on adaptation carefully illustrates change strategies to respond to the impacts of climate change on all scales and uses case studies regarding water. Since there is little conversation about energy supply and use in the adaptation chapter, it is imperative this topic should be explored in the Energy Supply and Use chapter of this document. For example, current status and adaptive plan for energy supply infrastructure need additional discussion. Due to the current location of fuel refineries and electrical generation facilities, a significant number are in jeopardy as a result of rising sea levels. As was demonstrated by Hurricane Katrina as low lying facilities were incapacitated for months impacting not just the local area but throughout the United States. Significant portions of the transmission system are older and less efficient leading to significant losses along those pathways (EIA, 2012). The subject of alternatives to fossil fuel energy supply received little or no attention in this document nor did the discussion of cogeneration plants using both alternative energy and fossil fuels for electrical generation. Solar photovoltaic and wind have been increasing steadily across the United States (EIA, 2012). Biogas and biomass energy supplies are also being considered (DOE, 2012). One option is the utilization of biogas (methane gas), from landfills & feed lots, as an energy resource (DOE, 2012). Methane as a greenhouse gas whose warming capacity is significant, however its atmospheric lifetime is short. Therefore limiting the release of this gas into the atmosphere reduces overall greenhouse gas load more quickly (C2ES, 2013). Many areas that are projected to have reduced rainfall and increase incidence of drought also have substantial opportunities for solar electrical generation. Additionally these areas are also projected to have increased cooling days that may trigger an increase in electrical consumption for cooling. Grid tied roof solar in these areas could offset peak daytime demand for cooling by generating electricity without water (PA DEP, 2013). Another option for an alternative energy supply is that of biomass. Within the report there was concern raised with respect to drought in the Midwest impact the production of crops for use in biofuels. However, throughout the Southwest there is an overwhelming supply of biomass with in the forests which leaves these areas vulnerable to catastrophic wildfires. The removal of biomass from these forests addresses the vulnerability to extreme fire behavior while utilizing the excess forest biomass for electrical generation and/or ethanol production. As illustrated in these few examples, addressing climate change requires holistic systems thinking approaches which combine the dual challenge of both reducing and mitigating greenhouse gases while providing energy supply under changing conditions. Another serious infrastructure concern is the conditions of American levees that protect riverside communities. The American Society of Civil Engineers (2013) gives the current levee systems of the United State a grade of D-, which indicates significant risk. This is a serious energy and supply issue as many domestic refineries and energy generation facilities rely on levees for protection from rising sea levels and storm surges. Therefore, this issue must be considered in both resilience and adaptation plans (EIA, 2012). Resilience:					

		Current US Energy SupplyRetrieved from: http://www.eia.gov/totalenergy/data/annual/pecss_diagram.cfm 2011 data "The US energy supply system is diverse and robust (p. 167)." The above illustration demonstrates that 82% of our energy is fossil fuel products, 8% derived from Nuclear Electric Power and finally 9% from renewable resources. This may reflect some diversity, however, if there were a significant disruption in any of the fossil fuel sources there would be a significant impact on the system (EIA, 2011). Regarding the robust nature of the energy system there is conflicting evidence. Recently there has been an increase in domestic oil and natural gas production (EIA, 2011). However, we have decreasing capacity to refine crude into fuels for heating and transportation and therefore run a net domestic deficit in production. Additionally the US imported 60% of the oil refined in domestic facilities (EIA, 2012). The supply may be robust, but not from domestic sources leaving the nation vulnerable to supply disruption related to climate change. The electrical grid is a system of interconnected network generation, transmission and distribution facilities which provide electrical power to the consumer. The American Society of Civil Engineers (2013), since 1998, has given the US electrical grid a grade of D, this year it is slightly up to a D+. Aging equipment has increased vulnerability to intermittent power disruption, as demonstrated by the rise in significant incidents from 76 in 2007 to 306 in 2011. The report points to delayed maintenance, under-investment and the need for modernization as the major causes of the current poor condition of electrical grid (ASCE, 2013). The inefficiency of the current electrical grid must be addressed, as well as the projected impacts of extreme weather, wildfires, and sea level rise in any long term planning (EIA, 2012, ASCE, 2013).					
Mary	Stuever	The forestry chapter is organized around four key messages that were first published in 2012 in a governmental general technical report titled Effects of climatic variability and change on forest ecosystems: a comprehensive science synthesis for the U.S. forest sector. The first message regards the impacts of climate change on forest ecosystems. The second key message focuses on the potential of forests to sequester carbon. The third message discusses solutions such as the role of using forests for biomass. The final message addresses changes in the ownership status of forest lands. The input on this chapter is presented here in two sections: discussion on the key messages and specific editorial comments on the report. Discussion on the key messages. The key messages were developed by the chapter authors based on literature reviews, their own research, additional outreach with colleagues, and a 2011 workshop held by the U.S. Forest Service to gather input for the National Climate Assessment. The messages are based on extensive scientific research which includes identifying information gaps and ranking the confidence level based on the accumulated evidence (also presented in Table 3.) The background discussion regarding key message #1 on increased tree mortality from fire in the	7. Forestry				Our responses to individual portions of the comments (in brackets) are detailed here. [The background discussion regarding key message #1 .....]. We added text to mention that these impacts are compounded by a fire deficit, in that many U.S. forests have become increasingly dense due to past efforts to suppress fire (Covington et al. 1997, Swetnam and Baisan 2003, Rhodes et al. 2008, Swanson et al. 2010). We added two of the references but space constraints preclude adding others. Also we added text that identifies the importance of stand structure in the context of tree mortality. [Key message #2…] We have added text that recognizes the potential for

		Western United States fails to acknowledge widespread increases in stand density over the last century due to disruption of natural fire regimes on the landscape. The chapter suggests that tree mortality is resulting from increased temperature and evaporative water demand (Westerling, Hidalgo, Cayan, & Swetnam, 2006), which are certainly contributing to the situation, however changes in stand structure due to fire exclusion also need to be acknowledged as a primary driving force to increased fire behavior and resulting tree mortality (Covington, et al., 1997; Swetnam & Baisan, 2003; Swetnam, 1990; see also Chapter 20 – Southwest, Key Message #3). This situation is important to acknowledge here because of the opportunity to increase tree resilience and stand resistance to climate change through silvicultural treatments that restore stand structure within the range of natural variation under historic fire regimes (Bostwick, Menakis, Sexton, & Keller, 2011; Fulé, 2008; Graham, Jain, & Loeske, 2009; Graham, McCaffrey, & Jain, 2004). Key message #2 addresses the role of forests in carbon sequestration. The discussion for this key message discusses both the roles of forests and of wood products for the long term sequestration of carbon, but fails to mention the role of urban and community forests as a source of carbon storage. This important forestry-related carbon-storing method is sometimes referred to as the value of widely-spaced trees (CCX, 2009). As emphasized in other places in this comment report, key message #3 on the opportunity for biomass from forest residues is a critical finding of the National Climate Assessment. The suggestion is well documented here. The political constraints not mentioned include the lack of support from other alternative energy industries, in particular solar and wind. A recent initiative to add forest materials to the renewable standard for New Mexico (SB 204, 2013 New Mexico Legislature) experienced strong opposition from the solar and wind industry lobbies (personal communication with Brent Racher, New Mexico Forest Industry Association). As stated in the report, the inability to predict climate changes on the local level presents a challenge for land managers tasked with forest management for the future. What should be included in the discussion on key message #4 is the need for local innovation and heterogeneity of management activities within project design. Now more than ever, it is important not to standardize management prescriptions. By creating a mosaic of forest conditions, the landscape is better situated to respond to a wide range of possibilities (Millar, Stephenson, & Stephens, 2007). This challenge for foresters is to be innovative yet accountable. Currently the Society of American Foresters has a working group that addresses both sustainability and certification. In the past, forest management practices have been based on previous responses to management activities. The ability to predict ecosystem responses based on past experiences is more complex with changing climate conditions. Therefore, the certification of forest management practices needs to be flexible to consider future conditions as well as past and present forest conditions. It is refreshing to find the key messages for the Forestry Chapter focused on true sustainability issues and not wrapped up in the politics of certification.					carbon sequestration in urban forests. [as emphasized in other places…] Thank you for your comment, however policy issues are beyond the defined scope of the National Climate Assessment, a scientific document that provides the basis for decision making, but does not address policy. [As states in the report, the inability…] This comment does not seem to raise any question or suggest any revision.
Mary	Stuever	A statement without a reference seems to imply that is only in recent decades that private and public land managers have recognized the value of forests for providing non-timber product amenities such as clean water and wildlife habitat. In particular water and wildlife have been incorporated legally in public land management since the Multiple Use- Sustained Yield Act of 1960 and Wood, Water, Wildlife & Recreation has been logo with the American Tree Farm System (a network of private forest landowners) since at least that amount of time. A more correct statement might be: Forest managers, policymakers, and the public have for over half a century recognized that forests are valuable in many ways, providing everything from clean drinking water to wildlife habitat. In recent	7. Forestry		263	36	The text has been revised to incorporate this suggestion. Rather than focus on changes from the past here, we focus on current forests, their locations and uses. The text was deleted.

		decades, this recognition has resulted in increased eco-system-based conservation management on both public and private land.					

Mary	Stuever	Page 264, lines 15-16, in a discussion of carbon sequestration, fails to mention the value of the urban forest in sequestering carbon and seems to imply that loss of forest to development implies a wholesale loss of trees and subsequent sequestration opportunities.	7. Forestry		264	15	This text has been revised and references to land use change in the past have been deleted.
Mary	Stuever	Page 267, lines 28-30 the suggestion that large-scale disturbance events such as wildfire may alter soil moisture and nutrients is an amazing understatement. As the Burn Area Emergency Rehabilitation (BAER) coordinator following the Rodeo-Chediski fire (pictured in this report on page 268), one of the commenters (Stuever) can provide personal testimony that it is not uncommon to lose several inches of soil during intense rainstorms following severe burns.	7. Forestry		267	28	We appreciate this suggestion, but space is limited. We focused on broad trends rather than delving too deeply or providing such a level of specificity.
Mary	Stuever	Page 272, lines 17-19 list management practices that might increase carbon storage by increasing forest growth. The practice of thinning is missing from this list. Although some may assert that removing trees reduces carbon storage, increasing individual tree vigor increases the amount of carbon sequestered per tree (Zhu, et al., 2010), and thinning reduces the risk of losing the forest to extreme fire behavior (Brown, Kolden, & Abatzoglou, 2008; Graham, et al., 2004; Ryan, 2008; Keane, et al., 2002).	7. Forestry		272	17	The text has been revised to incorporate this suggestion. The treatment of "species/density management" was added to list as this is a basic forestry tenet and a citation included also.
Mary	Stuever	Page 276, lines 40-41, suggests that reducing stand densities may be more effective in reducing extreme fire behavior for the wildland urban interface. Experience from landscape scale fires including Rodeo-Chediski (Ffolliott, Stropki, & Neary, 2008) and Wallow (Bostwick, et al., 2011) in Arizona clearly show benefits of forest management activities whether or not or they are next to human developments. The reason these activities are currently applied more often in wildland-urban settings is that the expense of these treatments can be justified in terms of protection of lives and property, not because the treatments are more effective there. This distinction is important as it ties back to the justification of supporting biofuels in key message #3 which would greatly enhance the number of acres both in the forests and the rural fringes that could be treated effectively.	7. Forestry		276	40	The text has been revised to incorporate this suggestion. We have deleted the text 'particularly at rural-urban interfaces)'.
Mary	Stuever	Page 278, lines 5-6, the title cited here (National Climate Assessment—Forest Sector's Technical Report) is different than what is on the actual report (Effects of climatic variability and change on forest ecosystems: a comprehensive science synthesis for the U.S. forest sector) (Vose, Peterson & Patel-Weynard, 2012).	7. Forestry		278	5	The text has been revised to incorporate this suggestion.
Gavriela	Reiter	This chapter is very effective in teaching the reader about the science of many issues concerning climate change, ecosystems, biodiversity, and ecosystem services, but this chapter could be more effective at convincing people to change their lifestyles and how to be more environmentally conscious. This chapter could accomplish convincing its audience to be more conscious about their decisions concerning the environment by bringing the issues back into the micro scale. By looking at issues from the perspective of an individual, this chapter would be able to suggest ways in which people can alter their daily habits. This chapter is very good at educating the reader about the macro scale of these issues, giving great scientific information.	8. Ecosystems, Biodiversity, and Ecosystem Services				No change. Convincing people to change their lifestyles is beyond the scope of this chapter.
Mary	Stuever	An extremely valuable section in this chapter starts at line 14 on page 444 and addresses the importance of recognizing and utilizing Traditional Ecological Knowledge (TEK) in responding to climate change on tribal lands. As this chapter points out earlier, Tribal people are not limited to reservations. It is important to acknowledge that TEK may be useful beyond tribal boundaries. For example, there may be important correlations between TEK and systems thinking approaches that should become core values guiding landscape scale and local scale planning and collaboration. Perhaps one perspective is to consider landscapes from the historical perspective of influence …for example the idea that Apacheria encompasses a large breadth of the American Southwest and Mexico, even though today the majority of Apaches may reside on the Mescalero, Jicarilla, White Mountain, and San Carlos Apache Reservations. This suggestion to include the wisdom of TEK beyond reservation boundaries and influence on tribal populations comes with the expectation that any sharing of TEK is done with respect	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and				The point is well taken. Due to the geographic distribution of indigenous populations, and the page limit for the chapter, we focused on broad trends rather than delving too deeply or providing such a level of specificity. We thank the reviewer for this thoughtful insight.

		and honor, and is only solicited where local tribes are given the capacity to insure that their knowledge is presented and used in ways that are appropriate to tribal custom and culture.	Resources				
Michael	MacCracken	I would suggest some rethinking about the title of this section. In particular, saying “American People” seems a strange way to be focusing this assessment. First, there are Americans around the world, and this report really only focuses on what matters to those in the United States proper. Second, there are many, many people in the US (legally and illegally, or undocumented) for whom the information is valuable, and saying “American People” seems exclusionary. Third, there are many industries and people in the world who are dependent on the situation in the US for selling their goods or producing what they buy and depend on, and they would have a real interest in this report. Fourth, reading literally, the assessment covers lots more than what happens to people—it covers the environment, and more. It might work better to rephrase to “Climate Change and its Impacts in the United States”	Introduction: Letter to the American People				The intent of this letter is to connect with the primary audience of this report - Americans, whether at home or abroad. Directly addressing this letter to them is not meant to exclude others but to bring this important topic to their attention.
Michael	MacCracken	I would suggest adding a sentence about Americans in the Northwest being affected by ocean acidification. That issue merits greater attention, and the phrase “climate change” is not adequate to raise that issue. Similarly, I would suggest, in this paragraph or early in the next, specifically mentioning the phrase sea level rise. Or perhaps somewhere specifically indicating that the use of fossil fuels involves effects on the climate, sea level, ocean acidification, biodiversity, etc. so it is clear how encompassing the issue is. The few examples here are just not adequate at doing this.	Introduction: Letter to the American People		1	11	Thanks for this comment - the existing reference to oyster growers in Washington State does recognize the importance of ocean acidification. Sea level rise is mentioned later in the text.
Michael	MacCracken	While summer sea ice has receded, the storms tend to occur in the fall and winter, and this is when the erosion of coastlines occurs. So, it is the retreat and thinning of fall and winter sea ice that is causing the erosion. Additional summer heat absorption is what allows this	Introduction: Letter to the American People		1	19	The existing language is correct; no change is needed.
Michael	MacCracken	While I appreciate the need to give some indications of beneficial effects, at least for the examples here, and likely for others, they should be put in a qualified context. Longer and warmer growing seasons can increase the period over which evaporation occurs and so deplete soil moisture faster, to the longer season is only beneficial if there is sufficient moisture, and this needs to be added. Similarly for the Great Lakes, a longer ice-free season is only useful if the levels of the Great Lakes are not so diminished that ships can pass—and so the longer period of evaporation can be critical. Just giving these examples without qualification is seriously misleading.	Introduction: Letter to the American People		1	27	This kind of detail is more fully discussed in subsequent chapters, including the agriculture chapter.
Michael	MacCracken	A serious omission here, and also, but to a slightly lesser extent in the Executive Summary, is the failure to indicate that, even if not be fully specific about, impacts of climate change elsewhere can have effects on the well-being of those in the US; we have a global footprint, and consequences everywhere (e.g., in disease vectors, food production, habitats for migrating species, etc.) can have effects on us here. There is also no discussion at all of how impacts here in the US could affect those in other nations. For example, reduced (or enhanced) agricultural production in the Great Plains could have very deleterious (or beneficial) impacts on those in many countries around the world. Note also that there are Americans and American interests all around the world; so, given the title of this section focuses on “the American People” some account must be indicated that Americans will be affected around the world. At the very least, there needs to be mention that climate change is a global phenomenon and that, given the interconnected world we live in and depend on, what happens around the world matters and the impacts on the US that are described in this assessment are only a part of what needs to be considered by the American people in making decisions about this issue—for example, there are ethical, economic, environmental, resource, security, and many other types of couplings that matter.	Introduction: Letter to the American People		1	32	The authors appreciate the suggestion, but space is limited. The intent of this letter is to connect with the primary audience of this report - Americans, whether at home or abroad. More emphasis on the international context has been included in the Context and Background section of the Introduction, as part of changes in the overall framing of the report.
Michael	MacCra	This suggested benefit really needs to be qualified. In particular, longer, warmer growing seasons lead	1.		3	11	The word "potential" qualifies the

	cken	to greater evaporation and loss of soil moisture, so conditions can become too dry for crops. Also conditions can become too hot for crops (including nighttime temperature too warm for setting fruits, tomatoes, etc.). I just do not think that saying this in an unqualified way at all represents a responsible portrayal of the situation. Where in the United States, other than Alaska, is it that this would have a really important effect given the other changes that are going on?	Executive Summary				benefits here…and so no change is required.
Michael	MacCracken	These need to be conditional statements. So "provides" needs to be changed to "can provide" and "will" to "can"—at present, a lot of people seem not to be paying attention to the projections.	1. Executive Summary		3	14	Language has been modified in response to this comment.
Michael	MacCracken	"the planet is warming" seems a bit obtuse and incomplete—much more is happening than warming. And it is blah and very hard to relate to real people leading real lives. I think it would be much more communicative and to the point to say something like: "The choices we have made to derive energy are changing the conditions of the atmosphere, oceans, vegetation, and snow and ice, mostly in ways leading to adverse impacts for society and the environment."	1. Executive Summary		3	20	The authors believe the simpler statement is less confusing for a general audience.
Michael	MacCracken	In addition to the statement made here, I think a phrase or sentence needs to be added to say that at lower latitudes, while the temperature increase is a bit less, there is more evaporation and, in many locations more intense downpours. Basically something needs to be said about precipitation.	1. Executive Summary		3	24	It is important to keep the executive summary language relatively simple; the authors are comfortable with the current language.
Michael	MacCracken	This phrase is seriously misleading. The lower emissions scenario can only be met if we in the US start reducing our emissions NOW—the phrasing sort of implies we in the US can wait until after 2050. What the scenario involves is reductions in GLOBAL emissions after 2050, but the US cannot wait that long to get very seriously started. It is essential to make clear here that US emissions need to start down now (or soon) if the global trajectory of B1 is to me met	1. Executive Summary		3	29	Language has been modified in response to this comment.
Michael	MacCracken	The UNEP-WMO assessment and Shindell et al. make clear that the projected warming between now and 2050 could be CUT IN HALF if there were sharp emissions cuts in methane and other short-lived species—and their proposed emissions cuts may well have underestimated the potential cuts possible if we would get away from using the GWP for 100 years and use the GWP for 20 years. There can be an important moderation of warming in the next few decades if the potential for doing this were not hidden by use of GWP-100 in negotiations and analyses—this has been a very serious hindrance in really addressing the issue. So, somewhere here, short-lived species and their potential need to be mentioned!!!	1. Executive Summary		3	26	Although short-lived species are not introduced here, there is an expansion of the discussion of this topic in Chapter 2 and elsewhere in the Executive Summary.
Michael	MacCracken	Sea level "is rising"—it is happening now. The phrasing sounds like it has happened in the past and is not happening any more.	1. Executive Summary		4	3	The existing language adequately reflects the state of knowledge on this topic.
Michael	MacCracken	I'd suggest changing to "These changes an other climatic changes" to "These and other ongoing changes in climate" to indicate that climate change is continuing and will continue to change—this sounds as if all that will cause future impacts is past climate change.	1. Executive Summary		4	5	The authors believe the existing language reflects the state of knowledge.
Michael	MacCracken	I'd suggest changing to "heavy downpours and rapid melting of deep snow" to cover range of situations.	1. Executive Summary		4	10	This paragraph refers to impacts that are common across regions. This specific suggestion does not work as well in southern regions as it does in northern ones…no change is recommended.
Michael	MacCracken	It is not just storm drains that are being overwhelmed—it is channeled rivers like the Mississippi, Red, and other rivers. A broader vision of infrastructure is needed.	1. Executive Summary		4	11	Modifications have been made in response to this comment.

Michael	MacCracken	I'd suggest changing to "roughly equal in area to"	1. Executive Summary		4	15	The authors believe the current language is accurate.
Michael	MacCracken	I'd suggest changing to "far-away regions" to "over wide areas"	1. Executive Summary		4	19	The existing language accurately represents the author's intent.
Michael	MacCracken	I'd suggest changing "global circulation" to "atmospheric circulation over global scales"	1. Executive Summary		4	20	Leave as is.
Michael	MacCracken	This needs to say "Southeast and Northeast" given the vulnerability shown by Hurricane Sandy	1. Executive Summary		4	25	This is a key message for the Southeast, with multiple events over time. A new introduction has been added to the info graphic derived from the original regional key message table explaining the choice of messages.
Michael	MacCracken	I do not understand how one can include 8 inches as the lower bound. IPCC clearly left out a key term that is already adding mass to the oceans, and it is irresponsible to be suggesting so small a number. And 8 inches is so close to 1 foot it really is meaningless to distinguish. I would suggest changing "from 8 inches to 6.6 feet" to "up to 6-7 feet, even though such levels might not be reached until into the 22nd century."	1. Executive Summary		4	30	The rationale for using the extension of the historic rate of sea level rise as a lower bound, while explaining that this is not within the "expected" range of future sea level, is explained in the climate science chapter and the underlying Sea Level Rise scenario report. The authors believe the existing language is appropriate (see Ch 2 Key Messages).
Michael	MacCracken	I don't think most of the public will understand "pH." I'd suggest saying "long-time chemical balance." I would also start the next sentence by saying "Of most importance, ocean surface waters ..." and here it is said the waters are becoming more acidic.	1. Executive Summary		4	37	No change is recommended here, it is already referenced in the same paragraph.
Michael	MacCracken	I would suggest indicating what a few of the threats are—so infectious diseases, physical harm, allergens, etc. The text of paragraph lists some of causes, but not what the actual health danger is.	1. Executive Summary		5	9	This is a good suggestion and modifications have been made.
Michael	MacCracken	Using the term "rising sea levels"—so the plural--I think needs some clarifying explanation, especially as charts of given of the rising global sea level (singular); and I think a bit more care is needed in the text, so differentiating, perhaps, rising global sea level from changes in sea levels along coastlines resulting from the varying pattern of global sea level, coastal uplift and subsidence, changing ocean currents and winds, changing mass of ice sheets, etc.	1. Executive Summary		5	13	The authors believe the existing language is acceptable.
Michael	MacCracken	On phrase "distorted rhythms of nature," very poetic, but I'd suggest giving an example such as "timings and success of species migrations"	1. Executive Summary		5	28	This is a good point and the language has been modified.
Michael	MacCracken	The phrase "some amount" is unacceptably vague. I'd suggest saying "several decades" which would necessitate changing "is" to "are" on the next line	1. Executive Summary		5	41	Thank you for the suggestion. Modifications have been made to clarify the sentence.
Michael	MacCracken	It is not a "threat" of irreversible impacts, it is a "very high likelihood"—it is essential to make clear this is an unavoidable condition given the path we are on.	1. Executive Summary		6	11	It is important to use measured language in this report, so the authors have chosen to keep the sentence as it

							now stands.
Michael	MacCracken	Delete second “and”	1. Executive Summary		6	24	Change has been made.
Michael	MacCracken	This is almost an exact quote out of the findings of the WMO-etc.-sponsored Villach Conference in 1985. Somehow this needs to be made clear (it might even be plagiarism not to mention that earlier conference finding), perhaps even actually quoting from their findings and indicating that this conclusion is now much, much, much stronger—perhaps even say that, 28 years later, that advice has been fulfilled and needs to be even more strengthened. I think doing this would help to make the point even more clearly that this is not a new problem—science has been saying this for some time and the situation is getting more and more serious.	1. Executive Summary		6	32	There are now many publications that refer to non-stationarity, so it does not seem necessary to cite a specific historical source.
Michael	MacCracken	Change “will be” to “are being and will be”	1. Executive Summary		6	35	The suggested change is not consistent with the rest of the sentence and the intent of the authors.
Michael	MacCracken	I’d suggest changing “the need” to “the urgent need”	1. Executive Summary		6	39	Changes have been made.
Michael	MacCracken	This section needs a wrap-up paragraph as strong as the first paragraph, perhaps starting with something like “There is no more time for dawdling...” [well, something stronger and nicer], but something is needed here.	1. Executive Summary		7	24	Because this is a scientific report, it is important that it not contain specific policy recommendations.
Michael	MacCracken	Overall, the Report Findings section is very well done. I do recommend, however, including a specific (so twelfth, but not in spot 12) finding about the rapid and severe change and impacts occurring in the Arctic. In that many of the other findings are aimed at the lower 48 states, the Arctic changes get really short shrift in the set of 11 findings. I think the changes in the Arctic are large, fast and significant enough to really set out in a distinct finding—having 11 instead of 12 is no justification not to. The changes in the Arctic, which are quite well captured in that chapter’s findings, lay out a lot of types of impacts, and they require a quite different type of government response—the US has a very low Arctic presence, but now will have to have for our own purposes and to keep track of everything else going on. There has just been a recent Arctic national strategy put out by OSTP, etc.—this just has to be a point.	1. Executive Summary		8	1	There is a new report finding that is focused on Native Peoples, including in the Arctic.
Michael	MacCracken	There needs to be more attention in this finding to distinguishing impacts on overall food production and supply and the very widely differing situations that are going to be facing farmers and farm communities across the nation. For overall food production to be “relatively resilient” farmer are going to have to do a lot of adaptation and there could be many areas of significant disruption of farm communities (especially in some states). This all gets too downplayed.	1. Executive Summary		9	28	This is a good point that is also included in the rural communities chapter; changes are made to reflect this.
Michael	MacCracken	It is good to mention that what happens elsewhere in the world will affect the farm economy here. That should also be said the other way around. I would also add it is not just how agricultural systems adapt around the world, but also how adaptation occurs here—fine to say one can change the crop grown, but one also has changing markets to create and learn to operate within.	1. Executive Summary		9	31	Thanks for your comment; the authors agree with your observations.
Michael	MacCracken	There needs to be a consistency in how “Hawai’i” is spelled in this report. Here, there is an apostrophe, earlier there was a backwards apostrophe, and in Table 1.1 there is no apostrophe.	1. Executive Summary		9	18	We agree and have ensured the official spelling of the State is used consistently.
Michael	MacCracken	I think the words “more acidic” might be problematic, and they are also not very informative. The way the wording is here, it is indicated that the ocean is acidic, and this is not really the case given pH is over 7 (at least that is what everyone who has taken a chemistry class will think). To avoid that criticism	1. Executive Summary		10	12	Thank you for the suggestion. Modifications have been made to clarify this Report Finding.

		(especially from the professional Skeptics) and to be more informative, I would suggest replacing these words with something like “less conducive to and favorable for the formation of shells, coral reefs, and the skeletons vital to fish.” And no complaints this is too long given the lengths of other findings.					
Michael	MacCracken	Northeast: I would suggest changing “Heat waves” to “More frequent and intense heat waves” or something similar—there needs to be a modifier to indicate change is occurring	1. Executive Summary	1.1	11		After consideration of this point, we still think the existing text is clear and accurate..
Michael	MacCracken	Southeast: The phrase “risks associated” needs to be changed. This table is about observations of what has and is happening, not about the future. Say something like “increased disruption” or something.	1. Executive Summary		11	1	After consideration of this point, we still think the text is clear and accurate.
Michael	MacCracken	More needs to be said here—this is too incomplete a portrayal of the linkages of US to the world. I would suggest adding reference to health impacts [breakout of a disease somewhere can quickly become a breakout anywhere (or even everywhere)], creation of environmental refugees, shared resources (like water with Canada and Mexico), migrating species, and more. I just think too little is said here. I would also suggest mention of some specific examples, giving ones that go both ways.	1. Executive Summary		12	34	This section has been expanded in response to this comment, and there is a new section on National Security in the Introduction.
Michael	MacCracken	This is far too bleak a portrayal of what we know. In particular, we have observations documenting that some of the tipping points are, or may be, pretty close. For example, the Greenland and Antarctic ice sheets are already losing mass, the permafrost is already giving off methane in some regions (and so are the clathrates), some forests (e.g., western pine) is almost dead over a very large region due to a climate-induced pest outbreak. In my view, the phrasing is a total cop-out, far too much downplaying the present situation, and too vague in not listing what some of the tipping points are. I’d suggest saying something like “The amount of climate change that would lead to crossing of critical “tipping points” is difficult to predict, but there are already indications that some are likely to be near. In particular, the Greenland and Antarctic ice sheets are losing mass (and so adding to sea level rise) at an increasing rate; the permafrost is warming, thawing, and starting to give off CO2 and methane (and so amplifying global warming through the natural carbon cycle); and vast forest areas are dying due to pest survival through warmer winters (exposing the weakness of models in treating pests, weeds, etc.).”	1. Executive Summary		13	6	The authors believe they have provided a balanced view of the current state of knowledge on these topics.
Michael	MacCracken	I’d suggest changing this to “is likely to be exceeded” in that this is not a reality, but a chance of occurrence.	1. Executive Summary		13	29	Thank you for the suggestion. The section has been revised, and this sentence was deleted.
Michael	MacCracken	I’d suggest changing “gives” to “is intended to provide” to reflect that a good number just are not into receiving gifts of this kind.	1. Executive Summary		15	23	This comment is unclear.
Michael	MacCracken	I’d suggest moving the phrase “in development of this draft report” to the start of the sentence.	1. Executive Summary		15	29	The word draft has been removed.
Michael	MacCracken	Some clarification is essential here. It needs to be clear that what this stage review can do in terms of review and approval is limited. Were these the provisions during the Bush Administration, all sorts of hell would have been raised, and it should be raised here as well. To really ensure the credibility of the report, and the perception of this, it needs to be very clearly indicated that the entity determining the final version of the report is the set of non-federal members of the NCADAC, that this is an expert report and not a government agency report, and that policy considerations are not determining the content of the report. Fine to say that the agencies will be providing this team comments to ensure that the report does not impinge on policy prerogatives and that it does provide relevant information on key topics and meets the charter of the committee, but the phrasing here gives the impression that	1. Executive Summary		15	31	Modifications have been made to the language to emphasize that the NCADAC developed the report, but the reason the government must review it is that it becomes a government report in order to meet the legal mandate.

		the agencies can dictate the final content of the report, and this needs to be clearly shot down as a possibility. What needs to be made much more clear here is who is in charge.					
Michael	MacCracken	It is USGCRP	1. Executive Summary		16	3	This error has been corrected.
Michael	MacCracken	With the report apparently not due out until early 2014 due to allowing far too much time for the review and approval by the agencies, the report is going to end up seeming to be nearly two years out of date when it is finally published. This is really unfortunate. The final review and approval should take no more than a week, not a few months as the calendar once allowed. Basically, the agencies should get their scientific review comments in along with everyone else.	1. Executive Summary		16	11	New sources of information are included through April of 2012; this extensive review process is required because the government is legally responsible for producing this report and it must meet Information Quality Act standards.
Michael	MacCracken	I'd suggest that the international "Arctic Climate Impacts Assessment" merits specific mention—it is a good bit more than regional.	1. Executive Summary		16	16	The authors do not believe this report needs to be mentioned here.
Michael	MacCracken	To get around the jargon, I would suggest adding a few examples of "non-carbon-emitting energy sources", so specifically list solar and wind power as examples (and nuclear if need be).	1. Executive Summary		17	5	The language has been modified in response to your suggestion.
Michael	MacCracken	I'd suggest a consistent style in the numerical indications here, and would suggest saying "at least a 2 out of 3 chance" and "at least a 9 out of 10 chance"	1. Executive Summary		17	40	Thank you for the suggestion, but we still feel the existing language is clear and accurate.
Michael	MacCracken	Two problems here. It is really strange to be saying "about 3.7 F"—first because the conversion of 2 C is really 3.6 F and more important because it sounds and is far too precise; saying about 3-4 F might work better. Second, and most important, this is the change in the global average temperature increase—and this is an assessment about the US, so I'd urge giving an explanation that the changes in the US would be likely to be larger, especially because changes tend to be larger than the global average in mid and high latitudes, often with drier conditions, while typically being less in low latitudes due to evaporative cooling, which often leads to the potential for greater downpours.	1. Executive Summary		19	17	After consideration of this point, we still feel the existing text is clear and accurate.
Michael	MacCracken	For clarity, I'd suggest rewording to "Projected changes in average annual temperature (F) over the contiguous"	1. Executive Summary		20	3	Modifications to the language have been made.
Michael	MacCracken	Has "RCP" been explained at this point?	1. Executive Summary		20	6	Acronyms have been defined in the caption.
Michael	MacCracken	For an Executive Summary, this graph has a lot of lines with mnemonic names, etc. I'd suggest saving this detailed version for a chapter and here reduce the number of curves a bit and have the labels be for low, middle, and high emissions scenarios. I do like including observations that historical model results; I am not sure one needs to have two historic modeling curves. The caption also needs to indicate that the observations are annual values and give the averaging time for the model simulations.	1. Executive Summary		20	2	Thank you for your comment; the authors plan to maintain the current graphic because it is illustrating relationships between historical scenarios and the ones developed in the context of recent modeling efforts.
Michael	MacCracken	Two suggested changes: Change to say "SRES global emissions scenario"—it is vital to be indicating this is global. And I think the phrase "recommended for use" is really confusing here; how about replacing it with "that were most extensively considered as possible future conditions"? This latter suggestion might force a bit of smoothing of overall sentence.	1. Executive Summary		20	9	Thank you for the suggestion. The text has been changed to indicate that the NCADAC recommended the two SRES global emissions scenarios used in the report.

Michael	MacCracken	Two suggested changes: Change to be “global emissions” and in both places change “can” to “could”—this indicates plausible possibilities, not the full range of what is possible.	1. Executive Summary		20	12	Language has been modified in response to this comment.
Michael	MacCracken	Change “unknown” to “not possible to predict because of dependence on political and societal choices.”	1. Executive Summary		20	14	The language has been modified in response to your suggestion.
Michael	MacCracken	I would suggest changing “over the last” to “during the 20th” to be really clear.	1. Executive Summary		20	17	The authors prefer the existing language.
Michael	MacCracken	To be clear and correct, the start of the sentence should be “Global sea level is rising” (singular). For sea levels (plural) around the world, there are lots of additional causes of changes in sea level.	1. Executive Summary		20	22	This change has been made.
Michael	MacCracken	Two suggested changes. First, I’d suggest changing “in this” to “during the 21st”—it is really critical to be explicit and definitive where one can be. Second, I’d add a phrase at the end of the sentence so that it says: “during the 21st century, with sea level rise very likely to continue at a significant rate for centuries thereafter.”	1. Executive Summary		21	1	The authors believe the existing language is clear but have made changes to the graphic to improve it.
Michael	MacCracken	It needs to be said here that both the Greenland and Antarctic Ice Sheets are losing mass NOW. Yes, the processes are dynamic, but the dynamic possibilities would seem to have a lot more upside than downside potential if seeking to make a projection.	1. Executive Summary		21	2	This conclusion is already explicit that the projections are provided by the climate science authors.
Michael	MacCracken	Can delete “are shown”	1. Executive Summary		21	10	This change has been made.
Michael	MacCracken	Two points: I’d suggest rephrasing to “The scenarios for the increase in sea level during the 21st century range from about one up to almost 7 feet.” There is virtually no chance of 0.66 feet—that projection leaves out a critical term. And saying .66 and 6.6 is just too precise. Fine to say that if the higher levels do not occur by 2100, it is likely that they would occur not very far into the 22nd century if global warming were not significantly moderated.	1. Executive Summary		21	11	The caption has been revised to clarify the range of future sea level rise scenarios.
Michael	MacCracken	I’d suggest changing to “mainly reflects”	1. Executive Summary		21	15	The language has been modified to address this issue.
Michael	MacCracken	This sentence merits some elaboration based on what we do know; namely, it needs to be said that these and other ice sheets have proven to be very responsive to changing temperatures in the past as indicated in the paleoclimatic record, during which slow changes in temperature have caused the ice sheets to grow and shrink enough such that sea level was down about 120 meters with a global cooling of about 6 C, higher by 4-6 meters when the temperature was higher by about 1 C, and higher by up to 70 m when both the Greenland and Antarctic ice sheets were absent several tens of millions of years ago. At least for slow changes in the global average temperature, the relationship seems to be about 10-20 m of sea level change per degree, which can be seen immediately as very serious given that the global average temperature is projected to be increased by 4 C or even more by human activities.	1. Executive Summary		21	15	More detail on this topic is available in the climate chapter.
Michael	MacCracken	It seems to me that the second sentence ought to be extended to say “and the largest changes have been over and around the Arctic Ocean.” It just seems to me that the Arctic deserves special mention. Most of the findings that are discussed concern the contiguous 48 states and so the Arctic gets slighted—mention it when you can.	2. Our Changing Climate		25	27	One of the bullets on this page relates directly to the decrease in sea ice in the arctic. It is not clear what the comment is referring to.
Michael	MacCra	I think it would help to indicate here that the largest changes (or events) have often been in areas	2. Our		26	10	The points the comment raises are

	cken	where the stream and river bed are not hydrologically well-suited for such events (e.g., in the upper Great Plains) and so substantial flooding has resulted.	Changing Climate				beyond the scope of this chapter.
Michael	MacCracken	Would it be correct to say “heat waves and downpours”? I think adding this would really give the flavor of the increased incidence of extremes that is occurring.	2. Our Changing Climate		26	18	Downpours are addressed in Key Message 6. As a result, no changes are necessary for Key Message 7 based on this comment.
Michael	MacCracken	At the end of line 31, I’d suggest adding the phrase, “depending mainly on the rate of acceleration in the loss of ice from the Greenland and Antarctic ice sheets.” There seems little doubt the rate will increase—the question is by how much.	2. Our Changing Climate		26	30	We have incorporated this perspective by adding information in the supporting text for the Key Message.
Michael	MacCracken	I would urge adding a sentence in this finding with respect to the decreasing snow cover, both in terms of extent and duration, and also perhaps including lake and river ice. These are important points that merit mention in the findings.	2. Our Changing Climate		26	32	The text has been revised to incorporate this perspective, by providing information and references summarizing recent trends in snow extent on land in the supporting text for Key Message. The wording of the Key Message itself has not been changed because it already states that rising temperatures are reducing ice on land, and snow is a component of the ice on land.
Michael	MacCracken	Replace “potential” with “intensifying” as we are already seeing such impacts.	2. Our Changing Climate		26	36	Agreed. Key Message on acidification has been revised.
Michael	MacCracken	Overall, this is an excellent set of Key Messages. Nicely done.	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources		441	13	We greatly appreciate your positive comment.
Michael	MacCracken	In that the point mentions what is happening to Alaska Natives, the list of changes needs to mention the thinning and retreat of sea ice.	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands		441	14	The text has been revised, taking this suggestion into account.

			and Resources				
Michael	MacCracken	I think it would be helpful here to rephrase to make sure are making a point about the growing and harvesting (fishing, clamming, capturing, etc.) marine species, so lobsters, fish of various types, etc. Not having a point or coverage of what changes in the ocean and coastal environments are going to mean to those in the region seems a key omission. Perhaps this should be a separate point.	16. Northeast		549	20	The text has been revised to incorporate this suggestion.
Michael	MacCracken	I would suggest changing the word “expected” to “projected.” Were the world to act to limit emissions of short-lived species as well as CO2, etc., this does not have to happen in 2080, so we should not be expecting it. It is, however, projected if we do not act.	21. Northwest		721	22	The text has been revised to incorporate this suggestion.
Michael	MacCracken	There needs to be a key message on the changes and risks for wildlife in the region, including marine mammals, migrating species, new species coming into the region, native species facing extinction, etc.	22. Alaska and the Arctic		759	13	The text of key message 3 has been revised to incorporate this suggestion. Some wildlife issues are addressed in the text of key messages 3 and 5 related to permafrost and to Native Communities, as well as in the Tribal chapter (12).
Michael	MacCracken	I’d urge saying “by mid-century or earlier.” It is true that the ensemble averages for each model tend to favor toward mid-century, and so does the average of the various model ensemble averages. But the individual runs in the ensembles show that the loss of ice could occur decades earlier, and there is no reason that the observed world has to follow the mean of the model results—the whole idea of doing the ensemble is to get a sense of the range of possibilities.	22. Alaska and the Arctic		759	14	After consideration of this point, we still feel the existing text is clear and accurate. "by mid-century" implies that earlier dates are plausible. The range of dates given by recent model projections are given in the traceable accounts (i.e., the range of potential outcomes requested by this reviewer), and this statement follows Ch2. Our Changing Climate.
Michael	MacCracken	I’d suggest changing “altering” to “disrupting”—the situation is much more serious that just changing. And later in line could add how wildlife of various types is being threatened.	22. Alaska and the Arctic		759	15	After consideration of this point, we still feel the existing text is clear and accurate. There is a wide range of variation in the response of different ecosystem parameters and fish stocks (some increasing, some decreasing--see text and traceable accounts related to key message 4). Wildlife is dealt with in the text related to key message 5.
Michael	MacCracken	Saying “vulnerability” makes it sound as if impacts lie ahead rather than are occurring right now. One could say “disruption” here and be much more accurate. I would also note about this sentence that it could also refer to the ice retreat leading to heat uptake that delays and thins sea ice formation in the fall and winter, greatly affecting the regions weather (e.g., temperatures are much higher).	22. Alaska and the Arctic		759	16	After consideration of this point, we still feel the existing text is clear and accurate. "Is altering…and leading to" states explicitly that these changes are occurring now. The heat uptake mentioned by the reviewer is described in the text following key message 1, and the role of thinning sea ice is described in the traceable

							accounts.
Michael	MacCracken	I'd suggest changing it to say "shrinkage presently contributes" as this term is likely to decrease and be overwhelmed by greater loss of ice from the Greenland Ice Sheet in the future.	22. Alaska and the Arctic		759	18	The text has been revised to incorporate this suggestion.
Michael	MacCracken	This sounds far too sanguine. The traditional approach to adapting has been to move, to follow the resources, and it worked really well when the Arctic was not so highly populated and when there was not so much land ownership, need to be drawing on modern resources, etc. The disruption of some 150+ Alaska Native communities having to be moved (per GAO estimate) will be very disruptive.	22. Alaska and the Arctic		759	31	After consideration of this point, we still feel the existing text already addresses this point in the text related to key message 5.
Mary	Stuever	The five key messages for this chapter address diminishing snow-pack and water supply, impacts on agriculture, increasing wildfire threat, coastal issues of rising ocean levels, and health concerns due to rising temperatures. The wildfire threat discussion fills in some of the gaps re: the effectiveness of fuel treatments identified in our remarks for Chapter 7- forestry. The climate outlook discussion is particularly useful and accessible. The graphical display of temperature increases by model scenarios is alarming. The special box highlighting Tribal communities and border communities is appropriate, even though this report contains a chapter (12) for addressing Tribal issues. There is an opportunity to add forest biomass to the discussion of renewable energy options in the box discussion on page 692.	20. Southwest				We greatly appreciate your positive comment about our report and hope that you find the content useful. And thank you for your suggestion on adding information on forest biomass, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include.
Guillaume	Mauger	lines 18-21: This paragraph is great, and makes a critical point about climate impacts. However, my understanding is that we currently have excess power in summer (which we sell to other markets). All else equal, it's not clear to me why summer changes in hydropower are so problematic.lines 25-27: Mantua et al. (2010) do not address disease as a potential consequence of rising temperatures. If this is indeed a consequence, the appropriate reference should be included.lines 27-28: The buffering influence of snowmelt is fleeting, since earlier melt will ultimately remove this source of cold temperatures. This may be worth noting.	21. Northwest		725		The text has been revised to incorporate this suggestion.
Guillaume	Mauger	page 724:lines 4-5: Barnett 2005 is not an appropriate reference here -- the mention this result ("30 days earlier") in passing but do not make the calculations themselves and it's not even clear that the references they point to substantiate their claim. The USBR report is not particularly helpful either, especially since it's only concerned with the Columbia above the Dalles. I believe that Hamlet et al., 2007, 2010, 2013 and Elsner et al. 2010 have information on changes in timing, and that they give similar projections.line 7: "summer" streamflow peak is really a "late spring" peak, and changes in timing are really associated with increases in the month before historical peak flow, and decreases in the ~month after the historical date of peak flow. This distinction is important because (a) late summer flow changes are more related to changes in precipitation (and are therefore less certain -- an important fact about changes in summer flow), and (b) the months when flow increases (and therefore flood risk, etc.) are different for different basins, and do not always coincide with the months when winter flow has historically been greatest.line 8: Tohver et al. (2013, in review) show updated results from Hamlet and Lettenmaier (2007). Neither show a clear tendency for snowmelt basins, though I believe the general tendency is for increasing flood magnitude, not decreasing (~0-20%).lines 10-11: Uncertainty should be noted, including the std-dev of 7% cited by Kunkel et al. Figure 21.2 (right): (a) the title "combined flow" is confusing. Change to "total runoff", or similar, (b) "summer" is not defined (Jun-Aug? minimum flows?), (c) this figure could be improved by including results for routed flows (an associated dataset included routed streamflow data for 300 sites) -- routed summer flows will be	21. Northwest		724		The text and figure have been revised to incorporate this suggestion.

		different than the grid cell analysis shown since upstream catchment area is included. Tohver et al. (2013) find that minimum flows (7Q10) actually change the least for mixed rain/snow basins, and decrease the most for rain dominant basins (possibly due to increased evapotranspiration). Snow dominant basins show an increase, though this may be due to a shift in the timing of low flows from winter to summer.					
Guillaume	Mauger	page 722:lines 13-14: I'm not convinced that precip has increased: even if trends are statistically significant, they are (a) much smaller than interannual variability, and (b) very different depending on the endpoints chosen for trend calculations. These trends are not robust -- we know that interdecadal variability is undersampled, which is what should be emphasized in this report.lines 15-16: The evidence for increasing extreme precip is even less robust. Perhaps more importantly, Kunkel et al. (2013) -- presumably the basis for this report -- specifically state that there are no discernable trends in extreme precip.line 19: In the PNW, the expected response of precip to warming is still a subject of debate (see Scheff and Frierson 2011, 2012) -- thermodynamic changes ("dry get drier, wet get wetter") compete with changes in dynamics (poleward shift of storm track), with the former expected to increase precip, the latter to make it decrease.line 25: The difference in warming between summer and other seasons is not consistent among models. This should be emphasized.lines 30-35: Uncertainties in precip need to be emphasized more strongly. In my view, a reader's take-away (if they glean nothing else) should be that changes in temperature are robust (and as a consequence, changes in variables that respond to temperature), and that variability in precipitation dominates trends through 2100. A greater emphasis should be placed on the fact that (a) natural variability is large enough to mask a 30% decrease in precip, and (b) models (both GCMs and RCMs) do a poor job of simulating precip. My opinion is that an introductory paragraph should be devoted to uncertainty in projections, within which precip v temp uncertainties can be discussed. Discussion of uncertainty could then be kept to a minimum for the remainder of the text.	21. Northwest		722		The text has been revised to incorporate this suggestion.
Guillaume	Mauger	lines 25-27: I am glad that you mention natural variability, and the statement you make is correct at the global level (i.e., that natural variability is small compared to recent trends). However, it is generally not true at the scale of the coterminous U.S., and is definitely not true at the regional scale (e.g., southeast US has very weak trends in temperatures despite a clear global trend) -- see Deser et al., 2012 for an excellent treatment of this. The confounding influence of natural variability MUST be fleshed out more clearly in this text. This is of utmost importance for two reasons: (1) to clarify that variability and trends are not exclusive, and that a temporary lack of trend does not disprove global warming, and (2) to clarify that not all trends are related to anthropogenic warming -- at hemispheric scales, Wallace et al. (1995) estimate that only about 50% of variations are due to secular trends.	2. Our Changing Climate		28		We do discuss the recent slowdown in the increase in air temperature in the appendix. We have written a special subsection on the slowdown in the revised text to incorporate additional explanation of why the recent slowdown is consistent with the author team's assessment of the science.
Erika	Gavenus	Based on the findings of White et al. (2007), Johnson et al. (2009), and Kuhnlien et al. (2009), this chapter should integrate considerations of the human health impacts that will be felt due to the shifts identified, especially those related to fisheries. This issue clearly deserves state-level attention based on the potential burden it places on health and local economies. It deserves further state-level attention because of the role the State of Alaska has in increasing resiliency. The chapter indicates the strong adaptability of Alaska Native communities. However, the capacity for subsistence fishermen to adapt to shifts in run size and timing is limited by state-level regulation. Subsistence-fisheries regulations need to be revised to increase the health and economic resilience of Alaska to climate change. This chapter needs to better address the threats facing subsistence fishing, the human health implications of these threats, and the leading role the State of Alaska needs to play in adaptation to them. I have provided further comments and sources at specific points in the chapters where these issues can be addressed. Sources: Daniel M. White, S. Craig Gerlach, Philip Loring, Amy C. Tidwell and Molly C. Chambers. 2007. Food and	22. Alaska and the Arctic				We have added the suggested citations in our chapter assessment. In addition the tribal chapter (chapter 12, which is cross-referenced in the text) addresses this issue.

		water security in a changing arctic climate. Environmental Research Letters 2: 045018.Jennifer S. Johnson, Elizabeth D. Nobmann, Elvin Asay, and Anne P. Lanier. 2009. Dietary intake of Alaska Native people in two regions and implications for health: The Alaska Native Dietary and Subsistence Food Assessment Project. International Journal of Circumpolar Health 68(2): 109-122.Harriet V. Kuhnlein, Bill Erasmus, and Dina Spikelski. 2009. Indigenous Peoples' Food Systems: the many dimensions of culture, diversity and environment for nutrition and health. Food and Agriculture Organization of the United Nations, Centre for Indigenous Peoples' Nutrition and Environment. Rome.					
Erika	Gavenus	"Major U.S. fisheries" should be amended to "major U.S. and locally significant fisheries"Mauger, Sue. 2011. Cook Inlet Keeper. Stream Temperature Monitoring Network for Cook Inlet Salmon Streams 2008-2010.Available at http://inletkeeper.org/resources/contents/stream-temperature-report	22. Alaska and the Arctic		759	20	The text has been revised to incorporate this suggestion.
Erika	Gavenus	This text needs to be bolded like the previous key findings.	22. Alaska and the Arctic		759	30	The text has been revised to incorporate this suggestion.
Lara	Whitely Binder	The report mentions "specific sites in the Northwest…," however, it was my understanding the the NRC 2012 report applied to the entire coast of WA, OR, and CA. Please clarify what is meant by "specific sites" and "specific locations."	21. Northwest		726	35	The text has been revised to incorporate this suggestion.
Lara	Whitely Binder	Can the authors clarify whether this "40 inches" applies also to the inland waters of the Puget Sound, or is this just the effect on the outer coast?	21. Northwest		726	28	The text has been revised to incorporate this suggestion.
Erika	Gavenus	"commercially important fish" should be amended to include "fish important to commercial and subsistence fisheries"	22. Alaska and the Arctic		771	37	The text has been revised to incorporate this suggestion.
Erika	Gavenus	Discussion of the challenges to fishery regulation should address the complicating factor of having to balance multiple user groups.	22. Alaska and the Arctic		772	6	The text has been revised to incorporate this suggestion.
Hilda	Blanco	Dear NCA, On April 8th, from 4-6:15 pm, the Center for Sustainable Cities in partnership with the Schwarzenegger Institute at the Price School of Public Policy at the University of Southern California held a public forum on the draft National Climate Assessment. The forum was focused on the Southwest Region chapter and invited five scientists whose research has contributed to findings contained in the assessment.The objectives of the Public Forum were to: • bring attention to this sobering scientific assessment of the projected impacts of climate change on our nation, and specifically, our region; • showcase the work of several scientists whose research has contributed to the Southwest Region findings; • encourage informed comments from leaders and the public on the implications of the report on various sectors and suggest next steps. Here I submit links to the Public Forum videotapes. There are two links now. The first link is to the first 15 minutes of the Forum including talks by:	20. Southwest				We greatly appreciate your positive comment about our report and hope that you find the content useful.

		1)Dean Jack Knott, dean of the Price School of Public Policy at the University of California; 2) Governor Arnold Schwarzenegger; 3) Bonnie Reiss, director of Global Programs at the Schwarzenegger Institute at the Price School, USCThe link is the following: http://www.youtube.com/watch?v=awzwBBsQLw4&feature=youtu.beThe rest of the program can be found at the second link: http://new.livestream.com/accounts/113544/events/2000974 This second video contains presentations in the following order: 1) Hilda Blanco, USC 2) Philip Duffy, Lawrence Livermore 3) Tom Swetnam, University of Arizona 4)David Pierce, Scripps Institution 5) Rupa Basu, California EPA 6) Matt Heberger, Pacific InstituteAfter these speakers, we had a series of public comments by local leaders. The location of their comments on this second video, and a brief indication of the topic of their comments is found in the table below. Location of USC Public Forum Comments on Video Time Name Recommendation 1:12:00 Dan Jacobson • Invest in renewable energy, increase energy efficiency, more efficient cars • California as a leader in legislation1:16:22 Jon Parfrey • Use NCA to inform and draw attention from general public, regional and city planners, and policy makers • Critiques 30 km resolution (pg 39) because it does not account for Southern California's unique topography and microclimates o UCLA research at 2 km resolution1:21:55 Monica Gilchrist • Green Business Challenge (2008-2010) – resulted in reduced carbon emissions and costs1:24:00 John Simpson • Climate change adaptation program to come up with solutions1:29:06 Dan Dunmoyer • Brings a consumer perspective • Partner with fire chiefs to prevent people from buying homes in fire risk areas1:31:35 Sven Hackmann • How do we finance our policy solutions? • Public and private partnerships to translate research to actual policy action					

		o Promoting equity, stakeholder collaboration1:33:49 David Abel • Business response1:36:13 Woodrow Clark II • More emphasis on regionalism • Lack of discussion on the human causes • More on energy: Where do we get it from and what is its impact? • Health costs: More of a model to link climate problem with the cost • Mitigation chapter: not enough solutions, How are we going to pay for this? • Emphasizes mitigation					
Charles	Hunt	At one level, the report is an amazing accomplishment. It provides a well grounded, broad perspective view of the history, current understanding, and likely projections of climate change across the United States looking ahead to 2100. However, from the perspective of providing the information needed to guide the formation of Federal, regional, State, local, and commercial policy responses the report has significant shortcomings. In general, the report lacks comprehensive scope in terms of critical infrastructure and takes a too limited view of the systemic impacts of the changes identified in the draft report. Put bluntly, the report understates the magnitude of the synergistic impacts of climate change to an extent that could result in significant and perhaps catastrophic harm to the United States of America. It has become almost trite to state that the only constant is change. Unfortunately, the changes to climate that appear to be inevitable are effectively outside modern experience. Studies of how people make decisions have proved that there is a strong bias to depend overmuch on recent experience. There is good Archaeological evidence that a number of historic civilisations were not able to adapt effectively to significant regional climate changes and collapsed - a potent warning given the global scale of the coming changes. The report, while sobering, lacks the depth to help guide the decisions that will be critical to America's response. The majority of my feedback will attempt to identify the changes to the scope and organization of the report needed so that it could provide necessary information to policy makers. Given the work that has clearly gone into the report thus far, if it is not feasible to incorporate these recommendations into this report, I strongly recommend a follow on project to develop a more comprehensive document be initiated.The report suffers from an interesting shortcoming in one of its fundamental perspectives - that the climate changes that have occurred to date and that are projected to occur in the future are largely if not totally related to human activities. While I agree with the conclusions of the report's authors (and have not come lately to this belief), In examining the report, I believe that this approach needlessly politicizes the document. I recommend restructuring the report to address the observed changes and likely future trends (more on this later) to focus on needed policy changes independent of the underlying causes. If we were to assume that the observed changes and clear trends were not related to human activity (or not related in any significant way), we still need to respond decisively to hope to mitigate the effects of these trends. By separating a discussion of the causes from the trends, it would place the discussion of possible changes to human behaviors in the context of a broad range of policy decisions and would help identify how behavior changes that will likely mitigate the long term trends help to reduce the total costs across all categories. The approach taken by the Authors is understandable but the report should be restructured to improve its effectiveness without compromising its scientific rigor and credibility. There needs to be a section of the report that clearly addresses the scenarios that are used in the balance of the report. Chapter 2 presents a number of scenarios but they need to be clarified to facilitate policy analysis. From the standpoint of the behavioral impacts of the scenarios, there is support from research on policy formulation that there should be an even number of scenarios to					Thank you very much for your comment and offer to help. Policy considerations are beyond the scope of the NCA, a scientific document that provides the basis for decision making - without trying to guide policy formation. Edits have been made throughout the report to improve the description of synergistic impacts. The Climate Science chapter (Ch 2) and other separately address observed trends and projections, as recommended. Additional discussion of scenarios, climate models, regional uncertainties, has been improved in the Executive Summary and Climate Science chapters. Finally, while the authors attempted to include economic information where possible, for this report, economic information is limited to what could be developed from case studies and reports in particular sectors and regions. The ongoing sustained assessment process developed around this Third NCA report can hopefully contribute to an improved assessment of the valuation of climate impacts, mitigation, and adaptation. As in the development of the current report, there will be numerous opportunities for members of the public to contribute technical expertise.

		reduce reliance on the middle option to the exclusion of other scenarios. Even considering the complexity of the topic, four or six scenarios should be adequate to support policy analysis. Given the well documented optimistic bias present even in experienced Strategic Planners, Project Managers, and Risk Managers, and in The general population (including politicians) best practice would be to include scenarios for analysis that would be considered extremely negative. Experience from the "Stress Tests" now routinely administered to Financial Services Companies, while often challenged by companies (including those that pass the tests), supports this approach. Considering the range of climate change models, it would be tempting to simply use a subset of these to create the various scenarios. However, the intent of the models is understanding and prediction, while the goal of the scenarios is to support policy analysis and the development of public and private responses to climate change. Given this objective, while it is reasonable to allow the science to help establish the characteristics of the scenarios, at least two worst case scenarios would seem reasonable. For example, anything other than worst case analysis would not have identified an event such as the dust bowl in advance. A fundamental tenet of modern economics is that in the long run, short term local dislocations will be offset by long term adaptation and innovation. While this has been a useful perspective for the formulation of private and public policy, it has not been true during historic periods of major climatic change (except in time periods that extend beyond the establishment of a new climatic norm which could take hundreds of years or by considering a large scale view that would perhaps transcend the United States of America - either of these are clearly unacceptable for the establishment of America's response). It would be reasonable to include a scenario that includes persistent climate related changes that in economic terms would be characterized as catastrophic for at least two regions to help policy makers analyze the responses needed when economic dislocations are so fundamental that they result in significant economic contraction in at least some key sectors and shifts in spending that breaks the assumption of constant long term growth. While based on the report's findings, all of the scenarios would include an increase in weather related disasters, this scenario should be differentiated by multi-region, multi-year changes that would substantially disrupt, degrade, overload, or destroy multiple Critical Infrastructures. Such an approach should not be so extreme that is little more than the stuff of disaster fiction. However low probability worst case scenarios can be very useful starting points for analysis. Each region identified in the report is clearly unique. It might be argued that the regions are too large and it is likely that more fine grained analysis or analysis based more on geographic factors (e.g. The Gulf coast within 50 miles of the ocean) will be needed in the future. The regions as defined provide a good starting point. However, the organization of each regional section could be significantly improved. Each region should follow a standard outline with specific regional issues addressed in a consistent section (with subsections as needed). Additional comments on the regional sections:- Each region should include a clear impact assessment addressing a standard set of parameters and /or critical infrastructures. - If climate change is projected to alter the population of regions relative to each other as a result of changes to current trends the analysis should include this since the absolute and relative population will have far reaching impacts on critical infrastructures, politics, and the health and wellbeing of all Americans. - Each of the analytical scenarios should be addressed.New sections should be added to address each of the critical infrastructures. Each of these sections should follow a standard outline that takes the reader from overall summary to a summary of each of the scenarios to progressively deeper dives into the projected impacts of climate change on the critical infrastructure.While the regional analysis is important to understanding the varied impacts of climate change across the United States and should support a significant subset of policy analysis, the critical infrastructure analysis will provide policy makers with the perspective needed to understand the implications of climate change in terms that should foster the development of policy responses that address mitigation of the results and causes of climate change.The following notes are intended to suggest the kind of analysis that would be enabled by the addition of sections addressing critical					

		infrastructure (and to point out that the draft's treatment of the impact of climate change on financial services is completely inadequate)The changes described will have significant impacts on real asset valuation and associated wealth and ability to generate income within the life of these assets. These effects will not be evenly distributed and will not be uniform in direction and if not addressed in time could result in a significant dragon the economy and the ability of government, companies, and individuals to respond.In the absence of a clear understanding of the changes associated with climate change, financial services companies will not be able to help facilitate movement of investment away from areas at most risk over the asset's useful life. Policies that encouraged investment in the right locations or that discouraged investment in vulnerable areas (e.g. Through risk based pricing) could help preserve wealth, facilitate transitions, and reduce the overall impact of climate change to the United States and its citizens. Financing in at risk costal and heat / drought risk regions should be adjusted for repayment risk or prohibited through proactive zoning. There are similar issues for insurance rates. Legislation may be required to allow organizations to fully recognize and contain the risk. If excess risk is spread outside the at risk areas there will effectively be a subsidy for the at risk areas that will have the perverse effect of prolonging investment in the exact locations where it should be discouraged. Climate change will result in shifts in wealth for individuals, businesses, financial services, insurance, etc., These shifts could drastically impact income, retirement savings, etc. Proactive response could help to mitigate these effects.Steps must be taken well ahead of the asset and lending lifetimes. This means that lenders will need to address poorly understood risks over 30 year and perhaps longer time horizons. Early recognition of changes to repayment risk etc. will allow for more efficient use of market forces to implement needed changes. Late recognition will amplify the problems, costs, and economic and social disruptions.Finally, I fully recognize that I am proposing a lot of work. I am willing to volunteer time and assist in identifying additional technical resources that would be needed.					
Riley	O'Connell	The one critique that I have for this chapter is to make sure you are not coming across as biased from the perspective of the reader. While I realize that the information being presented here is probably as accurate as possible, it sometimes seems that the facts were handpicked to support the concept that climate change is happening quickly. Again, I completely agree with this concept, but I want to ensure that the reader does not distrust the information simply because it seems to only be displaying one perspective. I think it would be beneficial, and add to the validity of the report if you include the benefits associated with global warming, despite the fact that they are few and far between. This was touched upon on line 27 of page 298 where it says, "A longer growing season will benefit some crops and natural species, but there may be a timing mismatch between the microbial activity that makes nutrients available in the soil and the readiness of plants to take up those nutrients for growth." I would take this one step further and list which important crops would benefit from the longer growing season, and how that would be economically beneficial and how many more people it could feed. I understand that this positive seems negligible in comparison to the consequences climate change is responsible for, but it adds much more validity to the report. I personally felt that the information appeared to be handpicked in line 33 of page 298 where it says, "Longer growing seasons exacerbate human allergies." While I have no doubt that this statement is true, it came across as suspicious to me that you would present about a fact like this that seemed so insignificant and yet just gloss over the fact that there would be longer growing seasons, seemingly because one pushed forward your agenda while the other contradicted it. My general comment is to try to include more of the benefits attributed to global climate change in your reports, simply to gain more trust from the readers and add more validity to your claims.	8. Ecosystems, Biodiversity, and Ecosystem Services				No change. Several rounds of review have been conducted to guard against bias. Details about positive responses to climate change are more likely to be found in other chapters.
Jack	Kaye	The type face appears to have changed here.	30. The NCA		1047	22	Agree. Corrected.

			Long-term Process: Vision and Future Development				
Jack	Kaye	We should be clear and consistent about "climate change" vis a vis "climate and global change"	30. The NCA Long-term Process: Vision and Future Development		1048	28	Agree. To address the comment at least in this chapter, the following text was added at the end of the sentence in original line 15 on page 1047: "…in the context of other global change factors."
Jack	Kaye	Would it be good to start line 2 off with something like "Like the rest of the country, …"? Right now it could be inferred that this is an unusual occurrence, rather than what I suspect could be said for every chapter.	16. Northeast		552	1	The text has been revised to incorporate this suggestion.
Jack	Kaye	It seems strange to give information on hot days but not the corresponding information for cold days.	16. Northeast		552	16	We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include.
Jack	Kaye	It would be good to give dates for Sandy, since dates are given for Irene, and they should be treated consistently	16. Northeast		553	33	The text has been revised to incorporate this suggestion.
Jack	Kaye	Unless there is a map somewhere, it would be good to give a sense of where Delanson, NY is. Most people in the Northeast will have never heard of it, and NY is a big enough state that it is important to give some sense.	16. Northeast		553	35	After consideration of this point, we still feel the existing text is sufficient.
Jack	Kaye	It may be ok, but it's a bit strange to say that the precursor events "exacerbated" what came later - maybe something like "left the region predisposed to …" so it's clear what the cause and effect are.	16. Northeast		553	36	The text has been revised to incorporate this suggestion.
Jack	Kaye	The caption seems to repeat some information provided previously. Does one need all this information in the text on p. 553 and in the caption on p. 554?	16. Northeast		554	3	The text has been revised to incorporate this suggestion.
Jack	Kaye	I don't think it's appropriate in a written document to start a sentence with "But" - but maybe grammatical standards have deteriorated so much, that's actually now allowable. (I hope not!)	16. Northeast		554	11	The text has been revised to incorporate this suggestion.
Jack	Kaye	it's not clear that "serious consideration" will actually improve anything - it's actions/decisions that will change things. Serious consideration is a necessary but not sufficient step.	16. Northeast		555	19	The text has been revised to incorporate this suggestion.
Jack	Kaye	Poor grammar - lack of parallel construction - has "advance" but then "supporting, improving, and	29.		1035	16	The introduction has been completely

		expanding" - text should be consistent	Research Agenda for Climate Change Science				rewritten.
Jack	Kaye	There should be a reference pointing the reader to where the research goals are - it's not terribly helpful to cite some particular part of a document and provide no direction to that point	29. Research Agenda for Climate Change Science		1035	24	The chapter has been restructured to make this clearer. In addition, the electronic version will link to specific parts of other chapters.
Jack	Kaye	"risk assessment and scenario development" does not seem to fit under the subject of "policy alternatives" - maybe there is a better term that can be used there.	29. Research Agenda for Climate Change Science		1036	17	These topics are in the chapter but are treated under different headings
Jack	Kaye	The word "biogeophysical" doesn't seem to work terribly well, although I've seen it used a few other places. "Biogeochemical" and "geophysical" are much more common. If we have to live with this, we can, but it's certainly undesirable from my point of view	29. Research Agenda for Climate Change Science		1036	25	This is no longer in the chapter.
Jack	Kaye	Should it be "its" or "their" - since there are 3 parameters whose rate is changing? If one wrote "rates of change …" then it would be clear that it should be "their".	29. Research Agenda for Climate Change Science		1036	36	This is no longer in the chapter.
Jack	Kaye	It is not clear how having an indicator by itself will "allow for anticipation of abrupt changes" unless it is know in advance where the threshold is. Maybe that is what is intended, but the text is not clear on this point.	29. Research Agenda for Climate Change Science		1037	10	Language in the chapter has been modified in response.
Jack	Kaye	It's confusing to mix temporal and spatial scales in the same bullet - does this mean that it has to be both long-term and regional-scale, or could one be ok with long-term moderate scale and shorter-term, regional-scale?	29. Research Agenda for Climate		1037	16	This is now separate bullets.

			Change Science				
Jack	Kaye	It is not completely clear how this bullet differs from the first one in this series (starting on page 1037, line 34). The text should make this clear.	29. Research Agenda for Climate Change Science		1038	6	Bullets have been combined into smaller number which reduces overlap.
Jack	Kaye	It's not clear why the focus is on "public" understanding but "individual and corporate mitigation actions" - wouldn't there be potential "public" mitigation actions? Why would we want to ignore those?	29. Research Agenda for Climate Change Science		1039	7	This is no longer in the chapter.
Jack	Kaye	I would not normally consider "prioritizing" to be a research goal. Rather, it's something that's done based on research needs, capabilities, and resource implications. If the idea is to "Provide the research basis for prioritization …" that's okay, as then it makes clear that the actual prioritization may not be a pure research activity.	29. Research Agenda for Climate Change Science		1040	5	Wording has been changed; there is now a separate section on how to prioritize among the research needs
Jack	Kaye	Isn't "physical" part of "natural"? If not, I have no idea how to interpret this! If one wants to say "physical" and "biological" that could work, I guess. Right now, I can't figure out what the authors are trying to say!	29. Research Agenda for Climate Change Science		1041	33	The text has been amended to address this suggestion.
Jack	Kaye	It's unclear why it says "… other relevant professional schools" since that's in a parenthetical expression following "related fields of study" - so why not just say "other relevant professional disciplines" and leave the "schools" out of it?	29. Research Agenda for Climate Change Science		1041	34	The text has been amended to address this suggestion.
Jack	Kaye	I can't figure out if this is supposed to relate to the recent report from the NRC on modeling, in which they suggest the development of a pool of "translators" (perhaps with dedicated programs to help educate/train them). If there is to be some relationship here, it may be good to note the consistency with that recommendation.	29. Research Agenda for Climate Change Science		1041	3	This goal has been substantially rewritten to focus on research in support of assessments rather than modeling per se.
Jack	Kaye	I remain concerned about why just "STEM education and training programs at Native American colleges and universities and other similar institutions …" is cited - I understand that there may be some	29. Research		1042	3	The section has been edited to provide a description of the more general need

		particular reason, but then there should be a reference to something (some conference report, perhaps?). Otherwise, it seems strange to have pulled this out from all the other possibilities, including those directed towards underserved populations. WIth appropriate explanation, this could be okay (for instance, if the point is the size of the reservations and the environmental sensitivity of many of these areas, then stating that could make this okay, but right now it cries out for explanation!	Agenda for Climate Change Science				to build capacity, including in Tribal Colleges.
Amanda	Babson	It is not clear why average annual temp and precip are shown. A figure showing change would be more meaningful. It would also be useful to use consistent figs of temp and precip change for each regional chapter.	16. Northeast	16.1	550		We thank the reviewer for the helpful suggestion, but the figures have been removed in favor of more informative ones on extremes.
Amanda	Babson	Since many of the chapter examples are NY specific, it may be advantageous to pick a gauge in a different location. Either way, it would be beneficial to include context of how SLR at this station compares to the range of Northeast SLR rates.	16. Northeast	16.2	551		The text has been revised to incorporate this suggestion.
Amanda	Babson	This statement would benefit from including the “unplanned retreat” aspect of the discussion of it, or reference to the fact that these populations will be exposed to higher vulnerability to hazards prior to the displacement. Also applies to p. 882 line 20-21.	25. Coastal Zone Development and Ecosystems		867	21	After consideration of this point, we decided to leave the message almost unchanged. We believe that “retreat” is a communication red flag for many people in the U.S. and that displacement is actually more appropriate to describe what we expect to see happen. Growing risk is acknowledged now.Retreat is discussed more now in the social vulnerability section, but the key message has not been changed (except for removing the word "unmanaged"), as we did not intend to have a message about retreat in general, but about the social injustice of some portions of the population facing a GREATER risk of being dislocated without assistance than other, wealthier segments of the population.
Amanda	Babson	Caption needs clarification: The maximum SLR on the figure is 2.0-2.3 ft, yet the caption says the scenario in b) is 3.9 ft. Is this saying that 3.9 ft is the global average and the US is much less than global (this isn’t consistent with regional chapters), or is the figure for a different time period?	25. Coastal Zone Development and Ecosystems	25.3	871		The title and caption have been revised to correct the time period covered by the graphic (2050 rather than 2100).
David	Reidmiller	1) Agricultural and forestry systems rely on many ecosystem services, such as soil fertility, water provisioning, and genetic diversity. It seems logical to mention this in Chapter 8, even if just a few sentences. While these sectors are covered in great detail in the Agriculture and Forestry Chapters (6 and 7) - and, therefore, a choice was probably made to omit them from Chapter 8 - fisheries are mentioned repeatedly, on Page 292, L21 and Page 292, L6-16 and Page 297 L19-26 and in many of the	8. Ecosystems, Biodiversity, and				No change. After much discussion, we deleted mention of agriculture and forestry from this chapter due to space limitations.

		observed biological responses in Figure 8.4. And then the marine ones receive even more coverage in Chapter 24. This may give the reader a skewed impression that ecosystems, biodiversity, and ecosystem services re: fish are more important than for agriculture and forestry. Given the reliance on, and contribution to, ecosystems, biodiversity, and ecosystem services from agriculture and forestry, equal attention seems prudent in Chapter 8; Some references the authors can cite are included below in case they are useful to support this message.Scott M. Swinton, Frank Lupi, G. Philip Robertson, Stephen K. Hamilton. Ecosystem services and agriculture: Cultivating agricultural ecosystems for diverse benefits, Ecological Economics, Volume 64, Issue 2, 15 December 2007, Pages 245-252, ISSN 0921-8009, 10.1016/j.ecolecon.2007.09.020.Scott M. Swinton, Frank Lupi, G. Philip Robertson, and Douglas A. Landis. Ecosystem services from agriculture: Looking beyond the usual suspects. American Journal of Agricultural Economics, Vol 88, No. 5, Proceedings Issue (December 2006) pp. 1160-1166.	Ecosystem Services				
David	Reidmiller	Soil and ecosystem services are mentioned in the chapter on Agriculture (page 239, Lines 5-13) and would encourage the authors to ensure that they also be mentioned in Chapter 8. Soil is just as integral to Ecosystems, Biodiversity, and Ecosystem Services as water and plants and animals. Or, are there simply not enough studies on the impacts of climate change on soil to merit a review?	8. Ecosystems, Biodiversity, and Ecosystem Services				No change. We do include some soil-related responses, e.g., nutrient leaching. But we deleted mention of agriculture and forestry issues from this chapter due to space limitations.
Amanda	Babson	p. 882 line 3: This should be “such as beach replenishment” but there are other options under “soft protection”.	25. Coastal Zone Development and Ecosystems		882	3	The text has been revised to incorporate this suggestion and add other examples of "soft protection."
Amanda	Babson	I appreciate that this figure includes Cultural Heritage.	25. Coastal Zone Development and Ecosystems	25.8	884		We greatly appreciate your positive comment. We felt it was important to include given its frequent oversight.
Allison	Leidner	Integrated is the wrong word to use here, because it is unlikely that one would bring together the large data systems into a single data system; rather, the data systems would be made interoperable. Integrated should be replaced with "made interoperable".	29. Research Agenda for Climate Change Science		1039	20	The text has been amended to address this suggestion.
Allison	Leidner	The key message reads as if the purpose of ecosystems is to improve water quality. A benefit of healthy ecosystems is that they help maintain water quality; degradation of natural ecosystems often (but not always) leads to lower quality. Suggestion - change improve to maintain.	8. Ecosystems, Biodivers		291	14	No change. This wording is consistent with an ecosystem services approach to evaluation of ecosystem functions.

			ity, and Ecosystem Services				
Allison	Leidner	The figure caption should indicate the climate scenario used to create the map on the right from the 2050s.	14. Rural Communities	14.4	501		Thank you for your comment. The map shows projections under the A2a emissions scenario. The caption has been revised to indicate the scenario used.
Allison	Leidner	The figure source is listed as updated from Wang et al 2011, which is an abstract from AGU. Chapter 18 (cites page 632-633, figure 18.8) has the same graph (but different satellite images) and cites Wang et al 2012, which is a Journal of Climate article. The Wang et al 2012 is a better reference to use here. Furthermore, the journal article (Wang et al 2012) is cited in the traceable account on page 88 for the Chapter. However, in the reference section for the Chapter (pg 101, line 33-35), only Wang 2011 is listed, and this reference is listed as the Journal of Climate, but the link is to the AGU abstract, not the Journal of Climate paper.	2. Our Changing Climate	2.27	66		Reference has been corrected to Wang et al. (2012, J. Climate).
Allison	Leidner	Note that the figure is on page 631, and the caption is on page 632 (line 2-9). This figure cites Wang et al 2012, but the data in this paper only goes through 2010. The graph from this figure appears in Chapter 2 (Figure 2.27) and has a notation that the data are updated from Wang et al. 2011 (see related comment on Chapter 2). The figure in Chapter 18 should also have a similar notation. Note that the reference for Wang et al 2012 (pg 653, line 27-28) has an asterisk after the title. The asterisk should be removed.	18. Midwest	18.8	631		We thank the reviewer for the helpful suggestion, which has been incorporated into the figure. The asterisk is in the official citation on the AMS website.
Allison	Leidner	Note that the figure is on page 631, and the caption is on page 632 (line 2-9). The caption says the following: “Photos contrast extensive vs. minimal ice cover on Lake Erie. (Source: Wang et al. 2012. Images are from NASA MODIS satellite imagery processed by SSEC, University of Wisconsin and obtained from the CoastWatch Great Lakes Program)". If the “photos” are images from the MODIS sensor, then they should be referred to as images rather than photos. Also, the wording of the caption suggests that MODIS is a satellite, which it is not. It is a sensor on two different satellites – Terra and Aqua. Suggested rewrite: Images are from the NASA MODIS sensor processed by SSEC	18. Midwest	18.8	631		We thank the reviewer for the helpful suggestion but have removed the images in response to other comments.
Allison	Leidner	The bottom image of southeastern floods is listed as a photo courtesy of NASA. If this is a satellite image, it should be referred to as an image, not a photo. The source of the image should be listed.	3. Water Resources		123		We have replaced this image with a different image.
Allison	Leidner	The Appendix is referenced throughout the report, but there are actually two appendices - CAQs and climate science. The specific appendix that is being referenced should be noted.					Thank you for the comment. Cross references will be corrected in the final electronic version.
Allison	Leidner	Images taken from sensors on satellites should be referred to as images, not photos. Additionally, the source of the image should be listed in a consistent manner throughout the report so that the data are traceable. An example - page 123 says “The 2009 Southeast floods affected several counties throughout northern Georgia (bottom; photo credit: NASA)”, whereas the caption for figure 9.11 ends with “Source: NASA MODIS data provided by R. Stumpf, NOAA” and the caption for figure 16.6 says “Source, Data are from NASA Landsat 7, Band 6. Source: Center for 6 Climate Systems Research, Columbia University”					Thank you for the comment. References in the final version will be consistent with the chosen NCA format.
Allison	Leidner	The agency (or agencies) associated with sensors and satellites should be consistently listed, or consistently not listed. For example, page 1086 refers to the GRACE satellites, but pg 557 refers to NASA Landsat 7. Note that Landsat 7 could be listed as NASA/USGS.					Thank you for the comment. References in the final version will be consistent with the chosen NCA

							format.
Allison	Leidner	The "new information" entry about GRACE should include literature references.	20. Southwest		706		Thank you for your suggestion.We have added several citations to our chapter assessment.
Allison	Leidner	It is atypical to start a chapter on Ecosystems, Biodiversity, and Ecosystem Services with a detailed explanation of climate impacts on water quantity (see Figure 8.1) and water quality, followed by an even less biological section on Extreme Events. It would be better to move these two services sections so that they appear after the Plants and Animals and Seasonal Patterns sections and before the Adaptation section. The desire to hook people by starting with ecosystem services that they directly relate to is understood. However, people also relate to living things and this is the one chapter addressing these issues, while water appears in multiple chapters--at least two others by name. Services are fine to highlight, but it would be better to lead the chapter with the impacts of climate change on ecosystems and biodiversity.	8. Ecosystems, Biodiversity, and Ecosystem Services		292	14	No change. We will stick with the idea of "starting with ecosystem services that people directly relate to." And water quantity and quality are central to ecosystems.
Allison	Leidner	Key Message 4 makes a true statement (many societal goals can be advanced via adaptation) then appends a conclusion that does not necessarily follow, that adaptation "can be incorporated" into existing decision-making processes. Stating something such as “current decision-making processes offer many opportunities to consider adaptation . . . ” seems more consistent with the evidence in this chapter.	28. Adaptation		983	30	The authors are saying it is an option but not a requirement. We appreciate the suggested wording change but have decided to leave the text as originally written.
Allison	Leidner	The table would be strengthened by including additional examples from Federal programs.	28. Adaptation	28.6	1001		Thank you for your comment. The authors have clarified the text, introducing the map to make it clear it covers state, local, and private actors.
Allison	Leidner	The source of the satellite image should be listed by agency/mission	9. Human Health	9.6	341		This is a MODIS satellite image courtesy of the Land Rapid Response Team, NASA/GSFC, Greenbelt, MD. We have modified the text.
Allison	Leidner	Sources for these statements need to be incorporated into the text (e.g. NRC 2009). Moreover, the general public's knowledge and use of data and technology is vastly improved from a decade ago. People are quite used to maps on mobile devices, as well as searching for data and information. Consequently, the barriers may be a bit overstated here.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		926	39	The text referred to by the reviewer has been significantly revised and is now included in the section describing decision support. References, such as NRC, 2009, have been included to support statements within the text.
Allison	Leidner	What is meant by 'data management' here? Do the authors mean the actual management of data or are they referring to how data may be displayed or organized?	26. Decision Support: Supporting Policy,		927	31	Removed data management from this list; this concept is clarified in a box in the chapter. The organization of the chapter has been better explained.

			Planning, and Resource Management Decisions in a Climate Change Context				
Allison	Leidner	Evidence or citations should be provided that articulate examples of the access to information problem.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		930	11	This section has been expanded to include additional examples and references.
Allison	Leidner	The land uses planning tool is a fine example, but much of the narrative and examples given are very much GIS-oriented. An example that uses remote sensing imagery would provide a different perspective. One option could be and example from NASA's Earth Science Data and Information System (ESDIS) Project, used by many in the science and applications community: http://earthdata.nasa.gov/labs/worldview/. A text description: Worldview shows the entire Earth as it looks "right now" - or at least as it has looked within the past few hours. Worldview supports time-critical application areas such as wildfire management, air quality measurements, and weather forecasting. The imagery is generally available within three hours of observation and can easily be compared to observations from the past - just click or drag the time sliders at the bottom of the page. Imagery is available from May 2012 onward and NASA is working to provide access to earlier dates. Arctic and Antarctic polar stereographic views of several products are also available for a "full globe" perspective.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context	26.3	932		The cited tool shows Earth "right now" and does not provide capabilities to integrate scenarios or projections of future change. Text added to caption to indicate climate change considerations are being added to a tool in development. Additional examples have been provided in the chapter to illustrate the main messages of the chapter.
Allison	Leidner	It would be more useful to provide examples of the boundary processes earlier in the chapter.	26. Decision Support: Supporting Policy, Planning, and		940	23	The chapter has been reorganized and examples of boundary processes have been included.

			Resource Management Decisions in a Climate Change Context				
Allison	Leidner	The caption on the lower right panel is incorrect. It should be "Difference in Number of Cooling Degree Days."	18. Midwest	Figure 18.2	620		The caption has been clarified.
Allison	Leidner	There are four figures in the report that show images of minimum Arctic sea ice extent - figures 2.28 (pg 67), 22.2 (pg 763), 12.4 (pg 450), and 33 (pg 1174 of the Climate Science appendix). Figures 2.28 and 22.2 are consistent for images, although the captions are different and the citations are not the same – the consistency between them should be improved. The captions should also note that the graph shows average Arctic sea ice extent in September, not the minimum extent recorded in that month. Figure 12.4 is a similar image of sea ice extent, but references the NASA Earth Observatory website. Although the results are the same (declining sea ice), it is probably best that the same figure be used in Chapter 12 as in Chapter 2 and 22, for consistency. Also consider using this figure in the Climate Science appendix, as the images in figure 33 are a little blurry, the scale is hard to read, and the caption cites an unclear source that is probably not the primary data source.					Thank you for the comment. The images used will be chosen for consistency and clarity of message.
Allison	Leidner	It's not clear why certain assessments were included and not others (e.g., WMO/UNEP, WOA). At a minimum, instead of "including" it could say "for example" to be clear that only some that could be cited are actually listed.	29. Research Agenda for Climate Change Science		1035	31	While the specific text is no longer in the chapter, the proposed “for example” rewording is in the new text.
Allison	Leidner	This paragraph seems to contradict the previous one which is suggesting a much broader view (e.g., "and a range of International assessments." The text should be clear if this is "NCA only" or "NCA plus".	29. Research Agenda for Climate Change Science		1035	36	The Introduction was rewritten to focus on NCA and research to support assessments.
Allison	Leidner	This research goal is seemingly quite broad - it could certainly fit for the whole USGCRP - not just the NCA. The breadth here seems to contradict the previous paragraph. At a minimum, there would need to be some explanatory text saying that the NCA cannot fulfill its goals until we have a deeper understanding of climate.	29. Research Agenda for Climate Change Science		1036	2	Yes, all of the research goals are broad. We have rewritten the introduction to this goal and have mentioned that climate science underpins assessment.
Allison	Leidner	"Understanding …" uncertainties seems less appropriate than "characterizing" or "quantifying" uncertainties.	29. Research Agenda for Climate		1036	4	The text has been amended to address this suggestion.

			Change Science				
Allison	Leidner	It is not obvious why only "physical" is included and not "biological" as well. Either both should be included or there should be some statement as to why only physical is included.	29. Research Agenda for Climate Change Science		1036	4	The text has been amended to address this suggestion.
Allison	Leidner	It is unclear why this sentence is qualified with "for the nation" if this is referring to "future assessments, particularly the sustained assessments of the USGCRP …" If the USGCRP sustained assessments are global, then presumably global information would be needed. The "sustained assessments of the USGCRP" should not be considered to be the same as NCA - the "conduct sustained assessment" of the USGCRP should include all the assessments for which the USGCRP enables US participation.	29. Research Agenda for Climate Change Science		1036	12	This is no longer in the chapter.
Allison	Leidner	It is a little unclear as to whether or not the authors want to acknowledge that some of these could represent feedback effects and not just forcing functions. Right now, the way it is worded, the feedback component is not acknowledged. It may help to say something like "... that are directly caused by human activities" to allow for additional components from feedbacks.	29. Research Agenda for Climate Change Science		1037	1	Feedbacks are now mentioned in climate science goal, RG1 in relation to uncertainties in the climate system.
Allison	Leidner	As written, there is no direct climate link here – this type of goal could fit perfectly well in a CENRS SWAQ report focused on current conditions. A climate connection should be clearly stated.	29. Research Agenda for Climate Change Science		1037	17	This is no longer in the chapter. RG1 now has explicit climate connection throughout.
Allison	Leidner	"Explore options and actions …" does not constitute a "Research Goal". If the objective is to quantify required actions and/or potential impacts of externally provided options and actions, then this should be made clear. The term “explore” here could be interpreted to mean that scientists should investigate options, rather than answering “if/then” questions.	29. Research Agenda for Climate Change Science		1038	25	The text has been amended to address this suggestion.
Allison	Leidner	This should also include global, as our observation systems need to include global coverage.	29. Research Agenda for Climate Change Science		1039	18	The text has been amended to address this suggestion.
Allison	Leidner	It is strange to provide a direction for sea level ("sea level rise") when the others in the series are all just parameters with no direction provided. Simply saying "sea level" would be more consistent.	29. Research		1039	21	Now written as sea level changes except in impacts goal.

			Agenda for Climate Change Science				
Allison	Leidner	A wording change is needed, as monitoring is not a “data need”; rather, it is a process that creates long-term, consistent observations.	29. Research Agenda for Climate Change Science		1039	26	This is no longer in the chapter.
Allison	Leidner	The wording needs to be revised, as the NCA should be to provide the information that will help the nation anticipate, mitigate, and adapt. The NCA is not directly taking on the actual adapting that the nation does.	30. The NCA Long-term Process: Vision and Future Development		1047	13	Disagree. The NCA can assist the nation in various ways to anticipate, mitigate, and adapt to climate change. The provisioning of information is only one such mechanism. The sentence as written does not imply that the NCA is directly taking on adaptation activities. No changes were made to the chapter in response to this comment.
Allison	Leidner	It may be good to remind the reader of what some of these "accelerating changes" are or point the reader back to a place where they are presented (chapter 2).	30. The NCA Long-term Process: Vision and Future Development		1047	18	Agree. The following text was added on original line 19 on page 1047 after "these changes": "…(for example, the recent rapid reductions observed in the extent and thickness of Arctic sea ice)…"
Allison	Leidner	This statement should include an acknowledgement of the community needed to support these activities.	30. The NCA Long-term Process: Vision and Future Development		1047	27	Agree. The following text was added at the end of original line 30 on page 1047: "..., and 4) supporting the capacity of the assessment community to maintain such interactions."
Allison	Leidner	The "sustained assessment process" should also include the advancement of the science that enables successive assessments to be "better" - if the assumption is that the science is being done outside the assessment process, that should be explicitly stated.	30. The NCA Long-term		1047	31	Agree. Addressed by revising number 1) on original line 27 on page 1047 to read: "advancing the science needed to improve the assessment process

			Process: Vision and Future Development				and its outcomes, building associated foundational knowledge, and collecting relevant data;…"
Allison	Leidner	The "sustained assessment process" is not going to create these communities; rather, it will support these communities and leverage ongoing work. This sentiment should be reflected in the wording of this bullet point.	30. The NCA Long-term Process: Vision and Future Development		1048	32	Agree in part; however, it should be noted that the establishment of the NCAnet was a direct result of activities taken as part of the NCA. For number 5) on original line 32 on page 1048, "create" was changed to "Facilitate creation of, support, and leverage…."
Allison	Leidner	"Set priorities for their resolution" may go too far. It makes sense that a sustained assessment process should inform priority discussions, but it is not clear that the process can set priorities for the broader program. If this is not the intent, the wording needs to be changed.	30. The NCA Long-term Process: Vision and Future Development		1048	35	Agree. Changed "to set" on original line 35 on page 1048 to "...assist in setting...."
Allison	Leidner	Is the vision only to deal with the "knowledge about the intersection of human and natural systems" or does it also include knowledge about the "base" system? Or is that assumed to come from somewhere outside the sustained assessment process?	30. The NCA Long-term Process: Vision and Future Development		1049	3	The middle of the sentence on original line 3 on page 1049 was changed to read: "...build knowledge about human and natural systems and their interactions...," which implies reference to both initial (base) conditions of each system and then their interactions.
Allison	Leidner	It would be good to define what is meant by "very heavy events" - without such a definition, it is hard for the reader to know what this means.	16. Northeast		551	17	The text has been revised to incorporate this suggestion.
Allison	Leidner	The source of the image (satellite/sensor) should be listed so that the information is traceable.	16. Northeast		554	8	The text has been revised to incorporate this suggestion.
Allison	Leidner	This is a confusing mix of qualitative ("relatively rare") and quantitative ("an additional 5 days") information. It is confusing to give a "change" number on top of an unclear base - if being quantitative, one should be quantitative on both ends.	16. Northeast		557	16	We have modified the quantitative portion due to a switch to new heat event metrics and maps. After extended consideration, we have not

							removed the qualitative statement; for a region as diverse as the Northeast, the qualitative phrase is more inclusive than a precise number would be.
Allison	Leidner	Figure 2.27 Caption: Include satellite/mission from which images were captured.	2. Our Changing Climate		66	13	Per another reviewer comment, we have removed the two single-year satellite images of Lake Superior because they could be considered misleadingly representative of the adjacent years.
Allison	Leidner	Include satellite/mission from which image was captured.	3. Water Resources		123	3	We have replaced this image with a different image.
Allison	Leidner	Figure 16.4 Caption: Include satellite/mission from which image was captured.	16. Northeast		554	6	The text has been revised to incorporate this suggestion.
Allison	Leidner	Figure 16.4 Caption: Include satellite/mission from which image was captured.	16. Northeast		554	8	The text has been revised to incorporate this suggestion.
Allison	Leidner	Figure 16.4 Caption: Include satellite/mission from which image was captured.	16. Northeast		554	9	The text has been revised to incorporate this suggestion.
Allison	Leidner	Figure 16.6 Caption: Would be more appropriate to cite source as NASA/USGS Landsat 7.	16. Northeast		557	6	The text has been revised to incorporate this suggestion.
Allison	Leidner	Figure 16.8 Caption: Include satellite/mission from which image was captured.	16. Northeast		562	3	The text has been revised to incorporate this suggestion.
Allison	Leidner	Replace "satellite's" with "satellites".	20. Southwest		706	2	Thank you for pointing out this error. The text has been changed accordingly.
Allison	Leidner	Replace "data from satellite" with "data from satellites".	22. Alaska and the Arctic		776	17	The text has been revised to incorporate this suggestion.
Allison	Leidner	Figure 18 Caption: Include satellite/mission from which image was captured.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A		1086	10	Caption revised to incorporate this suggestion.

			to Z				
Allison	Leidner	Revise sentence, "Satellites also provided new capabilities for mapping precipitation and upper air temperatures, subject to uncertainties inherent in algorithms and instrument calibrations." The uncertainties inherent in other types of measurements are not mentioned. All should be consistently qualified.	Appendix: The Science of Climate Change		1128	12	The qualifier has been removed.
Allison	Leidner	"satellite estimates" should be changed to "satellite derived estimates"	2. Our Changing Climate		39	22	We have made the suggested change.
Allison	Leidner	Suggested rewrite for NASA activity: Action: Initiated NASA's Climate Adaptation Science Investigator (CASI) Workgroup to partner NASA climate modelers, scientists, engineers, and NASA institutional stewards to investigate climate impacts and explore potential adaptation strategies for NASA research centers and facilities. Description: The CASI team leverages internal NASA technical capabilities and resources to build capacity to address climate change, and has engaged in a range of activities since CASI's launch in the summer of 2010, including: 1) downscaling NASA center and facility-specific climate hazard information and projections for managing at a local scale; 2) conducting climate research customized to the needs of each location; and 3) leading resilience and adaptation workshops at NASA Centers that spur community-based responses tuned to local needs.	28. Adaptation	28.1	987		We thank the commenter for this suggestion and have made the change.
Allison	Leidner	In several places in the traceable accounts, there is a statement that "The key message and supporting text summarizes extensive evidence documented in the climate science peer-reviewed literature. Technical Input reports (82) on a wide range of topics were also reviewed; they were received as part of the Federal Register Notice solicitation for public input." The "(82)" is very confusing – does it refer to a technical report number or the number of reports? Either way, the technical reports should be cited.	2. Our Changing Climate				All technical inputs that were used by the authors will be cited in the final report. In this case, the 82 refers to the number of special reports developed as technical inputs from government agencies and other organizations as input to the NCA for the Climate Science chapter. These provided additional materials to consider iin the assessment process.
Allison	Leidner	The discussion of associations of ENSO with weather events in the US should include literature citations.	Appendix: The Science of Climate Change		1134	21	Added several references as requested.
Allison	Leidner	The listing of forces/factors should match the specific language in the bullets that follow (temperature vs. rising SST), and they should be specific. Are there research publications or peer-reviewed publications that point to ocean acidification as a more of a coastal vs. open ocean issue? If so, these publications should be listed. There is a link between ocean acidification and fisheries, but this link should be highlighted, as the general terms weaken the impact of the statements.	25. Coastal Zone Development and Ecosystems		869	31	We appreciate this suggestion, but space is limited. The author team has deliberated and agreed that adding additional specificity here as well as in the bullets would increase length and reduce space to specific points to be made.
Allison	Leidner	The last bullet mixes two topics: circulation and CO2. If the publication findings listed relate circulation and CO2 specifically in the two separate sentences, then this should be clarified.	25. Coastal Zone		870	31	After consideration of this point, we still feel the existing text is clear and accurate. The authors agree that the

			Development and Ecosystems				second sentence does not imply a relationship between circulation and acidification. Rather the link is that they both influence coastal fisheries. There is limited space in the chapter to make these two separate bullets and we think the combination of the two climate issues, both important to coastal fisheries, does not cause undue confusion.
Allison	Leidner	Another question to include here that could help explain climate change to the public is “How much of the climate change evidence described is actual observations versus the results of models?”	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z				Many of the existing questions refer to the strong observational basis for the concerns about climate change. In CAQ B, we added a sentence that the evidence that climate is changing comes from observations and the evidence that climate is changing because of human activity comes from observations AND basic physics AND models.
Allison	Leidner	The key message is mostly based on the PDSI, which is a somewhat dated measure that has received some criticism. It is now only one of many tools used in drought prediction. The text should focus on additional indicators and research, and should also acknowledge the drawbacks of the PDSI.	Appendix: The Science of Climate Change		1169	1	The discussion on drought has undergone substantial modification. The limitations of and statutory requirements of PDSI are discussed. Also, other measures of drought such as Consecutive Dry Days has been added.
Allison	Leidner	The message is important to convey, but should include more references that supports findings related to drought impacts on agriculture (such as the literature cited in the Agriculture and the Water Resources chapters).	Appendix: The Science of Climate Change		1169	1	Such references should be cited in the impacts chapters, not in a climate science chapter.
Allison	Leidner	The phrase "and are being studied intensively" should be removed from the key message to be consistent with other places in the report where the amount of research/level of funding for a given research area is not identified.	2. Our Changing Climate		59	7	The text has been revised to incorporate this suggestion.
Allison	Leidner	The question itself should be changed to “extreme and severe weather” since some of the phenomena on the list are not usually categorized as severe storms.	Appendix: NCA Climate Science - Addressing Commonly Asked Question		1090	1	Question does not say storm but indeed says "severe weather". Therefore no change was made in the chapter.

			s from A to Z				
Amanda	Babson	This statement makes it seem like the entire Plan is an adaptation strategy; it should clarify that parts of it support adaptation.	28. Adaptation		986	7	We thank the commenter for their response. We have added clarifying language.
Amanda	Babson	Since the map is not comprehensive, I don't see what value it provides, other than you found examples from a lot of different places. Can you add more info to the map like color coding the markers to what kind of project it is an example of (e.g. your steps of the adaptation process)? Is this idea that it will be interactive on the website to connect with the table? The map itself needs a Figure number.	28. Adaptation		1001	1	This comment is beyond the scope of what the authors were tasked with addressing. The map is mainly trying to display some of the geographic breadth of adaptation activities and not label where each discrete action is in regards to the broader adaptation process. Moreover, since the process followed by each entity can be unique, labeling actions may arbitrarily assign them a value in the process that is not reflective of their true place. As such, no change was made.
Meredith	Jagger	The authors of the "Human Health" chapter of the draft National Climate Assessment (NCA) should be credited for including mental health as an aspect of health threatened by climate change and for discussing the subject without engaging in the ablest discussion of mental health currently evident in other spheres of public discourse in the United States. However, the statement "first, mental health problems are common after disasters" (draft page 349, lines 17-18) is technically accurate but misleading. (Alternatively stating "physical injury and death are common after disasters" would not necessarily be useful). This statement elides the distinction between common emotional and psychological responses to stress following a disaster, preexisting poor mental health exacerbated by a traumatic event, and ongoing negative outcomes that are associated with disaster experiences. A common adage in disaster management is to describe the array of physical, behavioral, emotional, and cognitive responses seen in individuals impacted by disasters as "common reactions to abnormal events" (Halpern & Tramontin, 2007). (Note that "common" is now preferred over "normal"). Halpern and Tramontin suggest that these common normative responses do not necessarily indicate an individual is at risk for ongoing mental health problems (2007). On the other hand, some individuals impacted by disaster will develop ongoing mental (and physical) health problems, such as depression or PTSD (Fritze et al., 2008). Given the constraints of this format, adding a phrase to clarify "common after disasters" may be helpful to the diverse audience who will be referring to the final NCA.	9. Human Health		349	14	The authors appreciate this nuance. Change "First, mental health problems are common after disasters" (p 349, lines 20-21) to "First, following disasters, mental health problems increase, both among people with no history of mental illness and those at risk, a phenomenon known as "common reactions to abnormal events." These reactions may be short-lived or, in some cases, long-lasting."
Amanda	Babson	A suggested addition to the Barrier to Climate Change Information and Decision Making Section: Mismatch between time scale of future climate information (2100) and decision horizon (1-50 years).	28. Adaptation	28.7	1005		Thank you for your comment. While the timescale difference can be a barrier, more near term projections of climate change are available. This barrier was added to the table.
Amanda	Babson	There is an opportunity to say something more meaningful than just give examples of overcoming barriers. For instance, a lot of projects are done as pilots and are not repeated to learn from what happened when barriers were found. The Cape Cod transportation example is a great one that they are now soliciting for a next round of projects building on the pilot experience. I suggest you follow up with the Volpe Center so you can include something about what they are doing differently this time based on the lessons learned.	28. Adaptation		1006	13	Thank you for your comment. The authors have added the following sentence: "In many cases, lessons learned from initial pilot programs help inform future adaptation strategies."

Amanda	Babson	This report will be an excellent resource and reference for a range of audiences.					Thank you for your positive comment.
Amanda	Babson	The format for the Traceable Accounts sections does not work for every key message, and they may fit better in an Appendix.					Thank you for the suggestion. Because of the variety in the Key Messages, there is some variety in the content of the Traceable Accounts.
David	Reidmiller	The UCS 2007 citation is not included in the references for the Appendix. Please add it.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z	33	1112		Reference has been added.
Justin	Chu	The space of time between the release of greenhouse emissions and observable effects on the environment can be quite large. Even if measures at pollutant sources are taken to protect Arctic ice, will not our past actions and consumption habits for dirty energies mark doom for Arctic ice and permafrost, considering that much air pollution has occurred recently? Is the melting of such areas irreversible?	22. Alaska and the Arctic				This comment is inconsistent with the current state of the science on this topic. There is considerable speculation about whether changes in sea ice are reversible. See traceable accounts for key message 1
David	Reidmiller	The caption inaccurately states what was agreed upon internationally and needs to be revised accordingly.Under the G8 we agreed to the reductions stated - with no specified base year - if others took action to reduce emissions by 50% by 2050 (again against an unspecified base year). See para 65 of: http://www.g8italia2009.it/static/G8_Allegato/G8_Declaration_08_07_09_final%2c0.pdf "we reiterate our willingness to share with all countries the goal of achieving at least a 50% reduction of global emissions by 2050, recognising that this implies that global emissions need to peak as soon as possible and decline thereafter. As part of this, we also support a goal of developed countries reducing emissions of greenhouse gases in aggregate by 80% or more by 2050 compared to 1990 or more recent years."Under the UNFCCC, the US and other Parties have continued to reaffirm their commitment to limit warming to 2C above pre-industrial levels (Copenhagen, Cancun, Durban, Doha): "Further recognizes that deep cuts in global greenhouse gas emissions are required according to science, and as documented in the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, with a view to reducing global greenhouse gas emissions so as to hold the increase in global average temperature below 2 °C above preindustrial levels" (para 4 of FCCC/CP/2010/7/Add.1). However, there has never been an agreement to a pathway to getting there OR to a 2050 emissions reductions target.The UCS reference (http://www.ucsusa.org/global_warming/solutions/big_picture_solutions/a-target-for-us-emissions.html) states: "Given our aggressive assumptions about reductions by other nations and the fact that 450 ppm CO2eq represents the upper limit needed to avoid a potentially dangerous temperature increase, the United	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z	33	1112		The figure caption has been revised and the statement "a level agreed by international negotiations to be a limit above which impacts become more severe" has been removed.

		States should reduce its emissions at least 80 percent below 2000 levels by 2050."The authors need to take great care when they are trying to make a statement regarding what the US has agreed to in international negotiations so as not to mischaracterize previous decisions or to pre-judge future ones. Please amend the text accordingly in light of the information provided above.					
TRCS	TRCS	The Right Climate Stuff(TRCS) Research Team is submitting the following comments on the January 11, 2013 Draft National Climate Assessment(DNCA). Our comments address errors and misstatements in the DNCA Executive Summary, Report Findings, and the underlying chapters. As taxpayers, we expect full transparency as the process proceeds including posting of our comments, posting of the responses to our comments, and all changes in the DNCA resulting from our comments. We would also like to see every version of the report drafts beginning with Version 1 as well as all of the changes together with the names of those responsible for revising the report. The details of our comments can be found at: http://www.therightclimatestuff.com/AGW Science Assess Rpt-1.pdfor on our website at: http://www.therightclimatestuff.com/ and select Anthropogenic Global Warming Science Assessment ReportThe Right Climate Stuff (TRCS) research team is a volunteer group of more than 20 scientists and engineers who are primarily retired veterans of our manned space program. We began our investigation into the controversial issue of Anthropogenic Global Warming (AGW) in February 2012. We have reviewed, studied and debated available data and scientific reports regarding many factors that affect temperature variations of the earth's surface and atmosphere. We note that our assessment report used more current papers and data than was used in the DNCA. We have also studied the well-documented beneficial, as well as potentially detrimental effects, of more CO2 in our atmosphere. Here is a summary of our comments: 1. Contrary to the DNCA, The science that predicts the extent of Anthropogenic Global Warming is not settled science. 2. There is no convincing physical evidence of Catastrophic Anthropogenic Global Warming. Most of the alarm regarding AGW results from output of unvalidated computer models. We understand scientific arguments regarding how doubling CO2 in the atmosphere over a hundred years or more (if possible) can have a small direct warming effect, but we question the accuracy of feedback simulations in current models computing climate system responses that amplify CO2 effects. Efforts to estimate climate sensitivity to CO2 based solely on physical data have large uncertainties because many factors affect global temperatures, and CO2 levels rise in the atmosphere after the earth warms due to other factors. While paleoclimate data clearly show CO2 levels rise and fall in the atmosphere hundreds of years after temperature rises and falls due to other causes, the evidence is very weak to support claims of a catastrophic rise in global temperatures caused by CO2 emissions related to human activity. 3. Computer models need to be validated before being used in critical decision-making. Our manned aerospace backgrounds in dealing with models of complex phenomena have convinced us that this rule must be followed to avoid decisions with serious unintended consequences. 4. Because there is no immediate threat of global warming requiring swift corrective action, we have time to study global climate changes and improve our prediction accuracy. While there are many benefits due to some global warming, the major threats appear to be associated with a net loss of	1. Executive Summary				Thank you for your comments. All of the comments and responses to comments will be posted for review when the report is finalized, and all of the people responsible for reviewing the report will be named. We respond here to the substance of your summary, but the climate science chapter and the associated appendices and references contain the evidence used by the authors in coming to their conclusions. There are now more than 20 global circulation models developed and used by teams in multiple countriies that are tested and validated by teams of independent scientists. The limitations as well as the utilities of these models are well understood by those who build and use them on a regular basis. Many of the conclusions in this report are based on actual observations of change, not only on models that represent physical processes. If the only changes being observed were gradual, there would be less cause for concern; however, the number and intensity of climate and weather events is also changing and this is much more difficult to adapt to. The authors agree that investment in alternative energy sources has many advantages.

		Greenland and Antarctica ice sheet mass that would contribute to a gradual sea-level rise. The history, current trends, and specific causes of ice sheet melting and ice accumulation by precipitation must be better understood before determining how best to respond to threats of accelerated sea-level rise. 5. Our US government is over-reacting to concerns about Anthropogenic Global Warming. More CO2 in the atmosphere would be beneficial for forest and crop growth to support the earth's growing population, so control of CO2 emissions is not an obvious best solution to hyped-up concerns regarding AGW. Eventually the earth will run out of fossil fuels and alternative energy sources will be required. Market forces will (and should) play a big role in this transition to alternative energy sources. Government funding of promising research and development objectives for alternative fuels appears to be a better option at this time than expenditures of enormous resources to limit CO2 emissions. 6. A wider range of solution options should be studied for global warming or cooling threats from any credible cause. CO2 effectiveness in controlling global average temperatures or sea levels has not been established. More reliable and greater control authority may be available from engineering solutions that would accommodate the beneficial aspects of more CO2 in the atmosphere.					
David	Reidmiller	This statement is inaccurate: "The current U.S. contribution to global emissions is about 20%."According to IEA's CO2 Emissions from Fuel Combustion 2012 report, Part III "Greenhouse Gas Emissions" (i.e., the table sin the back of the report that also list CH4, N2O and F-gas emissions) shows that World emissions of all 6 Kyoto Protocol gases (CO2, CH4, N2O, HFCs, PFCs, and SF6) in 2010 were 49503 Mt CO2e. Emissions of the same 6 GHG in the U.S. in 2010 were 6656 Mt CO2e. This results in the U.S. contributing 13% of current total global GHG emissions. (For comparison, the biggest emitter, China, contributes 22% [10740 Mt CO2e] of current total global GHG emissions).	1. Executive Summary		6	21	Thank you for the comment. The sentence has been revised with the correct value.
David	Reidmiller	The current text is not quite accurate with the numbers it uses: "To meet the rapid emissions reduction (B1) scenario used in this assessment, global mitigation actions would, within the next 25 years, need to limit global greenhouse gas emissions to a peak of around 44 billion tons of carbon dioxide per year. In 2011, global emissions were around 37 billion tons, and have been rising about 0.9 billion tons per year for the past decade. The world is therefore on track to exceed this level within a few years."Where is the 37 Gt coming from? Is that energy CO2 only? Or all GHG? Either way, the nubmer seems incorrect. Accordingly to IEA's CO2 Emissions from Fuel Combustion report, Part III. Greenhosue Gases, global fuel combustion CO2 in 2010 were 30.3 Gt CO2. Total global GHG (all CO2, Ch4, N2O and F-gases) was 49.5 Gt CO2e. Please revise the text accordingly.	27. Mitigation		955	24	The GHG numbers are corrected to be consistent with the Global Carbon Project.
David	Reidmiller	This statement about US emissions projected to continue to rise is not supported by the the objective assessment made by DOE's Energy Information Administration. See the Annual Energy Outlook. See Figure 4 here: http://www.eia.gov/forecasts/aeo/er/pdf/0383er(2013).pdfAnd revise the text accordingly.	27. Mitigation		955	30	Concerning emissions projections, EIA projections to 2040 offer the possibility that CO2 emissions could remain roughly constant. However, after consideration we still consider the Key Message clear and accurate.
David	Reidmiller	Clarify over what timescales this natural forest sink is expected to decline and to what degree.	27. Mitigation		955	36	The text is clear that "a few decades" is the time span, but it is not possible to be significantly more precise.
David	Reidmiller	This bulleted list has some glaring omissions, such as the RGGI regional trading program in the NE and California's AB32 and its assocaited trading plan. Either state that this list is illustrative or include many, many more examples.	27. Mitigation		962	28	RGGI and others are covered under the Regional Agreements web-site reference and is mentioned in the text.
David	Reidmill	This statement is inaccurate: "The current U.S. share of global CO2 emissions is about 20%."According	27.		964	36	This number has been corrected to be

	er	to IEA's CO2 Emissions from Fuel Combustion 2012 report, Part III "Greenhouse Gas Emissions" (i.e., the table sin the back of the report that also list CH4, N2O and F-gas emissions) shows that World emissions of CO2 in 2010 were 37602 Mt CO2. Emissions of CO2 in the U.S. in 2010 were 5477 Mt CO2e. This results in the U.S. contributing 14% of current global CO2 emissions. (For comparison, the biggest emitter, China, contributes 22% [8321 Mt CO2] of current global CO2 emissions).	Mitigation				consistent with IEA estimates.
David	Reidmiller	The authors should refer to the 5th U.S. Climate Action Report (CAR5) undertaken by the USG to fulfill commitments under the UNFCCC on reporting of various policies and meaures (Ch 4) at the national and suib-national level. CAR6 is currently being prepared with EPA (Stacey Angel, I believe) being charged with drafting Ch 4 (Policies and Measures). It would be worth reaching out to her to ensure these two documents present consistent information.	27. Mitigation	27.1	968		Information from this reference has been incorporated into the text.
David	Reidmiller	The authors should refer to the 5th U.S. Climate Action Report (CAR5) undertaken by the USG to fulfill commitments under the UNFCCC on reporting of various policies and meaures (Ch 4) at the national and suib-national level. CAR6 is currently being prepared with EPA (Stacey Angel, I believe) being charged with drafting Ch 4 (Policies and Measures). It would be worth reaching out to her to ensure these two documents present consistent information.	27. Mitigation	27.2	969		Information from this reference has been incorporated into the text.
David	Reidmiller	A key reference here that should not be excluded is the Susan Solomon-led NRC report, "Climate Stabilization Targets" from 2011.	27. Mitigation		971		We've included the reference.
David	Reidmiller	The numbers cited for how much the world is currently emitting seems off. Total global GHG emissions in 2010 were about 49.5 Gt CO2e with global fuel combustion CO2 emissions being 30.3 Gt CO2 (see: IEA, CO2 Emissions from Fuel Combustion, 2012), so it's unclear where this 37 Gt number continues to come from.	27. Mitigation		972		Numbers have been corrected to be consistent with IEA.
David	Reidmiller	It's misleading to simply state that "...in the absence of additional public policies greenhouse gas emissions are expected to continue to rise." As EIA's Annual Energy Outlook 2013 shows, through 2040, emissions will continue to be 5% below 2005 levels. So, yes, they are slated to increase, albeit at very slow rates which are projected to remain well below peak US levels even without additional policies and measures over the next 30 years.	27. Mitigation		973		We have corrected this statement to be consistent with the latest EIA analysis.
David	Reidmiller	Please clarify by how much and over what timescales the natural carbon sinks via forests is projected to decline.	27. Mitigation		974		The text is clear that "a few decades" is the time span, but it is not possible to be significantly more precise.
Zach	Berzolla	While on page 565-566 in Chapter 16 you talk about culverts in quite a bit of detail, I believe it will work better if you put culverts into the bigger picture of climate change. The heading says that culverts are used as adaption, and are "atop a wish list for help in adapting to climate change" but I believe that there is information that needs to be added in that culverts can only do so much. I believe adding in something like: “Bigger culverts are great examples of short-term solutions meant to funnel storm water away from built-up areas, but they prove, in addition, as an example of a short-term solution that will not stand up to future changes. Rising sea levels can leave culverts without a flowing exit, potentially backing up and flooding the streets that were supposed to be emptied.I did not do a great job of phrasing it, but I believe you must include some conversation about culverts, and although you can increase the size, when there is no place for the water to go, larger, newer, culverts, will not help. But, the work on the culvert governance map is a great example of working together across boundaries to find solutions to climate change.	16. Northeast		565	16	The text has been revised to incorporate this suggestion.
VASEEE	VASEEE	These are comments related to extreme weather events. The errors and factual inaccuracies need to be corrected. Apparently the same misinformation was provided to President Obama for use in his	1. Executive				Thank you for your comments. Evidence related to extreme events is

		State of the Union address. The Data Quality Act requires that the White House must post the corrections on the official web site. The text is entered below. To see the figures that COULD NOT BE ENTERED AS COMMENTS go to the link: Fact checking analysis on the claims being made about severe weather related to warming (which stopped 15 to 17 years ago) http://icecap.us/images/uploads/NCA_DAleo_04-12-13.doc The failure to provide a fully transparent and user-friendly public comment portal (regulations.gov)raises the question of whether the USGCRP has intentionally tried to limit the comments. Fact Checking: the Truth about Extreme Weather Joe D'Aleo, Certified Consulting Meteorologist February 26, 2013 "The truth is the truth even if nobody believes it, and error is error even if every everyone believes it." Bishop Fulton J. Sheen I have been an operational meteorologist/climatologist for over 40 years. I have been a college professor, a co-founder and first Director of Meteorology at The Cable TV Weather Channel, and chief meteorologist for three other companies for 26 years.I was active in the largest professional society, the AMS. I was elected a fellow of the AMS and earned the Certified Consultant Meteorologist seal. I chaired the AMS Committee on Weather Analysis and Forecasting. I was elected a councilor, the only private sector meteorologist to ever achieve that. I was part of a group of scientists that showed in an Amicus brief to the DC Circuit Court that EPA's "three lines of evidence" – warming was increasing and global, that extremes are increasing and the IPCC models are accurate and can be used for forecasts -- are each grossly flawed. Even stronger science will be presented to the Supreme Court if the Court agrees to review the DC Circuit dispute.QUICK FACT CHECK ON CLAIMS BEING MADE We have heard the same justification before: "Unless we announce disasters no one will listen." -Sir John Houghton, First chairman of the IPCC President Obama: '… the 12 hottest years on record have all come in the last 15' First, temperatures have flat-lined for over a decade with no statistically significant warming for up to 17 years. NASA's James Hansen even admitted 'Mean Global Temperature Has Been Flat For The Last Decade'. THE UN's climate change chief, Rajendra Pachauri, has acknowledged a 17-year pause in global temperature rises, confirmed recently by Britain's Met Office. All of the data sets confirm the pause: satellite data, land surface data, sea surface data and balloon data.SERIOUS DATA INTEGRITY ISSUES You may recall that NOAA was scolded by the GAO for allowing 41% of their climate observing stations to degrade so they no longer met minimum standards for accuracy as established by the WMO. There is evidence of other ways the data that NOAA has compiled and is used by NASA and Hadley in their analysis is flawed. It appears to be intentional because every change made results in more apparent warming, in large part by cooling off the past.	Summary				documented in several recent sources (see climate science chapter and associated appendices). The comment portal was actively monitored throughout the comment period to ensure that users were not experiencing difficulties and we are not aware of any individual who was unable to submit their comments through the system. The National Climatic Data Center maintains the official climate records for the US and the sources used for climate science chapter conclusions are all cited within the chapter itself and in the climate science appendices. There is no doubt that the urban heat island effect is real; however, the official US climate data have been carefully scrutinized to ensure that overall temperature records are not biased by proximity to urban areas. The conclusions related to droughts and floods have been carefully scrutinized to ensure that the language in the report is accurate. Although the number of wildfires has declined, the size and total acreage burned has increased dramatically in recent decades. There is no conclusion related to tornado frequency and links to climate change in this report. The authors do not claim that Superstorm Sandy was directly caused by climate change, but this storm provides excellent evidence of coastal vulnerability and infrastructure impacts associated with extreme events. Significant changes have been made to the climate science chapter to explain the relationship between recently observed temperatures and long term trends. In addition, there are multiple sources of evidence that show that recent temperature trends cannot be explained by solar variability, volcanoes, and other naturally occurring phenomena. The authors respectfully disagree with this

		As for why the temperatures are ranking now always high: It can be shown the data centers have flawed data sets and have, multiple times, modified the data to cool the past and warm the recent data to achieve the politically desired result. NCAR's Kevin Trenberth, IPCC author and AMS spokesman said, "It's very clear we do not have a climate observing system...This may be a shock to many people who assume that we do know adequately what's going on with the climate, but we don't." As of 2000, the US climate data had an adjustment for urbanization (artificial heat islands) and despite its warts, was widely regarded as the best data set globally. As of 1999, it showed no warming, just cyclical change.Findings from a large body of peer review papers including papers by Tom Karl, head of NOAA's National Climate Data Center(NCDC) (whose urban adjustment was used in that data set) and Phil Jones of the UK Hadley Center, suggest adjustment to account for this urban warming is necessary to assess real background trends accurately. "Across the U.S. as a whole, approximately 50 percent of the warming that has occurred since 1950 is due to land use changes …rather than to the emission of greenhouse gases. Most large U.S. cities, including Atlanta, are warming at more than twice the rate of the planet as a whole ..." Brian Stone 2009 Georgia Tech. The plot below (Dr. Ed Long NASA) shows the trends of rural and urban data that show the problem beginning in 1965.Blue is rural, purple urbanAnother problem showed up: the US data (figure a) was corrected for urban heat affects while the global data (figure b) was not.But NOAA tired of having to explain why their U.S. data set with the urban adjustment showed no warming, while the global data sets (which made no urban adjustment) did. So in 2007 they came out with a new version of the US Climate Network data that removed the urban heat island adjustment. In the process they cooled off the past and warmed recent years.President Obama: 'Heat waves, droughts, wildfires, and floods – all are now more frequent and intense' Contrary to what the President said, there are not heat records - if you only look at stations that were around 80 years ago during the prior warm periods. Last July was hot but not more so than the Dust Bowl1930s or 1950s.Source Dr.John Christy Data NCDC USHCNDROUGHTS: NO TRENDS IN THE LAST 100 YEARSDuring a recent Senate "briefing" the AMS's Marshall Shepherd said droughts today are different because they persist longer. This is pure fiction. The Dust Bowl 30s had a decade long drought and the drought in the 1950s lasted 7 years. Drought was shown (McCabe and Betancourt (2004)) to be related to ocean cycles, especially the Atlantic – and was much more likely with the current combination of Atlantic and Pacific ocean patterns – which occurred last in the 1950s. FLOODS HAVE NOT INCREASED "US floods have not increased over a century or longer (same globally)". Dr. Roger Pielke Jr referencing IPCC's 2012 Special Report on Weather Extremes(SREX) WILDFIRES ARE DECLINING					perspective ("THEIR OWN WORDS SHOW ITS NOT ABOUT SCIENCE:").

The National Interagency Fire Center reports the number of annual wildfires in the United States has been declining for more than 30 years.

TORNADO OUTBREAKS IN 2011 BLAMES ON GLOBAL WARMING

When a series of major deadly, spring tornado outbreaks occurred in 2011, alarmists quickly blamed global warming. Actually Global warming – where the higher latitudes warm more than lower, would reduce the contrast of temperatures that powers the jet streams that produces tornado outbreaks. It is only during a cooling when the gradients are tightened and the jet stream stronger that outbreaks are more frequent and deadly. In 2011, following the second strongest La Nina, the result of a strong cooling in the Pacific, the number of tornadoes increased. In 2012 in a warm rebound year, the number fell. Note the large number of tornadoes in the cold period of the late 1950s to 1970s.President Obama: 'We can choose to believe that Superstorm Sandy….a freak coincidence…"

"It doesn't matter what is true, it only matters what people believe is true." -Paul Watson, Co-founder of Greenpeace'

Sandy was neither unique nor extreme. Most all hurricanes undergo conversion to extratropical lows (ask anyone from the Canadian Maritimes or UK). The East Coast has seen many more substantial hurricane strikes. Hurricane frequency, intensity and landfall probabilities are all cyclical in nature – we had 8 major landfalls on the east coast in the last active period from the 1930s to 1960. Again this is related to ocean cycles.

Hurricane direct hits on NYC occurred in 1815, 1821 and 1893 in prior active periods. The 1821 was the worst since 1800. But it came at low tide(six foot swing). Sea levels coming out of the mini ice age were about a foot lower. 152,000 people lived in NYC then versus 8.2 million today.

Adjusting the 1821 (a Category 3 hurricane) hurricane for the same conditions as Sandy (a borderline Category 1 storm) yields a surprising comparison.If the great 1938 Category 3 hurricane had come ashore 80 miles to the west at high tide, the surge would have topped easily 20 feet in New York City.

Globally hurricane frequency is at a 30 year low and US intense hurricane landfalls are currently in the longest lull (7 years+) ever documented.SNOW INCREASING NOT DECREASING

NOAA, NCAR, IPCC (and parroted by UCS) had all projected a decrease in snow for the hemisphere and snowstorms for the major cities as they tend to be near the critical 32F in winter. Instead we have seen an increase in snow throughout the hemisphere (4 of the top 5 snow years this last decade) with an upward trend since the 1960s.

And since 2000 we have had 18 major impact snowstorms (NOAA North East Snow Impact Scale) for major cities from DC to PHL to NYC to BOS. Increases in snowstorms are characteristic of a climate that is turning colder – like the 1960s. The same is happening in Europe where cold and snow has hit for 5 straight years. This is also related to ocean and solar cycles.In Europe, scientists are said to be stumped, baffled and confused by the unexpected developments, which completely contradict their super computer models. Even James Hansen has said climate models have overdone warming.

CO2 IS RISING, BUT NOT TEMPERATURES

Most obvious is that temperatures have not risen for 16 to 17 years while CO2 has risen 9%. Temperatures have correlated positively with CO2 trends less than half the time in the period from 1895 to 2012.Kevin Trenberth says they can't account for the lack of recent warming and that it is a travesty that they can't. (famous climategate e-mail). Kevin, we can. The cycles in the sun and oceans fit the temperature cycles (and the extremes of weather) to a tee. We are most like the 1950s and 1960s – when numerous hurricanes hit the east coast, when there was central drought, and big winter snow years.

TEMPERATURES TRACK NATURAL PHENOMENA

The historical temperature record correlates to natural phenomena. The upper left chart shows multi-decadal cycles in the Pacific (PDO) and the Atlantic (AMO) versus temperature. The lower right shows that the Total Solar Irradiance (TSI) is in sync with the ocean cycles. The IPCC is only now (AR5) accepting that the sun may be a significant factor as has long been argued by critics of the IPCC.If you account for the full effects of the sun, including the visible spectrum, the UV spectrum, cosmic ray effects on lower clouds and geomagnetic storms, the total solar effect is substantially greater than the IPCC admits.The IPCC has assumed the relative importance of the sun based on a primitive assessment. If one corrects the sun impact for other larger effects other than the observed visible spectrum effects, the actual impact overwhelms the “human activities” effects, which the behavior of temperatures suggests is overstated.Yes, but what about the arctic ice?

The International Arctic Research Center at the University of Alaska Fairbanks, has shown arctic warming and changes to ice cover is cyclical with similar warming and reduction of ice in the 1930s to1950s. Its cycle matches these same cycles in the ocean and sun.What we have presented and could add falsifies the greenhouse theory according to the famous physicist Richard Feynman. http://www.youtube.com/watch?v=EYPapE-3FRw&feature=player_embeddedTHEIR OWN WORDS SHOW ITS NOT ABOUT SCIENCE:

"In searching for a new enemy to unite us, we came up with the idea that pollution, the threat of global warming, would fit the bill." Club of Rome First Global Revolution

“Urgent and unprecedented environmental and social changes challenge scientists to define a new social contract…a commitment on the part of all scientists to devote their energies and talents to the most pressing problems of the day, in proportion to their importance, in exchange for public funding”. NOAA exiting Administrator for NOAA Dr. Lubchenko when she was president of AAAS in 1999 (explains NOAA’s obsession with ‘finding’ warming, extremes)

No matter if the science of global warming is all phony ... climate change provides the greatest opportunity to bring about justice and equality in the world." -Christine Stewart, Canadian Environment Minister

“We have got to ride the global warming issue. Even if the theory of global warming is wrong, we will be doing the right thing in terms of economic and environmental policy.” Timothy Wirth, U.S. Senator, president of the United Nation’s Foundation

“One has to free oneself from the illusion that international climate policy is environmental policy.” Instead, climate change policy is about how “we redistribute de facto the world’s wealth.” UN IPCC official Ottmar Edenhofer 2010

		In Eisenhower's Farewell Address remembered for concerns about the military industrial complex, he was also concerned about science becoming corrupted for political and economic gain. "The prospect of domination of the nation's scholars by Federal employment, project allocations, and the power of money is ever present – and is gravely to be regarded."					
Peter	Marra	For all plants and animals, events throughout the year can affect a species' ability to survive. This includes carry-over effects between wintering-ground climate (including climate change-related events) and breeding-ground survival and reproductive success. For migratory animals, this can involve interactions between widely disparate regions such as South America and the U.S.A. This is a very important point to make that is usually overlooked, and we suggest adding text that explains this complexity, particularly for migratory animals. Understanding how climate change affects individual species or suites of species requires year-round knowledge about climate and biology, including how events between seasons may interact and influence each other. References: Radchuk, V., C. Turlure, and N. J. Schtickzelle. 2012. Animal Ecology. http://dx.doi.org/10.1111/j.1365-26562012.02029.x. Rockwell, S., C. Bocetti, and P. P. Marra. 2012. The Auk 129: 774-752. Studds, C. E. and P. P. Marra. 2011. Proc. R. Soc. B 278: 3437-3443. Wilson, S., S. L. LaDeau, A. P. Tottrup, and P. P. Marra. 2001. Ecology 92: 1789-1798. Zipkin, E. F., L. Ries, R. Reeves, J. Regetz, and K. S. Oberhauser. 2012. Global Change Biology 18: 3039-3049.	8. Ecosystems, Biodiversity, and Ecosystem Services		296	20	No change. This point is made pretty well, with some specific examples in the "seasonal timing" section.
Peter	Marra	There is a critical need to assess vulnerability of species throughout their entire annual cycles. Most vulnerability assessments currently in use by land managers and researchers focus on a single, short, time period (e.g. the breeding season). However, events during other time periods can have significant impacts on a species' ability to survive and reproduce. The lack of full life cycle vulnerability assessments is most pronounced for migratory animals. This is probably because they are under the jurisdiction of North American land managers for a limited time each year. However, even though life cycle events are occurring far away and sometimes in different countries, they can dictate a species' persistence and the ability of land managers to effectively conserve individual species or suites of species. For this reason, information on migratory connectivity (i.e. understanding where specific populations spend each part of their annual cycle) is very important for assessing vulnerability of migratory species to climate change. We suggest adding text that explains this complexity and warns against using overly simplistic vulnerability assessments. Understanding how climate change affects individual species or suites of species requires year-round knowledge about climate and biology, including how events between seasons may interact and influence each other.References:Radchuk, V., C. Turlure, and N. J. Schtickzelle. 2012. Animal Ecology. http://dx.doi.org/10.1111/j.1365-26562012.02029.x. Rockwell, S., C. Bocetti, and P. P. Marra. 2012. The Auk 129: 774-752. Small-Lorenz, S. L., L. A. Culp, T. B. Ryder, T. C. Will, and P. P. Marra. 2013. Nature Climate Change 3: 91-93. http://www.nature.com/nclimate/journal/v3/n2/full/nclimate1810.html.Studds, C. E. and P. P. Marra. 2011. Proc. R. Soc. B 278: 3437-3443. Wilson, S., S. L. LaDeau, A. P. Tottrup, and P. P. Marra. 2001. Ecology 92: 1789-1798. Zipkin, E. F., L. Ries, R. Reeves, J. Regetz, and K. S. Oberhauser. 2012. Global Change Biology 18: 3039-3049.	8. Ecosystems, Biodiversity, and Ecosystem Services		299	5	Added a paragraph which points out this complexity and cites the Battin et al article as one example of a full life cycle analysis.
Peter	Marra	RE: Figure 8.4 / Box 2 (pages 302-305)Understanding how climate change affects individual species or suites of species requires year-round knowledge about climate and biology, including how events between seasons may interact and influence each other. We suggest an example be added to the list in Box 2 and map in Figure 8.4 that illustrates this complexity. The Kirtland's warbler is a great example for demonstrating carry-over effects and seasonal interactions. It also highlights some of the complications inherent in migratory animals. In addition, it illustrates the need to assess vulnerability throughout the entire annual cycle and the importance of migratory connectivity information. CARRY-OVER EFFECTS OF WINTER CLIMATE ON SPRING ARRIVAL DATE AND REPRODUCTIVE SUCCESS IN THE	8. Ecosystems, Biodiversity, and Ecosystem Services	8.4	302		We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include in this chapter.

		ENDANGERED MIGRATORY KIRTLAND'S WARBLER: The Federally endangered Kirtland's warbler is a long-distance migratory songbird that breeds in Michigan and overwinters in the Bahamas. Research shows that climate change occurring in the Bahamas affects the ability of the Kirtland's warbler to successfully reproduce and maintain its population in Michigan: drier winters in the Bahamas are significantly associated with lower reproductive output (Rockwell, et al. 2012. The Auk 129: 774-752). Because climate models predict increasingly dry conditions in the Bahamas, this could have negative effects on Kirtland's warbler population growth in Michigan and limit its ability to maintain a viable population size. Reference:Rockwell, S., C. Bocetti, and P. P. Marra. 2012. The Auk 129: 774-752.					
VASEEE	VASEEE	These comments relate to the underlying science in the report relating to ozone, warming and health effects. The references to the human health issue in the Executive Summary are wrong and must be corrected. The full report with graphics is posted.Review and Critique of the Environmental Protection Agency's Analysis and Conclusions Regarding the Effect of Climate Change on Future Ozone Levels and Ozone-Related Health Effects Joel Schwartz 2012 Introduction This report presents a review and critique of EPA's analysis and conclusions regarding the effects of climate change on future ozone levels (EPA 2009c; EPA 2009a; EPA 2009b). Our findings can be summarized as follows: With or Without Climate Warming, Ozone Will Decline Substantially in the Future. The lesson of the past few decades is "higher temperatures, lower ozone." Ozone declined all over the U.S., with the greatest improvements occurring in the most polluted areas of the country. The ozone declines were due to reductions in ozone-precursor emissions. Already-adopted measures will eliminate the vast majority of remaining ozone-precursor emissions during the next few decades, resulting in continued ozone reductions, even if the climate warms in the future. EPA's ozone modeling exaggerates both future ozone levels and the absolute effect of climate change on future ozone levels. The studies EPA relies on for predictions of future ozone levels generally use ozone-precursor emission inventories from somewhere between 1996 and 2001 to "predict" ozone levels in the 2050s or 2090s. These studies are trying to predict the effect of warming on ozone levels in the 2050s using an ozone-precursor emissions inventory that is twice as high as current emissions and about ten times greater than likely ozone-precursor emissions in the 2050s. The use of such unrealistic scenarios renders EPA's ozone modeling invalid as a guide to the effects of climate warming on future ozone levels. Both modeling and observations suggest that ozone-precursor reductions between the late 1990s and 2011 have already eliminated most of the "climate penalty". Since ozone-precursor emissions are dropping rapidly, whatever climate penalty remains will likely disappear within a decade or two, as most remaining ozone-precursor emissions are eliminated by already-adopted measures. EPA implies that the Clean Air Act requires EPA and states to allow ozone to increase to dangerous levels before they can take action to reduce ozone, and that this means warming has to cause harm before EPA can do anything about it. While this may, in principle, be the legal structure of the Clean Air	9. Human Health				Policy issues are beyond the defined scope of the National Climate Assessment, a scientific document that provides the basis for decision making but does not address policy. After consideration of the suggestions provided, the chapter's air pollution text and citations were updated, along with the Traceable Account for Key Message 1, to reflect and hopefully clarify some points raised about factors that affect uncertainty in projecting ozone concentrations, under a changing climate. Commenter's points about the complexity of atmospheric processes associated with ozone formation and climate change are well taken. Nationally, average 8-hour ground-level ozone concentrations were 17 percent lower in 2010 than in 1990, according to EPA (US EPA 2012), which is indeed a great improvement as noted. However, those are average national values and unhealthy ozone levels persist in some areas, despite clean air progress. An estimated 108 million people live in counties with 8-hour ozone concentrations above the current health-based National Ambient Air Quality Standard (NAAQS) of 0.075 ppm in 2010. Ozone can have adverse effects on public health even at low levels (Bell et al. 2006). Besides the role of ozone precursor emissions, weather affects the formation of ground-level ozone, as do other factors that include: rising baseline ozone levels from global sources (mainly NOX and methane); possible

		Act, it has little to do with the reality of how measures to reduce ozone precursors have been and are implemented. EPA has been pre-emptively reducing ozone-precursor emissions for decades in all areas of the U.S. and will continue to do so. Local and state governments are taking additional actions to reduce the few sources of ozone precursors that are not under federal control. There has not been, is not now, nor will there be in the future any location in the country that is just sitting around waiting for ozone levels to rise. Ozone at current, historically low levels is not a significant human health concern, and future ozone levels will be much lower, regardless of climate warming. EPA's claims for ozone's most serious health effects—premature death and respiratory and cardiovascular hospitalizations—are based on the results of observational epidemiology studies. However, in cases where observational studies have been tested against randomized controlled trials, the observational study results are nearly always falsified. Laboratory studies with several different animal species show that animals do not die, even when exposed for the equivalent of many years to ozone at levels nearly ten times greater than the highest ambient levels. These results make it biologically implausible that ozone at real-world outdoor levels could be causing premature death in humans. Studies of low-level ozone exposure with human volunteers demonstrate that an 8-hour standard of 85 ppb is more than stringent enough to protect human health with an adequate margin of safety, even from the most mild health effects EPA claims for ozone. In its characterization of ozone's health effects, EPA selectively emphasizes studies and portions of studies reporting harmful ozone effects, while downplaying studies reporting no effects or apparently protective ozone effects. This creates an impression that the evidence for harm from ozone at real-world levels is far more robust and consistent than the full weight of the evidence suggests. The overall result of the above considerations is that the 85 ppb 8-hour ozone standard protects human health with plenty of room to spare. Peak annual ozone levels are already below this level in about 90 percent of the country. Continued ozone-precursor reductions will ensure that the entire country will be well below this level by the time any significant additional warming occurs. Thus, even if warming causes ozone to decrease a bit less than it otherwise would have, future ozone levels around the U.S. will still be below a level of concern for human health, with or without climate warming. Taken together the weight of the evidence indicates that EPA has exaggerated both future ozone levels and the effects of warming on ozone levels. In reality, future ozone levels will be below a level of concern for human health, regardless of whether the climate warms. 1 With or Without Climate Warming, Ozone Will Decline Substantially in the Future Even if EPA is correct about how much the climate will warm and the effect of warming on ozone levels, the worst-case scenario in a warming climate is the following: ozone will decrease substantially during the 21st Century with or without climate warming, however, ozone will decrease slightly less substantially if the climate warms as much as EPA claims it will. We can draw this conclusion for the following reasons: (i) During the last few decades this is exactly what has happened. The U.S. climate warmed about 2°F, but ozone dramatically declined. Areas with					future increases in less stringently-regulated precursor emissions from shipping; uncertainty about the sensitivity of ozone formation chemistry to methane emissions; and climatic warming (Fiore et al. 2012). All these factors can affect regional ozone concentrations and potentially lengthen the ozone high-pollution season, despite precursor emissions reductions. Taken together, this means that ozone concentrations don't change in direct relation to precursor emissions, given ozone's complex formation chemistry.

the worst ozone achieved the greatest improvements. Ozone declined because ozone-precursor emissions declined.

(ii) The fact that peak ozone levels and ozone exceedance days have dropped even as the climate has warmed, shows that ozone formation is becoming less and less sensitive to temperature. (iii) Ozone-precursor emissions will continue to dramatically decline. Just as in the past, the result will be continued declines in ozone, even with warming. To the extent any significant warming occurs in the next few decades, nearly all anthropogenic ozone-precursor emissions will have been eliminated, mitigating concerns over the effect of warming on ozone levels.

1.1 Between 1970 and the present, the U.S. climate warmed about 2°F, yet ozone dramatically declined. The lesson of past experience is "higher temperatures, lower air pollution."

Past experience shows that reducing ozone-precursor emissions reduce ozone, regardless of whether the climate warms. EPA itself reports dramatic declines in ozone during the last few decades, despite climate warming over the same period. EPA's Technical Support Document (TSD) for its Endangerment Finding states, "According to studies cited in Karl et al. (2009), the annual average temperature in the Northeast has increased by 2°F (1°C) (relative to a 1960-1979 base period) since 1970" (EPA 2009c). Nevertheless, EPA's own monitoring data demonstrate that ozone levels decreased dramatically during the same period, as shown in Figure 1. Figure 1 comes directly from EPA's own AirTrends website (http://www.epa.gov/airtrends/ozone.html, accessed June 10, 2012).

As the graph shows, from 1980-2010, average peak ozone levels decreased by 28 percent. Peak ozone levels improved even more in areas with the highest ozone levels. The top of the blue-shaded area represents the 90th percentile among all monitoring locations in the U.S. Note that the 90th percentile ozone level declined from about 125 ppb in 1980 down to about 80 ppb in 2010, a 36 percent decrease.

Figures 2 and 3 show similar data over a longer time period. Figure 2 shows that average peak annual 8-hour ozone declined more than 30 percent from 1975 to 2010, while the maximum 8-hour ozone level declined more than 65 percent. Not only did peak levels of ozone decline, but Summer-average ozone levels declined also. Figure 3 shows that June-August average ozone declined as well. At the average monitoring location, June-August average ozone declined about 18 percent from 1975-2010, while June-August average ozone at the worst location in the country declined about 35 percent.

Overall, the lesson of the last 40 years is "higher temperatures, lower ozone." It is, of course, possible that ozone would have been even lower had the temperature not warmed. Regardless, the fact is that 2°F of warming did not prevent dramatic declines in ozone levels during the last 40 years. EPA never explains why we should expect the future to be the opposite of the past and does not even mention that past ozone levels declined dramatically despite warming of similar magnitude to what it predicts will occur between now and 2050.

Figure 1. National Trend in Peak Ozone Levels from 1980-2010Source: Graphic downloaded from http://www.epa.gov/airtrends/ozone.html (accessed June 12, 2012). Figure 2. Highest Annual 8-hour Ozone Concentrations for All U.S. Monitoring Locations from 1975-2010Source: Dennis Kahlbaum, Air Improvement Resource, using ozone monitoring data downloaded from EPA.

Figure 3. June-August Average of Daily Peak 8-hour Ozone Concentrations for All U.S. Monitoring Locations from 1975-2010Source: Dennis Kahlbaum, Air Improvement Resource, using ozone

monitoring data downloaded from EPA. 1.2 The fact that ozone has declined as the climate has warmed suggests that ozone levels are becoming less and less sensitive to temperature over time.

The fact that ozone has declined as the climate has warmed suggests that ozone levels are becoming less and less sensitive to temperature over time. One way to check this is by looking at the ratio of the number of ozone exceedance days each year to the number of hot days each year in a given city. Schwartz and Hayward (2008) did such an assessment for a number of U.S. cities representing major geographical areas of country and including cities with the highest ozone levels in the nation. The results are shown in Figure 4.

Figure 4 shows the ratio of the number of days exceeding a given ozone level to the number of days exceeding 90ºF each year average over 10 cities. In the early 1980s, the number of 8-hour, 85 ppb ozone exceedances per hot day was around 0.6 to 0.8. By the mid-2000s, the ratio had dropped to about 0.15 to 0.3. The improvement was even more dramatic for the higher ozone levels probed by the old 125 ppb, 1-hour standard. Between 1982 and 2005, the number of 1-hour exceedance days per hot day dropped from 0.3 to near zero. In other words, ozone levels have been becoming steadily less and less sensitive to temperature. The fact that ozone levels have continued to decline in the years since 2005 shows that this downward trend in the sensitivity of ozone levels to temperature has continued.Figure 4. Trend in the Ratio of Days per Year Exceeding A Given Ozone Level to Days per Year With Temperature Greater Than 90°FSOURCES: Air pollution data were downloaded from EPA's Air Quality System (AQS) database, http://www.epa.
gov/ttn/airs/airsaqs/detaildata/downloadaqsdata.htm and
http://www.epa.gov/ttn/airs/airsaqs/archived% 20data/downloadaqsdata-o.htm (accessed November 27, 2006). Temperature data were downloaded from the National Climatic Data Center, Summary of the Day (Data Set TD-3200), http://ncdc.noaa.gov (accessed October 3, 2006).

NOTES: Figure is based on ozone and temperature data for ten metropolitan areas: Atlanta, Baltimore, Charlotte, Chicago, Cincinnati, Houston, Los Angeles, Nashville, New York, and Philadelphia. Ozone exceedance days for a given metropolitan area were calculated as the average number of exceedance days each year for all monitoring sites in an area with continuous data. This was then divided by the number of days each year with peak temperature greater than 90°F. The graph gives the average ratio across the ten metropolitan areas. The year 1982 was the earliest time period for which all of the cities had at least one continuously operated monitoring site.Indeed, EPA itself presents data showing that ozone is becoming less and less sensitive to temperature. Figure 5 was downloaded from the EPA Region 1 (New England) web site. It shows the number of ozone exceedance days in New England from 1983 to 2011 based on both the 85 ppb 8-hour ozone standard and the new 75 ppb 8-hour ozone standard.

First, note that the number of ozone exceedance days has substantially declined. Exceedances of the 85 ppb threshold decreased from about 40 to 50 days per year in the late 1980s down to about 5 to 10 days per year during the last few years. Likewise, exceedances of the 75 ppb threshold dropped from about 55 to 70 days per year down to about 15 to 30 days per year over the same period.

Second, note that ozone levels are becoming much less sensitive to temperature. The graph shows that 1983, 2002, and 2010 all had about 39 days of at least 90°F, yet the number of 75 ppb ozone exceedance days dropped from 115 to 55 to 30 for the three time periods, respectively. Likewise, the number of 85 ppb exceedance days dropped from 90 to 43 to 10, respectively. In other words, given similarly hot summers, the number of 75 ppb and 85 ppb ozone exceedance days dropped 74 percent

and 89 percent, respectively. And this is in the Northeast—the region EPA says is among the most sensitive to the effects of temperature on ozone. Once again, this suggests that temperature is a minor factor when compared with reductions in ozone precursors.

Figure 5. Trend in Number of Ozone Exceedance Days vs. High Temperature Days in the New England Region.Source: EPA Region 1 (New England) web site: http://www.epa.gov/region1/airquality/graph.html (accessed June 13, 2012).

Note: Over time not only has the number of ozone exceedance days declined, the sensitivity of ozone to temperature has also declined. For example, in New England, since the early 1980s, the number of 75 ppb or 85 ppb ozone exceedance days during hot summers has dropped by 74 percent and 89 percent, respectively.

Recent studies also suggest that reductions in ozone precursors make ozone levels less sensitive to temperature. For example, Bloomer et al. (2009) concluded, based on observations of the real-world response of ozone to NOx reductions, that a 43 percent reduction in NOx emissions from power plants reduced the "climate penalty"—the amount by which ozone increases per degree of increase in temperature—by 31 percent, from 3.2 ppb ozone/°C to 2.2 ppb ozone/°C.

It is extraordinary that in hundreds of pages of documents claiming to have performed a comprehensive scientific analysis of future ozone levels in a warming climate, not once does EPA mention the simple fact that ozone has dramatically declined as the climate has warmed, or discuss the implications of this observation for predicting the effect of warming on future ozone levels.

1.3 Ozone will continue to decline in the future, with or without climate warming, because EPA will eliminate most remaining ozone-precursor emissions during the next few decades

EPA's TSD for its Endangerment Finding states, "Temperatures in the Northeast are projected to rise an additional 1.4 to 3.4°F (0.78 to 1.9°C) in summer over the next several decades (across low and high emissions scenarios)" (EPA 2009c). In other words, the temperature rise of 2ºF that EPA estimates for the last four decades is in the same ballpark as the range of temperature increases (1.4 to 3.4 ºF) that EPA predicts for the next several decades. Thus, as long as ozone-precursor emissions continue to decline, we can expect that ozone will continue to decline as well, regardless of any climate warming.

Ozone precursors will indeed continue to decline. In fact, over time EPA has only intensified its efforts to reduce ozone-precursor emissions, because its progressively tighter ozone standards can't be attained without large reductions in ozone precursors. As we show below, the measures EPA already has in place will progressively eliminate nearly all remaining ozone-precursor emissions during the next few decades. EPA shows no signs of reducing its production of new emissions control regulations and will no doubt adopt additional ozone-precursor reduction measures in coming years. Indeed, among other new regulations currently in the planning stages is a "Tier 3" rule to require additional emission reductions from automobiles.

Figure 6 displays the national trend in emissions of ozone precursors from 1970 to 2011 (EPA 2012a). Note that the rate of reduction in both NOx and VOC emissions has been accelerating in recent years. Large annual reductions in NOx and VOC emissions will continue, even if EPA adopts no new regulations to control emissions, because most of the emissions reductions from existing regulations have not yet been achieved. For example:

In 2004, EPA implemented Tier 2 standards for automobiles (cars, SUVs, pickup trucks, and minivans), which reduced NOx, CO, and VOC emissions by 77 to 95 percent (with the largest percentage reductions apply to the highest-emitting vehicle classes) when compared with the Tier 1 standards that were implemented in 1994. In 2007 EPA implemented new standards for on-road heavy-duty diesel trucks that reduced emissions from those vehicles by 90 percent below previous requirements. In 2010, EPA implemented Tier 4 standards for non-road heavy-duty diesel vehicles (e.g., construction and farm equipment), which reduced emissions from those vehicles by 90 percent below previous requirements. EPA has recently implemented requirements for many other types of mobile sources, such as trains, marine engines, snowmobiles, mowers, and many other non-road emissions sources. Taken together, even after accounting for population growth, these requirements will progressively eliminate more than 80 percent of ozone-precursor emissions from mobile sources during the next few decades, as the fleet turns over to models meeting these standards.

Figure 6. U.S. Anthropogenic Emissions of NOx and VOC from 1970 to 2011Source: EPA, "1970 - 2011 Average annual emissions, all criteria pollutants," http://www.epa.gov/ttnchie1/trends/ (accessed June 13, 2012).

Note: NOx and VOC emissions have been declining rapidly. The rate of decline has been accelerating in recent years.

EPA has likewise implemented dozens of rules for stationary and area pollution sources, many of which have future compliance dates. For example, the Clean Air Interstate Rule requires NOx and SO2 from power plants to be reduced by 70 percent. Eventually, the Cross State Air Pollution Rule (CSAPR) or some successor rule will require additional reductions from power plants. Dozens of Maximum Achievable Control Technology (MACT) rules, require emissions reductions from nearly all industrial sources. EPA's New Source Performance Standards (NSPS) require all new industrial construction to meet either the Lowest Achievable Emission Rate (LAER) or Best Available Control Technology (BACT) when constructing a new industrial facility. Thus, capital stock turnover during the next few decades will likewise continue to eliminate air pollutant emissions as old facilities are retired and new facilities with state-of-the-art pollution controls are constructed.

EPA will also continue to adopt new rules. A "Tier 3" standard for automobiles is already in the planning stages. More rules will be coming as EPA clamps down further on what few emissions remain in order to help states attain EPA's progressively tighter ozone and particulate matter standards.

Despite the certainty of continued large emission reductions during the next few decades, EPA in its TSD tries to create a false impression of uncertainty about future air pollutant emissions, stating: "Further, the range of plausible short- lived emission projections is very large. For example, emission projections used in CCSP (2008d) and in the IPCC Fourth Assessment Report (IPCC, 2007a) differ on whether black carbon particle and nitrogen oxides emission trends continue to increase or decrease. Improvements in our ability to project social, economic, and technological developments affecting future emissions are needed" (TSD, pp. 92-93). It may be true that the Climate Change Science Program (CCSP) and the IPCC chose to assume higher air pollutant emissions in the future. But this is a separate issue from whether such assumptions are plausible. Clearly they are not. As EPA knows full well, the requirements it has already adopted will eliminate nearly all remaining ozone-precursor emissions and it has more rules in the planning stages.

Although ozone-precursor emissions will be far lower on in coming decades, it is difficult to predict exactly how much lower. Nevertheless, it is clear that EPA has already adopted requirements sufficient to eliminate at least 80 percent of remaining ozone-precursor emissions, even after accounting for economic and population growth. Furthermore, both EPA's emissions inventory trend (see Figure 6, above) and studies of trends emissions and ambient levels of ozone precursors are consistent with these conclusions. In other words, current ozone-precursor emissions are about five times greater than ozone-precursor emissions are likely to be in 2050, while mid-to-late 1990s ozone-precursor emissions were about ten times greater than likely emissions in 2050. It is this reality, not the errant assumptions of the CCSP or the IPCC, that EPA should have used as the basis for its TSD.

2 The studies that EPA relies on for predictions of future ozone levels use unrealistically high emissions of ozone precursors, which exaggerates both future ozone levels and the absolute effect of climate change on future ozone levels.

The studies EPA relies on for predictions of future ozone levels generally use ozone-precursor emission inventories from somewhere between 1996 and 2001 to "predict" ozone levels in the 2050s or 2090s. However, even current ozone-precursor emissions are already only half of levels during the late 1990s and dropping rapidly. Also, as shown in Section 1, as a result of already-adopted and soon-to-be-adopted measures, U.S. ozone-precursor emissions in the 2050s will likely be no more than about one-tenth of late 1990s levels.

This means studies that use late 1990s ozone-precursor emissions and apply them to the predicted climate of 2050 are using an ozone-precursor emission inventory that is already twice as high as current ozone-precursor emissions and about ten times greater than a realistic ozone-precursor emissions inventory for 2050. As a result, both ozone levels and the absolute effect of warming on ozone levels will be far lower in the future than suggested either by EPA or the peer-reviewed research literature in general.

2.1 The studies EPA relies on to "predict" the effect of climate warming on ozone use drastically inflated ozone-precursor emissions inventories

EPA bases the ozone results of its Endangerment Finding (EF) on its report "Assessment of the Impacts of Global Change on Regional U.S. Air Quality: A synthesis of climate change impacts on ground-level ozone" (EPA 2009a), which it refers to as the "Interim Assessment" (IA) in its Endangerment Finding. As EPA states in the IA, "The aim of this phase was to consider the effects of climate change in isolation, without accompanying changes in anthropogenic emissions of precursor pollutants expected to occur over the same timeframe." (IA, p. xxii).

Table 1 displays assumptions about future ozone-precursor emissions in studies EPA cites in its Endangerment Finding. Table 2 provides similar information for studies cited in EPA's Interim Analysis. Reading from the left, the first column gives the citation. Articles from the same research group using the same assumptions are grouped together. The second column lists the "base year" for the ozone-precursor emissions inventory. The modeling was done either with ozone-precursor emissions equal to the emissions during this base year or scaled by some factor relative to this base year. The third column lists emissions of NOx and VOC assumed for 2050, relative to the base year from the previous column. For example, "no change" means that emissions were assumed to be the same in 2050 as in the base year; +29% means emissions were assumed to have risen 29 percent between the base year and 2050. Most of these studies used the highest-warming IPCC scenarios (A1 or A2) to project future climate

		conditions, so their results are worst-case scenarios for the effect of climate warming on ozone levels. Table 1. Assumptions About Future Ozone-Precursor Emissions in Studies of the Effect of Climate Change on Future Ozone Levels: Studies Cited by EPA in its Endangerment Finding Article Emissions Inventory Base Year 2050 Emissions, Relative to Base Year NOx VOC Notes Bell et al. (2007), Knowlton et al. (2004), Hogrefe et al. (2004) 1996 No Change +29% +8% No change for the base scenario. Increased emissions for sensitivity analysis. Denman et al. 1996 No Change This is the IPCC AR4 report. EPA cites it, and it cites Knowlton et al. (2004) for future ozone levels. Hauglustaine et al. (2005) 2000 +77% +85% Inventory change is for OECD countries. U.S.-only inventory not provided. Simulation for 2100, not 2050. Liao and Seinfeld (2006) 2000 +77% +85% Inventory change is for OECD countries. U.S.-only inventory not provided. Simulation for 2100, not 2050. Jacob and Winner (2009) Review article Mickley et al. (2004) 2000 No Change Not an ozone study, but looked at the effect of warming on black carbon and CO levels.Table 2. Assumptions About Future Ozone-Precursor Emissions in Studies of the Effect of Climate Change on Future Ozone Levels: Studies Cited by EPA in its Interim Analysis Article Emissions Inventory Base Year 2050 Emissions, Relative to Base Year NOx VOC Notes Avise et al. (2009), Chen et al. (2009) 1999 +6% +50% Included growth in emissions due to economic and population growth, but excluded reductions in emissions due to regulations. Aw and Kleeman (2003)					

		1995-1997 No Change Dawson et al. (2009) 2001 No Change Murazaki and Hess (2006) 1997 No Change Simulation for 2100, not 2050 Racherla and Adams (2008) 1990s No Change Racherla and Adams (2006) 1990s No Change Steiner et al. (2006) 2000 NOx -10% to -50% VOC -50% to -70% Emission reduction percentage varied by region of California. Tagaris et al. (2008), Liao et al. (2008), Woo et al. (2008) 2001 -55% -40% Tao et al. (2007) 1999 +30% ~+5% -50% -10% A1FI Scenario B1 Scenario Wu et al. (2008a), Wu et al. (2008b) 1999 -40% -52% Zeng et al. (2008) 2000 Increase					

Only worldwide emission inventory provided, however, the A2 scenario generally has ozone-precursor emissions increasing in OECD countries. Note that the four studies cited in the TSD assumed either no change or an increase in ozone-precursor between the base-year and 2050. Figure 7 shows the extent to which this approach exaggerates future emissions of ozone precursors. The two curves with filled markers are EPA's estimate of actual U.S. NOx and VOC emissions from 1970-2011 (as already discussed in Figure 6). The dotted horizontal lines extend the 1996 base-year emissions level (used in Bell et al. (2007)) out to 2050. The solid horizontal lines extend NOx and VOC emissions for 2011 out to 2050.

The graph shows that studies that use past ozone-precursor emissions to "predict" ozone in 2050 are guaranteed to drastically exaggerate both future ozone levels and the effect of warming on future ozone levels. Note, for example, that the ozone-precursor emissions assumed for 2050 by Bell et al. (2007) and Denman et al. (2007) (which cites the Bell et al. group's results) are more than twice as high as current ozone-precursor emissions. Thus, these studies aren't even suitable for assessing the effect of climate warming on current ozone levels. Hauglustaine et al. (2005) and Liao and Seinfeld (2006) are even more fantastical, because they assume increases in ozone precursors in the future.

Figure 7. Studies of Ozone in 2050 Use Drastically Exaggerated NOx and VOC Emission InventoriesNotes: Bell et al. (2007) and Denman et al. (2007) report ozone results for 2050 using an ozone-precursor emissions inventory for 1996. The graph shows how this drastically exaggerates likely ozone-precursor emissions in 2050. Note that NOx and VOC emissions in 2011 were already less than half of 1996 levels and dropping rapidly.Table 2 shows that most of the studies cited in EPA's Interim Analysis likewise assume that ozone-precursor emissions in 2050 will be the same or greater than they were during 1995 to 2001. Only four research groups—Steiner et al., Tagaris et al., Tao et al., and Wu et al.—assumed ozone-precursor emissions will be lower in 2050 than they were during 1995-2001. The largest decline assumed in a national study was the 55 percent drop in NOx emissions assumed by Tagaris et al., which used 2001 as a base year. Note, however, from Figure 7 that, compared with 2001, NOx and VOC had already declined 44 percent by 2011. At current rates of decline, both NOx and VOC will be 55 percent below their 2001 levels a year or two from now. Thus, even the most "realistic" of the ozone-climate studies are not realistic at all. At best they answer the question: "What would ozone levels be a year or two from now if the climate were a few degrees warmer than it actually will be?"

2.2 Climate Warming Will Have Much Less Effect on Future Ozone Levels than EPA Claims

It is difficult to predict with certainty how much smaller the effect of climate warming on ozone would be if EPA used a realistic ozone-precursor emission inventory to model future ozone levels, because no study to date has used anything close to a realistic ozone-precursor emission inventory for 2050. Nevertheless, one thing is certain: Reducing ozone-precursor emissions down to a small fraction of late 1990s or current levels would drastically reduce ozone levels. EPA's entire strategy to attain the ozone standard is based on exactly this premise.

Even though no one has modeled ozone in 2050 using a realistic ozone-precursor emissions inventory, studies that use somewhat lower ozone-precursor emissions than 1990s levels suggest that the "climate penalty" would be much smaller and would perhaps disappear under a realistic ozone-precursor emissions scenario.

Racherla and Adams (2009) modeled ozone in 2050 assuming that NOx and VOC would drop 61 percent and 39 percent, respectively, below 1990s levels. Given their base year and their assumed emission

reductions, their study effectively compares the change in ozone in the mid-1990s with ozone levels during the last few years. Their study assumes climate warming for 2050 under the A2 scenario. In effect, Racherla and Adams (2009) assessed the effects of climate warming on ozone levels during the mid-1990s and the last few years.

Figure 2 of their study, reproduced below as Figure 8, shows the results. Each of the six panels presents the results for a different region of the United States. Let's look at the panel labeled Northeast as an example. The panel has three pairs of boxplots. Each pair shows the distribution of ozone levels in based on the A2 climate scenario for the 1990s and 2050s. That is, each pair of boxplots displays modeled ozone without and with climate warming.

The two left-most boxplots represent the 1990s and 2050s climate with 1990s ozone-precursor emissions (pc_pe and fc_pe, or "present climate_present emissions" and "future climate_present emissions"). The two middle boxplots represent 1990s and 2050s climate with increases in ozone-precursor emissions (NOx +33%; VOC +18%) (pc_a2e and fc_a2e, or "present climate_A2 emissions" and "future climate_A2 emissions"). Finally, the two right-most box plots represent the 1990s and 2050s climates with lower ozone-precursor emissions (NOx -62%; VOC -39%) (pc_b1e and fc_b1e, or "present climate_B1 emissions" and "future climate_B1 emissions"). Note the following in the Northeast panel:

In the pc_pe vs. fc_pe scenarios, which represents 1990s ozone-precursor emissions, you can see a climate penalty in that the highest ozone days are almost 10 ppb higher in the warmed climate when compared with the 1990s climate. One the other hand, with the pc_b1e and fc_b1e scenarios (which effectively represent ozone-precursor emissions during the last few years) you can see two things: First, with or without warming, peak ozone levels are much lower, more than 20 ppb lower, than for the scenarios using 1990s ozone-precursor emissions. Second, the climate penalty has nearly disappeared.

The results are similar for the other areas of country. With or without warming, reducing ozone precursors from 1990s levels to recent levels results in large ozone reductions in all areas of the country. As we showed earlier, this is exactly what happened in the real world too—warmer climate, lower ozone—so it's a good thing that the model comports with this reality. Furthermore, in five of six areas of country, the climate penalty is also smaller when ozone-precursor emissions are reduced. The only exception is the southwest, where the climate penalty gets larger after reducing ozone-precursor emissions, even though overall ozone levels are still lower in the warmed climate.

The overall lesson from Racherla and Adams (2009) is that even modest reductions in ozone-precursor emissions reduces ozone everywhere in the country, even if the climate warms substantially (as it does in the A2 scenario), and gets rid of most or all of the climate penalty in the vast majority of the country.

Wu et al. (2008) model the IPCC A1B scenario for warming in 2050 and assume that U.S. NOx and VOC emissions due to fossil fuel combustion decline by 40 percent and 57 percent, respectively, relative to 1999. Although they report a climate penalty, like Racherla and Adams (2009), they also find that reducing ozone-precursor emissions reduces the climate penalty. They conclude, "We find that a 50% reduction in U.S. NOx emissions is needed in the 2050 climate to reach the same target in the Midwest as a 40% reduction in the 2000 climate. Emission controls reduce the magnitude of this climate change penalty and can even turn it into a climate benefit in some regions." Figure 8. Racherla and Adams (2009) modeling of ozone levels with and without warming and with and without modest emissions reductionsSource: Figure 2 from Racherla and Adams (2009). Wu et al. (2008) also find that the size of

the region in which climate warming increases ozone levels shrinks as ozone-precursor emissions decrease. For example, according to Figure 9 of their paper, with 40 and 57 percent reductions in NOx and VOC (relative to 1999 emissions), the area of greatest climate change penalty (6-8 ppb higher ozone given a 2050 climate relative to a 2000 climate) shrinks by about 85 percent. On the other hand, the area where climate change has no effect or even a benefit (that is, lower ozone due to warming) greatly expands, from about one-third of the U.S. to more than half the U.S., including the entire northeast, southeast and most of the west. In particular, given these emission reductions, climate warming lowers ozone in most of the southeast and pacific northwest.

This is a crucial finding, because NOx and VOC emissions have already decreased 47 and 52 percent, respectively, relative to 1999 levels (EPA 2012a), or roughly what Wu et al. assumed for 2050. In other words, taking Wu et al.'s modeling at face value, given current ozone-precursor emissions, climate warming of a few degrees Fahrenheit would increase ozone in about one-third of the U.S., decrease ozone in about one-fourth of the U.S. and have no effect in the remaining five-twelfths of the U.S. But we showed earlier that ozone-precursor emissions are dropping rapidly and will be far lower in coming decades. Given the fact that Wu et al. predict a shrinking area of "climate penalty" with decreasing ozone-precursor emissions and an expanding area of "climate benefit", it seems probable that using a realistic ozone-precursor inventory for 2050 would actually result in at worst no climate penalty and perhaps even an overall benefit of warming on ozone levels in the United States.

Finally, as noted earlier, Bloomer et al. (2009) concluded, based on observations of the real-world response of ozone to NOx reductions during the early 2000s, that a 43 percent reduction in NOx emissions from power plants reduced the climate penalty by 31 percent, from 3.2 ppb ozone/°C to 2.2 ppb ozone/°C.

Taken together, these studies lead to the conclusion that reducing ozone-precursor emissions reduces the effect of climate warming on ozone levels. These studies suggest that ozone-precursor reductions between the late 1990s and 2011 have already eliminated most of the climate penalty and perhaps even set the stage for a climate benefit in some areas. Since ozone-precursor emissions are dropping rapidly, whatever climate penalty remains will likely disappear within a decade or two, as most remaining ozone-precursor emissions are eliminated by already-adopted measures.

2.3 Contrary to EPA's conclusion in its endangerment finding, the weight of the evidence suggests that recent and future ozone-precursor reductions will soon eliminate any risk that climate warming will increase ozone levels.

As we showed earlier, ozone-precursor emissions are dropping rapidly. Even a decade from now, ozone-precursor emissions will be far lower than they are today. By 2050 the vast majority of remaining ozone precursors will have been eliminated. Because they use drastically exaggerated ozone-precursor emissions for 2050, studies of climate and ozone done to date drastically exaggerate future ozone levels and the effect of warming on future ozone levels.

In its Endangerment Finding TSD, EPA summarizes what it believes to be the weight of the evidence from ozone-climate research:

• "There is now consistent evidence from models and observations that 21st century climate change will worsen summertime surface ozone in polluted regions of North America compared to a future with no climate change (Jacob and Winner, 2009)." (TSD, p. 89)

		• "Studies reviewed in the IA and Jacob and Winner (2009) indicate the largest increases in ozone concentrations due to climate change occur during peak pollution events. The locations of peak ozone episodes tend to be large metropolitan areas such as Los Angeles, Houston, and the Northeast corridor, suggesting higher increases of potentially dangerous levels of ozone over significant population centers." (TSD, p. 92) • "Mickley et al. (2004) find that climate change projected to occur under the A1B (mid-range) scenario results in significant changes that occur at the high end of the pollutant concentration distribution (episodes) in the Midwest and Northeast between 2000 and 2050 given constant levels of criteria pollutant emissions." (TSD, p. 92) • "Climate change is projected to increase surface layer ozone concentrations in both urban and polluted rural environments due to decomposition of PAN at higher temperatures (Sillman and Samson, 1995; Liao and Seinfeld, 2006)" (TSD, p. 90). • "For A2 scenario in the 2050s, Bell et al. (2007) report that the projected effects of climate change on ozone in 50 eastern U.S. cities increased the number of summer days exceeding the 8-hour EPA standard by 68%. On average across the 50 cities, the summertime daily 8-hour maximum increased 4.4 ppb." (TSD, p. 92). • "Using the A2 (high-end) emissions scenario, Hogrefe et al. (2004) find that while regional climate change in the eastern United States causes the summer average daily maximum 8-hour ozone concentrations to increase by 2.7, 4.2, and 5.0 ppb in 2020s, 2050s, and 2080s (compared to 1990s), respectively, regional climate changes causes the fourth-highest summertime daily maximum 8-hour ozone concentrations to increase by 5.0, 6.4, and 8.2 ppb for the 2020s, 2050s, and 2080s, respectively (compared to 1990s) (Hogrefe et al., 2004)." (TSD, p. 92) • "Climate change is projected to increase surface layer ozone concentrations in both urban and polluted rural environments due to decomposition of PAN at higher temperatures (Sillman and Samson, 1995; Liao and Seinfeld, 2006)." (TSD, p. 90). The Interim Analysis contains similar conclusions. For example: • The Harvard group also found that peak O3 pollution episodes are far more affected by climate change than mean values, with effects exceeding 10 ppb in the Midwest and Northeast. (IA, p. 3-3). • "In five years of simulated summertime O3 under both present-day and future climate conditions (with constant anthropogenic precursor pollutants), the Washington State group found future O3 increases in certain regions, most notably in the Northeast and Southwest, with smaller increases or slight decreases in other regions (Avise et al., 2009). These climate change effects were most pronounced when considering the extreme high end of the O3 concentration distribution." (IA, p. 3-10) • "…the frequency of extreme O3 events increases in the simulated future climate: over the eastern half of the United States, where the largest simulated future O3 changes occurred, the greatest increases were at the high end of the O3 distribution, and there was increase episode frequency that was statistically significant with respect to interannual variability (Racherla and Adams, 2008)." (IA, p. 3-5)					

The results EPA cites in the TSD are based on ozone-precursor emissions that are the same as or greater than emissions during the mid-to-late 1990s. In effect, these studies asked "What would ozone levels have been back in the 1990s if the climate had been a few degrees warmer?" EPA has made it appear as if they are asking a question about future ozone levels when in fact they are merely asking a counterfactual question about past ozone levels. Even the IA's conclusions are based mainly on studies that used 1990s ozone-precursor emissions. Where they used lower emissions, the emissions were at about current levels, rather than the much lower levels that will obtain in 2050.

Even in cases where a study made some attempt to reduce ozone precursors below late 1990s levels, EPA excludes these results from the IA. EPA states: "Most of the groups whose results make up this synthesis of the impacts of climate change on O3 have also carried out additional, in most cases highly preliminary, simulations designed to investigate, to first-order, the effects of changes in climate relative to changes in worldwide and/or U.S. anthropogenic emissions of precursor pollutants. The results from these simulations are not included in the synthesis below to maintain the focus on first exploring climate change impacts alone." (IA, p. 3-14).

EPA's approach of using past ozone-precursor emissions to "predict" the effect of warming on ozone in 2050 is bizarre. No one would suggest that you should predict future climate by holding CO2 emissions constant at current levels in your model. Likewise, the only sensible way to predict the effect of climate warming on ozone levels in 2050 is to use a realistic prediction of ozone-precursor emissions in 2050 and then run the model with and without warming. One response might be that ozone-precursor emissions in 2050 are too uncertain. Of course there are uncertainties, but the uncertainties in future ozone-precursor emissions are minute compared to the uncertainties in future GHG emissions or the effect of anthropogenic GHG emissions on climate.

As shown in Section 1, measures needed to eliminate nearly all remaining ozone-precursor emissions have already been adopted or implemented. EPA is planning still more measures to eliminate the last smidgeons of ozone-precursor emissions that might remain. Furthermore, the Clean Air Act requires attainment of the ozone standard without regard to cost and EPA has continued to tighten the ozone standard. Thus, EPA and states will adopt additional ozone-precursor reduction measures in the future.

Taken together, these considerations mean that future ozone-precursor emissions will be somewhere between a-small-fraction-of-today's-levels and zero. Those are incredibly tight error bounds when compared with the panoply of uncertainties inherent in climate prediction.

If this doesn't convince you that EPA's approach to predicting future ozone levels is backwards, try this analogy: imagine I want to understand the effect of ozone-precursor reductions on ozone levels in 2050. I expect that between now and 2050, both ozone-precursor emissions and the climate will change. So how do I isolate the effect of ozone-precursor reductions alone? Clearly I need to hold the climate constant and apply current and reduced ozone-precursor emission inventories to the same climate. But which climate should I hold constant, the climate of the late 1990s or the predicted climate of 2050? Clearly I would want the predicted climate of 2050, because I want my results to apply to the future, not the past.

Likewise, EPA and scientists want to understand the effect of climate warming on ozone levels in 2050. Could it be more obvious that they should use a realistic ozone-precursor emissions inventory for 2050 and run their models with and without the warming predicted for 2050? Instead, they used ozone-

precursor emissions for 1996 to 2001 (depending on the study). In effect, the question they asked was: "How much higher would ozone levels have been back in the late 1990s if the climate had been a few degrees warmer?" This question has no policy relevance even today, when ozone-precursor emissions are about half their late 1990s levels, and is of even less relevance for the 2050s, when ozone-precursor emissions will be no more than about one-tenth of late 1990s levels.

EPA claims in its Endangerment Finding and supporting documentation "There is now consistent evidence from models and observations that 21st century climate change will worsen summertime surface ozone in polluted regions of North America compared to a future with no climate change" (TSD, p. 89). This claim is unsupportable, because it is based on studies using ozone-precursor emissions twice as high as current levels and ten times higher than likely levels in 2050. At most, EPA has shown that ozone levels would have been a bit higher in the past if the climate had been a bit warmer.

As an example of EPA's unsupportable conclusions, in its Endangerment Finding TSD, EPA states, "For A2 scenario in the 2050s, Bell et al. (2007) report that the projected effects of climate change on ozone in 50 eastern U.S. cities increased the number of summer days exceeding the 8-hour [85 ppb] EPA standard by 68%." This statement clearly leads readers to believe that climate warming is likely to cause a 68 percent increase in the number of days exceeding the 8-hour ozone standard. But even taking the model results at face value, this is only true if ozone-precursor emissions in 2050 are the same as ozone-precursor emissions in 1996. At realistic ozone-precursor emissions for 2050, their would likely be little or no increase in the number of exceedance days, because both absolute ozone levels and the increase in ozone levels due to warming would both be much lower. Once again, EPA's decision to use past ozone-precursor emissions for its modeling of ozone levels in 2050 rendered the whole exercise unsuitable for its intended purpose.

To be able to say anything about the effect of warming on ozone levels in the 2050s, EPA must run air quality models with a predicted climate for 2050 and a realistic ozone-precursor emission inventory for 2050. This is crucial, because ozone-precursor emissions in 2050 will be no more than about one-tenth 1990s levels. Indeed, more than half the emission reductions needed to go from late 1990s ozone-precursor emissions to one-tenth of late 1990s ozone-precursor emissions have already been achieved and the rate of emissions decline has been speeding up in recent years. Research discussed in sub-section 2.2 above shows that these ozone-precursor reductions have already eliminated most of the climate penalty and suggest that upcoming ozone-precursor reductions will eliminate what little climate penalty remains.

We close this sub-section with a brief discussion of the warming scenarios used in models of future ozone levels. Other commenters critique EPA's conclusions regarding the extent of future warming. However, it is important to note here that most of the modeling studies on the effect of climate warming on ozone use the IPCC A2 scenario, which is among the warmest of the IPCC scenarios. The A2 scenario assumes atmospheric methane will reach 2562 ppb by 2050 (Nakicenovic and Swart 2000). Figure 9 compares the actual trend in atmospheric methane with the trend that would be necessary for methane to reach the A2 prediction by 2050. As the graph shows, a large increase in the rate of methane growth would be necessary to match the A2 scenario. We raise this issue simply to note that if anthropogenic greenhouse gases do not increase as much as the modeling assumes they will, then, even if EPA is correct about the effect of warming on ozone levels, there will not be as much warming, and hence not as much ozone, as EPA claims.

Figure 9. Actual Trend in Atmospheric Methane Compared with Trend Needed to Match A2 Scenario by

2050Source: Methane measurements, Dlugokencky, E.J., P.M. Lang, and K.A. Masarie (2012), Atmospheric Methane Dry Air Mole Fractions from quasi-continuous measurements at Barrow, Alaska and Mauna Loa, Hawaii, 1986-2011, Version: 2012-04-05, ftp://ftp.cmdl.noaa.gov/ccg/ch4/in-situ/. A2 scenario assumptions, Nakicenovic and Swart (2000).

Note: The A2 scenario assumes methane would be 1865 ppb in 2011, compared with an actual value of 1818 ppb. Matching the A1FI methane trend (2668 ppb in 2050) would require an even more rapid increase in atmospheric methane.3 EPA creates a false appearance that ozone must rise before regulatory agencies can take steps to reduce ozone precursors

We showed above that ozone declined substantially during the last few decades, despite 2°F of climate warming over the same period. Furthermore, we showed that ozone will decline during the next few decades, with or without warming, and that recent reductions in ozone precursor have already eliminated most of the climate penalty. Nevertheless, in its endangerment finding, EPA creates a false impression that ozone is likely to rise in the future.

For example, EPA implies that the Clean Air Act requires EPA and states to allow ozone to increase to dangerous levels before they can take action to reduce ozone, and that this means warming has to cause harm before EPA can do anything about it. In its Endangerment Finding, EPA states:

"It is important to note that controls to meet the NAAQS are typically put in place only after air quality concentrations exceeding the standard are detected. Furthermore, implementation of controls to reduce ambient concentrations of pollutants occurs over an extended time period, ranging from three years to more than twenty years depending on the pollutant and the seriousness of the nonattainment problem. Thus, while the CAA provides mechanisms for addressing adverse health effects and the underlying air quality exacerbation over time, it will not prevent the adverse impacts in the interim." (Federal Register, December 15, 2009, p. 66530)

In other words, EPA claims ozone has to rise to dangerous levels in a region in order for EPA and the region in question to gain the authority to do anything about ozone-precursor emissions. Thus, EPA argues, the fact that the Clean Air Act requires attainment is no help in preventing harm from ozone increases due to climate warming, because regulators can't do anything about the ozone increases until after the harm has already occurred.

While this may, in principle, be the legal structure of the Clean Air Act, it has little to do with the reality of how measures to reduce ozone precursors have been and are implemented. First, back in the 1970s, nearly all populated areas of the country violated the one-hour ozone standard. For example, from 1975 to 1980, between 70 and 80 percent of the nation's ozone monitoring sites violated the 1-hour ozone standard (Schwartz and Hayward 2008, 30). As a result, nearly all activity to reduce ozone after that time has been proactive, rather than responsive.

Second, EPA's continued tightening of the ozone standard has added new pressure to reduce ozone-precursor emissions. When EPA tightened the ozone standard in 1997, it set off a flurry of additional proactive actions to reduce ozone. For example, in December 2002, 33 states voluntarily submitted "Early Action Compacts" pledging to take additional steps to reduce ozone levels beyond those nominally required by EPA. As EPA noted, among the communities that joined in the EAC program were "15 communities which met the [85 ppb, 8-hour ozone] standard and want to be proactive about reducing air pollution" (EPA undated).

Third, a number of communities around the country that used to be in non-attainment of either the 1-hour, 125 ppb or the 8-hour, 85 ppb standards came into attainment at some point in the past. But coming into attainment doesn't mean sitting around and waiting for ozone to rise again. Once an area comes into attainment, it must submit a "maintenance plan" to EPA demonstrating how the area will keep ozone from rising and remain in attainment. For example, measures in Kansas City's "Second Ten-Year Plan" for ozone maintenance include the following (EPA 2002):

Stationary Source Regulations: This plan relies upon continued implementation of regulations that reduce emissions from stationary sources and include the following rules:

• 10 CSR 10-2.040 Maximum Allowable Emission of Particulate Matter from Fuel Burning Equipment Used for Indirect Heating

• 10 CSR 10-2.080 Emission of Visible Air Contaminants from Internal Combustion Engines; rescinded March 18, 2003 (68 FR 12827). See 10 CSR 10-6.220

• 10 CSR 10-2.090 Incinerators

• 10 CSR 10-2.100 Open Burning Restrictions

• 10 CSR 10-2.150 Time Schdule for Compliance

• 10 CSR 10-2.205 Control of Emissions from Aerospace Manufacture and Rework Facilities

• 10 CSR 10-2.210 Control of Emissions form Solvent Metal Cleaning

• 10 CSR 10-2.215 Control of Emissions from Solvent Cleanup Operations

• 10 CSR 10-2.220 Liquefied Cutback Asphalt Paving Restricted

• 10 CSR 10-2.230 Control of Emissions from Industrial Surface Coating Operations

• 10 CSR 10-2.260 Control of Petroleum Liquid Storage, Loading, and Transfer

• 10 CSR 10-2.290 Control of Emissions from Rotogravure and Flexographic Printing Facilities

• 10 CSR 10-2.300 Control of Emissions from the Manufacturing of Paints, Varnishes, Lacquers, Enamels and Other Allied Surface Coating Products

• 10 CSR 10-2.310 Control of Emissions from the Application of Underbody Deadeners

• 10 CSR 10-2.320 Control of Emissions from the Production of Pesticides and Herbicides

• 10 CSR 10-2.340 Control of Emissions from Lithographic Printing Facilities

• 10 CSR 10-2.360 Control of Emissions from Bakery Ovens

		• 10 CSR 10-6.075 Maximum Achievable Control Technology Regulations • 10 CSR 10-6.220 Restriction of Emission of Visible Air Contaminants Fourth, and most important, nearly all ozone-precursor emissions come from nationally regulated sources—mobile sources such as cars, trucks, construction and farm equipment, trains, and planes, stationary sources such as power plants, refineries, and chemical plants, and area sources, such as paints, coatings and solvents. Measures to reduce ozone-precursor emissions from these sources are national in scope and improve ozone in all areas, regardless of whether their ozone levels are high, medium, or low, and regardless of their ozone attainment status. As noted above in sections 1 and 2, ozone-precursor emissions have been dropping rapidly on a national basis and existing requirements will eliminate nearly all remaining ozone-precursors during the next couple of decades. A few Google searches with terms such as “ozone attainment plan”, “ozone maintenance” or “ozone state implementation plan” will demonstrate the enormous amount of activity and resources that have been in the past and are currently being brought to bear by all levels of government to reduce ozone-precursor emissions and attain the federal ozone standard. EPA’s implication that there are areas of country where ozone will have to rise before anything can be done about it couldn’t be further from the truth. EPA has been pre-emptively reducing ozone-precursor emissions for decades in all areas of the U.S. and will continue to do so. Local and state governments are taking additional actions to reduce the few sources of ozone precursors that are not under federal control. Thus, there has not been, is not now, nor will there be in the future any location in the country that is just sitting around waiting to go into non-attainment. 4 Ozone at Current, Historically Low Levels Is Not A Significant Human Health Concern, and Future Ozone Levels Will Be Far Lower, Regardless of Climate Warming We showed above that without climate warming ozone will decline substantially in the future, and that with climate warming ozone will still decline substantially, but slightly less than without warming. Here we show that regardless of the effect of warming on ozone levels, ozone at current, historically low levels is already low enough not to be a health concern. There will be even less reason for concern about ozone at the much lower levels that will obtain in the future. Thus, regardless of the effect of climate change on ozone levels, there is no reason for concern over the effects climate warming on ozone-related health effects. In the TSD for its Endangerment finding, EPA cites its most recent Air Quality Criteria Document for Ozone and Related Photochemical Oxidants (Environmental Protection Agency 2006) as the source for its conclusions regarding the effects of ozone on health. Below we critique the claims in that document and also discuss more recent work since 2006. The topics we discuss can be summarized as follows: Observational studies generate false indications of risk where no risk in fact exists. EPA’s claims for ozone’s most serious health effects—premature death and respiratory and cardiovascular hospitalizations—are based on the results of observational epidemiology studies. We show that observational studies generate false indications of risk through data dredging and publication bias. This happens because (1) observational studies inherently allow great flexibility in modeling choices with little or no means of external validation, (2) large datasets are always filled with small chance					

correlations and the putative effects of ozone are within the same range as these chance correlations, and (4) from among the thousands or millions of superficially plausible models of air pollution and health, researchers seek out models that give statistically significant results. As a result, observational studies tend to confirm the preconceptions of the researchers, rather than provide realistic information on health effects. In cases where observational studies have been tested against randomized controlled trials, the observational study results are nearly always falsified. In its criteria documents and associated reports on ozone's health effects, EPA cites hundreds of air pollution epidemiology studies as evidence of harm from ozone. But implementing an invalid methodology over and over again doesn't improve its validity.

The claim that ozone can kill at real-world exposure levels is biologically implausible. Laboratory studies with hundreds of individual animals representing several different species show that animals do not die, even when exposed for the equivalent of many years to ozone at levels nearly ten times greater than the highest ambient levels. These results make it biologically implausible that ozone at real-world outdoor levels could be causing premature death in humans.

Selective characterization of evidence. In its characterization of ozone's health effects, EPA selectively emphasizes studies and portions of studies reporting harmful ozone effects, while downplaying studies reporting no effects or apparently protective ozone effects. This creates an impression that the evidence for harm from ozone at real-world levels is far more robust and consistent than the full weight of the evidence suggests.

Studies of low-level ozone exposure with human volunteers demonstrate that an 8-hour standard of 85 ppb is more than stringent enough to protect human health with an adequate margin of safety, even from the most mild health effects EPA claims for ozone. A few studies with human volunteers have assessed the effects of ozone at levels below 80 ppb. These studies find small, temporary reductions in lung function that EPA classifies as adverse. But EPA is mistaken on two accounts. First, the subjects in the study had to exercise for the equivalent of six consecutive gym workouts in less than 7 hours just to elicit small, temporary, and medically insignificant effects on lung function. Outside these artificial laboratory conditions, no one is active long enough or intensely enough to elicit even these tiny effects.

Second, EPA ignores the difference between personal exposure and ambient-monitor levels when interpreting these low-exposure studies. As a result of this difference, a 60 ppb personal ozone exposure in a laboratory study is equivalent to at least 100 ppb measured at an ambient ozone monitor. After correcting for this bias, even if EPA is correct that the minor effects seen in laboratory studies are adverse, these effects do not occur until ozone levels are well above a level equivalent to 85 ppb as measured at an ambient monitor.

The overall result of the above considerations is that the 85 ppb 8-hour ozone standard protects human health with plenty of room to spare. Peak annual ozone levels are already below this level in about 90 percent of the country. Continued ozone-precursor reductions will ensure that the entire country will be well below this level by the time any significant additional warming occurs. Thus, even if warming causes ozone to decrease a bit less than it otherwise would have, ozone levels around the U.S. will still be below a level of concern for human health, with or without climate warming.

4.1 Observational studies create false indications of risk where no risk in fact exists. All of the evidence for harm from ozone at realistic levels comes from observational studies and can therefore be discounted.

In making its case for a tougher ozone standard, EPA notes that "The Criteria Document prepared for this review [of the ozone standard] emphasizes a large number of epidemiological studies published since the last review…" Indeed, the Criteria Document (CD) and associated Staff Paper (EPA 2007a) cite hundreds of epidemiological studies that EPA claims provide robust and consistent support for the claim that ozone causes serious harm, even at levels below an 85 ppb, 8-hour standard. What EPA avoids discussing is that these epidemiological studies are all of a type known as an "observational" study and that observational studies have been shown to give spurious results.

Observational epidemiology studies work with non-randomly selected subjects and non-randomly assigned pollution exposures and then use statistical methods to try to remove the biases inherent in non-random data. Unlike controlled clinical or laboratory studies, which can produce direct evidence for cause-effect relationships, the evidence from observational studies is indirect. The implicit assumption in an observational study is that after researchers have controlled for all known sources of bias, any residual correlation between, say, air pollution and risk of an asthma attack, represents a genuine causal connection. However, several lines of evidence indicate that this assumption is false, and that observational studies instead tend to turn up false indications of risk that are statistical figments, rather than real effects.

First, it is nearly impossible to control for all of the biases inherent in non-random data, because most of these biases are either unmeasured or unknown. Even more importantly, incentives for publication bias and data dredging cause an exaggeration of the apparent size of any given health effect reported in the epidemiologic literature and encourage researchers to "find" what they are looking for.

Publication bias refers to the tendency of researchers to seek publication of, and for scientific journals to accept for publication, mainly those studies that find a statistically significant effect, while not publishing studies that do not find an effect. As a result, the real effect of any particular air pollutant, diet, medical intervention, etc., is smaller than the studies in the scientific literature would naïvely lead one to believe.

Data dredging refers to the risk that observational studies can become statistical fishing expeditions that turn up chance correlations, rather than real causal relationships. Think of the statistical models that researchers use to control for bias in observational studies as having lots of "dials" or "knobs" that researchers can turn in order to "tune" the statistical model to fit the observations. Researchers tend to turn these knobs and dials in ways that maximize the effects they "expect" to find, and are more likely to seek publication of studies that find the expected effect.

Researchers have been aware of these problems for a long time. Here is a recent caution on publication bias from a group of air pollution epidemiologists:

Publication bias arises because there are more rewards for publishing positive or at least statistically significant findings. It is a common if not universal problem in our research culture…In the field of air pollution epidemiology, the question of publication bias has only recently begun to be formally addressed. (Anderson et al. 2004)

Air pollution epidemiologists have also noted that it is common for researchers to selectively report results for statistical models that maximize the apparent risks of air pollution, rather than the full ensemble of results of their statistical modeling:

Estimation of very weak associations in the presence of measurement error and strong confounding is inherently challenging. In this situation, prudent epidemiologists should recognize that residual bias can dominate their results. Because the possible mechanisms of action and their latencies are uncertain, the biologically correct models are unknown. This model selection problem is exacerbated by the common practice of screening multiple analyses and then selectively reporting only a few important results. (emphasis added) (Lumley and Sheppard 2003)

each study can generate a large number of results for various outcomes, pollutants and lags and there is quite possibly bias in the process of choosing amongst them for inclusion in a paper. (Anderson et al. 2004)

Publication bias and data mining are serious problems not only in air pollution epidemiology but in health research in general. In just the last few years much conventional medical wisdom that was based on observational epidemiology studies has been tested and overturned by randomized controlled trials, which do not suffer from the biases inherent in observational studies. In a recent review of observational studies, Young and Karr reported that 12 recent randomized trials tested 52 different claims from observational studies (Young and Karr 2011). All 52 claims were contradicted by the randomized controlled trials.

A number of epidemiologists and statisticians believe that observational epidemiology methods are not even capable of providing reliable evaluations of health risks, especially when the putative risks are small, as they are for air pollution (Taubes 1995; Ioannidis 2005; G. D. Smith 2001). A number of studies have also provided direct evidence that observational studies of air pollution and health are generating false indications of risk as a result of data mining and publication bias (Anderson et al. 2004; M. L. Bell, Dominici, and Samet 2005; Ito 2003; Keatinge and Donaldson 2006; Koop and Tole 2004).

Because the vast majority of observational studies have been overturned when tested in randomized trials, the prudent course is to conclude that air pollution epidemiology studies are no more valid than other observational studies. Indeed, there is reason to believe that observational air pollution studies are even less likely to be valid. The chance that an observational study's results are spurious increases as the magnitude of the putative health effect decreases (Ioannidis 2005). The putative risks of current levels of air pollution are tiny compared to the putative health risks assessed in medical intervention studies.

EPA cites the large number of observational epidemiology studies claiming harmful effects of low-level ozone as evidence that the harm is real. But implementing an invalid methodology over and over again doesn't improve its validity. Rather, EPA should acknowledge that observational studies are not an appropriate basis for assessing the health effects ozone at or below current ambient levels.

An additional reason to discount epidemiologic studies is their lack of biologic plausibility. Laboratory studies with animals suggest that ozone is not deadly, even at concentrations many times greater than ever occur in ambient air. Researchers have exposed monkeys, rats, and other species to very high levels of ozone (as high as 1000 ppb) for the equivalent of years, yet none of the animals have died. At a 2005 meeting of EPA's Clean Air Science Advisory Committee to discuss a draft of EPA Ozone Criteria Document, Charles Plopper, a professor at UC Davis, expressed skepticism regarding the claim that ozone causes premature mortality, stating "I'm trying to look at it as a biologist and trying to figure out whether [ozone] exposure kills people. And I've never killed a rat in 35 years…and never killed a

monkey in 35 years. And I've been accused of using too high [ozone] levels…So I'm trying to figure out does this even make any sense from a biology point of view?"

4.2 EPA's Selective Characterization of evidence

Although EPA's Ozone Criteria Document (CD) includes many caveats in its discussions of the evidence on ozone's health effects, the CD overall selectively emphasizes studies and portions of studies reporting harmful ozone effects, while downplaying studies reporting no effects or apparently protective ozone effects. Likewise, the CD is quick to emphasize weaknesses in studies that report little or no harmful effect from ozone, while ignoring weaknesses in studies reporting harmful effects. Summary sections of the CD often draw conclusions that are at odds with the detailed evidence presented in more technical and detailed sections of the CD.

For example, in a summary in Chapter 8, the CD claims ozone effect sizes are relatively consistent across studies (Environmental Protection Agency 2006, 8–56). However, this claim is based on pooling of results across cities and/or studies, and masks the large heterogeneity of the results between individual cities and even the same city across individual studies. For example, the NMMAPS study (M. L. Bell et al. 2004) reported a range of a -5% to +16% increase in mortality per 10 ppb increase in 24-hour ozone across the 95 cities in the study. Higher ozone was associated with reduced mortality in nearly 40 percent of the cities in the study (see Figure 3 in Bell et al. (2004)). A more recent reanalysis of the NNMAPS data has only amplified these concerns (R. L. Smith, Xu, and Switzer 2009).

Nevertheless, EPA draws conclusions based on the pooled results, rather than the individual city results, creating an appearance of consistency that does not in fact exist. The city-by-city data from NMMAPS and other studies cited in the CD demonstrate the huge and biologically implausible range of apparent ozone effects on mortality, from very protective to very harmful.

The CD also fails to note that the pooled result in NMMAPS is sensitive to a few outlier cities. Moolgavkar (2002; 2005) has shown that the NMMAPS pooled PM10 mortality association becomes statistically insignificant when just two or three outlier cities are removed from the analysis. Examination of Figure 3 in Bell et al. (2004) suggests that one extreme outlier city and two or three more moderate outliers are driving the statistical association of ozone and mortality as well. The CD demonstrates the great heterogeneity of ozone associations in the technical sections of the document, but the summary sections draw conclusions about consistency that are at odds with this evidence.

In its recent Integrated Science Assessment for ozone EPA continues to ignore evidence against ozone having a causal role in mortality associations. EPA asserts that the mortality effects for ozone have been found at concentrations well below the current 75 ppb standard, citing an analysis of the NMMAPS data that excludes high-ozone days from its analysis (EPA 2012b; Michelle L. Bell, Peng, and Dominici 2006). However, in a follow-up study, Bell et al. (2007) restricted the analysis to days with low ozone, the variability of ozone effects across communities actually widened. When the analysis was restricted to days with ozone less than 20 ppb, the range of individual city ozone-mortality associations for a 10 ppb increase in ozone ranged from -20 percent to +30 percent. It is not plausible that such low ozone exposures could be causing large increases in mortality in some cities and large decreases in mortality in others. With such large variations and such biologically implausible results, the most plausible interpretation is that these are not real ozone effects, but statistical artifacts.

The CD makes a few mentions of publication bias and model-selection bias in ozone epidemiology

studies, but these concerns seem to have had little effect on the CD's actual use of evidence and conclusions. For example, the CD cites three EPA-commissioned meta-analyses (M. L. Bell, Dominici, and Samet 2005; Ito, De Leon, and Lippmann 2005; Levy, Chemerynski, and Sarnat 2005) in support of the conclusion that daily ozone fluctuations are increasing daily mortality, stating: "These three studies, along with the earlier meta-analyses, provide strong evidence that O3 is associated with mortality" (CD, p. 7-84). This claim ignores the degree to which publication bias inflated the ozone effect estimates in these studies. For example, Bell et al. (2005) presented evidence that publication bias may have inflated the meta-analytic ozone effect estimate by more than a factor of 3—a fact not mentioned in the CD.

The CD claims that the consistency of the results lends weight to their conclusions. But this consistency is more likely due to the three studies sharing the same biases, rather than to an underlying relationship of the results to real-world health effects. As a commentary accompanying the meta-analyses concluded: "In the absence of NMMAPS or other multisite analyses, some observers might have taken the agreement of the meta-analyses as confirmation that the meta-analytic method was reliable. However, if our observational methods are all subject to the same biases, as meta-analyses are when they are derived from the same pool of studies, the agreement criterion is testing a narrow range of assumptions." (Goodman 2005)

The CD's cursory treatment of publication bias also points up the selective way in which the CD marshals evidence. The CD uses the Bell et al. (2004) NMMAPS results as evidence of an ozone mortality effect, but discounts these same NMMAPS results when they provide evidence that publication bias inflates the meta-analytic ozone-mortality estimates.

As with the effect of publication bias, the CD mentions, but fails to adequately account for the degree to which model selection bias inflates ozone effect estimates. Koop and Tole used Bayesian Model Averaging (BMA) to conclude, based on data for Toronto, that ozone is unlikely to be associated with daily mortality (Koop and Tole 2004). The CD summarily dismisses this research with a few sentences about BMA's limitations in the introduction to Chapter 7, and does not consider the technique further. Koop and Tole (2004) is not mentioned at all in the Staff Paper.

Yet the problem of model selection bias is becoming widely recognized in air pollution epidemiology, and Koop and Tole (2004) is one of the few efforts to systematically address the issue. For example, the Health Effects Institute special panel that reanalyzed the GAM time series studies concluded that various model selection choices may "introduce an element of uncertainty that has not been widely appreciated previously" (Health Effects Institute 2003). Likewise, Ito (2003), in the same report, concluded:

"Weather model specification and the extent of temporal smoothing are not the only factors that can change pollution [Relative Risk] estimates. Others may include the location of monitors, choice of lags, and consideration of distributed lags. These factors can cause differences that vary by up to a factor of two in estimated pollution coefficients."

These problems are compounded by the selective publication of larger and more statistically significant effects. Lumley and Sheppard (2003) cautioned:

"Estimation of very weak associations in the presence of measurement error and strong confounding is inherently challenging. In this situation, prudent epidemiologists should recognize that residual bias can

dominate their results. Because the possible mechanisms of action and their latencies are uncertain, the biologically correct models are unknown. This model selection problem is exacerbated by the common practice of screening multiple analyses and then selectively reporting only a few important results."

Likewise, Smith et al. (2001) similarly warn:

"From a statistical point of view, the common epidemiological practice of choosing variables (including lagged variables, co-pollutants, etc.) that maximize the resulting effect estimates is a dangerous approach to model selection, particularly when the effect estimates are close to 0 (i.e., RR close to 1.0)."

In fact, Koop and Tole is not the only paper, and BMA is not the only method of demonstrating the effects of model-selection bias. Ito (2003) estimated 1,220 separate air pollution-mortality models for Detroit and substantial fraction suggested a "protective" effect of air pollution on health. More recent work suggests that failing to account for model selection bias can make air pollution effects appear statistically significant when in fact they are not (Roberts and Martin 2010).

Keatinge and Donaldson (2005) showed that changes in adjustment for weather can cause the apparent effect of ozone on short-term mortality to disappear. When they allowed in their model for cumulative effects of heat stress over several days, as well as the additional effects of direct sunshine, which adds to heat stress, the association of ozone with mortality was reduced by 90 percent and became statistically insignificant.

The CD's density plots indirectly show that consideration of publication and model-selection bias would have greatly reduced the health effects attributed to ozone. For example, the density plot for mortality on page 7-128 has 25 percent of the probability on the side of a protective effect for ozone. But for multi-city studies, the chart relies on pooled results, rather than individual city results. For example, NMMAPS includes 95 city results, nearly 40 percent of which suggested a protective effect of ozone. Entering results for individual cities would increase the amount of probably on the side of protective ozone effects. Furthermore, the density chart relies only on published point-estimate studies, and therefore suffers from publication bias (only partially accounted for by having a few multi-city studies) and model selection bias (not accounted for at all). Accounting for these effects would push still more of the probability toward negative (that is, protective) ozone effects.

The Health Effects Institute's recent APHENA study only amplifies concerns regarding EPA's exaggeration of ozone-mortality associations (Katsouyanni and Samet 2009). In single-pollutant models of ozone and mortality, only 12 of 24 models resulted in a statistically significant relationship between ozone and death in the U.S. Furthermore, when modeling risk of death in those over and under 75 years of age, 10 of 24 models gave statistically significant results for those under 75, and 6 of 24 for those over 75. In models that also controlled for particulate matter, ozone was no longer statistically significant in any of the models. None of these results suggests robust or consistent evidence for ozone as a cause of premature mortality.

Overall, EPA's conclusion of robustness and consistency of ozone associations with mortality and other health effects is mistaken, and its presentation of the evidence creates an appearance of consistency and robustness that does not exist in the full range of research results.

		The paragraphs above discuss EPA's general problem of mischaracterizing evidence. Below we point out some additional cases in which EPA's ozone Criteria Document mischaracterizes specific studies, creating a bias toward assuming greater air pollution health effects than the actual results of the studies would suggest. Children's Health Study Asthma Results: The California Children's Health Study (CHS) assessed the risk of developing asthma due to air pollution in a cohort of 3,535 children with a five-year follow-up (McConnell et al. 2002). According to the CD, "Asthma risk was not higher for residents of the six high-O3 communities versus residents of the six low-O3 communities" (p. 7-109). The Staff Paper makes a similar claim (p. 3-24). These claims are mistaken. The risk of asthma was 30 percent lower in the six high-ozone communities, relative to the six low-ozone communities in the study. The CD notes that asthma risk was 3.3 times greater for children in high-ozone communities playing three or more team sports (8 percent of the children), though this result was based on a small sample. This means the risk of developing asthma must have been 50 percent lower for the other 92 percent of children in the study (in order to match the 30 percent lower risk of asthma observed for the full cohort). When the 12 communities were divided into tertiles, increased asthma risk was reported for only the 4 highest ozone communities. These 4 high-ozone communities—all in the eastern portions of the South Coast Air Basin (the Los Angeles metro area)—at the time had by far the highest ozone levels in the country. The study was based on ozone levels during 1994-97, when these areas violated the old 1-hour ozone standard dozens of times per year and violated the 8-hour, 85 ppb ozone standard more than a hundred times per year. The rest of the U.S. has ozone levels typical of the medium- and low-ozone areas of the Children's Health Study, for which there was no increase in risk of developing asthma, even in very active children. Thus, this study suggests that even the old federal 1-hour ozone standard is more than protective against the development of asthma. If the higher asthma risk with higher ozone for very-active children is to be taken as causal, then there is no justification for not taking the lower overall asthma risk as also causal. If so, there are two conclusions that EPA should have drawn: First, overall, higher ozone levels reduce the risk of developing asthma. Second, the federal 1-hour, 125 ppb and 8-hour, 85 ppb ozone standards protect against the development of asthma with a huge margin of safety, even in the most physically active children. The CD and Staff Paper should not have created the impression that a more stringent ozone standard would reduce children's risk of developing asthma. Another important result from the Children's Health Study is that even after a exposure from birth to ozone exceeding the 1-hour 125 ppb standard more than a hundred days per year, ozone had no effect on teenagers' lung development or lung function (Gauderman et al. 2004). Multi-City Study of Ozone and Use of Asthma Medication. The CD claims "the strong evidence from the large multicities [sic] study by Mortimer et al. (2002)" (CD, p. 8-44) shows that ozone is associated with increased medication use. But the evidence from this study is not strong. The ozone effect was statistically significant only in a single-pollutant model. It became statistically insignificant when any other pollutant was added as a covariate. The CD creates the false impression that other pollutants had little confounding effect on the results: "In multipollutant models, the O3 effect was shown to be slightly diminished" (CD, p. 7-45; emphasis added). In fact, the ozone effect dropped by 40 percent when NO2 was added to the model, and dropped to zero when NO2, SO2, and PM10 were added.					

CARB/Kaiser Central Valley Study. This time-series study reported a statistically significant decrease in acute health effects with higher ozone levels (van den Eeden et al. 2002). The CD does not mention this study.

4.3 Laboratory studies with human volunteers indicate that an 8-hour ozone standard of 85 ppb is protective of human health with room to spare

In both the CD and more recent Integrated Science Assessment (ISA) (EPA 2012b), EPA asserts that laboratory studies with human volunteers provide direct evidence that ozone causes adverse effects at levels below the 85 ppb, 8-hour ozone standard, and even the newer 75 ppb ozone standard. In the CD EPA places special emphasis on studies by Adams (2006; 2002) because at the time they were the only studies that examined respiratory effects associated with ozone exposures for several hours at levels below 80 ppb. The ISA also cites more recent studies that also assessed effects of low ozone levels on human volunteers (Kim et al. 2011; Schelegle et al. 2009).

In these studies, healthy young-adult college students were exposed to ozone at various concentrations (60, 70, 80, and 87 ppb, depending on the study) for 6.6 hours while exercising, and their lung function and subjective symptoms were measured several times during the exposure period. Group-average changes in lung function with 60 ppb ozone were very small. After 6.6 hours, FEV1 (forced expiratory volume in one second) declined by about 1.7 to 2.7 percent (declines were not statistically significant), depending on the study, returning back to normal within 1 hour after ozone exposure ended. Subjective symptoms were not affected by exposure to ozone.

Schlegle et al. (2009) assessed a 70 ppb exposure and reported a mean reduction in FEV1 of about 5 percent that took a few hours to return back to normal. Total Symptom Score also increased, from a maximum of about 4 with ozone-free air to a maximum of about 13 with 70 ppb ozone. This is on a scale from zero to 160, so the change in symptoms was quite small.

These changes are small and clinically insignificant. However, EPA expressed concern over the fact that a few subjects experienced larger temporary reductions in lung function. Regarding the Adams studies, EPA reported that after 6.6 hours, 2 of 30 subjects in the Adams studies experienced temporary lung-function reductions in FEV1 of 10 percent or more, when exposed to ozone at 60 ppb (EPA 2007b, 37828). More recently, Schlegle et al. (2009) also reported that 6 of the 31 subjects in that study likewise experienced temporary FEV1 reductions greater than 10 percent at both 60 and 70 ppb. Based on these results, EPA concludes that standards of 85 ppb or 75 ppb do not sufficiently protect people from ozone. In its ISA, EPA concludes: “Though group mean decrements are biologically small and generally do not attain statistical significance, a considerable fraction of exposed individuals experience clinically meaningful decrements in lung function” (ISA p. 6-18).

This conclusion is unwarranted for two reasons. First, because of the well known difference between ozone concentrations measured ambient monitoring stations and actual personal exposures to ozone while outdoors, the personal ozone exposures in the Adams, Schlegle et al., and Kim et al. studies were equivalent to ambient-monitor ozone levels of 100 ppb or more. After accounting for the personal exposure-to-ambient monitor ratio, it is clear that ozone does not have adverse effects at ambient-monitor concentrations below 85 ppb.

Second, even without accounting for the personal exposure-to-ambient monitor ratio, EPA had to make

a heroic stretch to find adverse effects in the laboratory ozone studies. As discussed in more detail below, the studies used unrealistically extreme amounts of exercise (equivalent to four or five gym workouts in a row) and the few cases with FEV1 declines of greater than 10 percent could easily have been due to within-subject variability, rather than ozone.

i. Ignoring the difference between personal exposure and ambient-monitor ozone levels causes EPA to great exaggerate ozone's health effects. Once this difference is accounted for, there is no evidence for adverse effects of ozone at levels below 85 ppb (as measured at ambient monitors).

A great deal of evidence indicates that personal ozone exposures—the amount of ozone in the air people actually breathe into their lungs—even while outdoors, are much lower than ambient ozone levels measured at ambient ozone monitors. The reason is that ambient ozone compliance monitors are generally placed several feet above human head-height and away from surfaces, in order to avoid interferences from people and surfaces near the ground that could affect the fidelity and consistency of the ozone measurements. Ozone is very reactive and any nearby surfaces (such as clothing or the ground) reduces the amount of ozone in the air that people actually breathe into their lungs.

Evidence comparing ambient ozone concentrations with personal exposures includes the following:

• Trained technicians in eastern Los Angeles County wore personal ozone monitors and performed scripted activities, such as walking outdoors near or away from a roadway, sitting in a backyard, driving with windows open or closed, performing normal household activities indoors, and so forth, during specific times of the day (Johnson et al. 1996). Personal exposures while outdoors averaged 41 percent lower than hourly ambient ozone levels reported at the nearest monitors. The ratio of personal to ambient ozone level was the same whether the technician was near or away from roadways.

• Outdoor workers in Mexico City experienced average personal ozone exposures 60 percent lower than ambient-monitor levels in a study of thirty-nine shoe-cleaners (O'Neill et al. 2003). All ozone exposures in this study took place outdoors.

• In a study of thirty-six children in Tennessee, those in the top 25 percent for time-spent-outdoors nevertheless experienced personal ozone exposures 80 percent lower than levels measured at ambient monitors (K. Lee et al. 2004).

• A study in Baltimore had a trained technician perform scripted activities to simulate a typical daily schedule of a senior citizen while carrying a personal ozone monitor (Chang et al. 2000). The study reported that personal ozone exposure during the summer averaged 33 percent lower than ambient-monitor levels while outdoors near a roadway, and 11 percent lower while outdoors away from roadways.

• A companion study to the one above measured personal ozone exposures of 15 senior citizens during summer in Baltimore for a total of 12 days each (Sarnat, Koutrakis, and Suh 2000). The highest personal exposures—reflecting more time spent outdoors—were well below ambient-monitor levels. While the highest ambient-monitor level on any day was 54 ppb the highest personal ozone exposure for any of the 15 people in the study was 21 ppb (60 percent lower) and the second highest was 17 ppb (68 percent lower). As the authors noted, "[P]ersonal exposures to O3 [ozone], NO2, and SO2 were extremely low. Seventy percent of the measured personal O3, NO2, and SO2 values were below their respective LOD [limit of detection], even when ambient concentrations were well above their LOD"

(Sarnat, Koutrakis, and Suh 2000, 1188).

• Liu et al. (1997) found that a group of forty children and adults in Alpine, California, experienced average personal ozone exposures 75 percent lower than ambient levels.

• A year-long study of 169 children in Upland and the Crestline area, both high-ozone regions in San Bernardino County, California, reported that personal ozone exposures during the ozone season averaged 61 and 58 percent below the respective ambient levels in the two areas (Geyh et al. 2000).

• A study of 158 asthmatic children in Mexico City reported that personal ozone exposures averaged 77 percent less than ambient-monitor concentrations (Ramirez-Aguilar et al. 2008). The highest personal ozone exposure—reflecting the most time spent outdoors—for any child was 52 percent lower than the highest ambient-monitor ozone level and 7 percent lower than the median ambient-monitor ozone level during the study.

This difference between ambient ozone concentrations and personal exposures is key for interpreting the laboratory studies. The ozone levels used in laboratory studies such as Adams, Schlegle et al., and Kim et al., are personal exposures. To compare them to equivalent ambient-monitor levels, one must account for the fact that personal ozone exposures while outdoors are typically at least 40 percent lower than ozone levels measured at ambient monitors. Or, to turn this around, ozone levels measured at ambient monitors are typically at least 1.67 times greater than concomitant personal outdoor exposures.

Table 3, below, translates the personal ozone exposures used in the laboratory studies into equivalent concentrations at ambient compliance monitors. Because ambient-monitor levels are at least 1.67 times personal exposures, Table 3 uses a conversion factor of 1.67 to go from the personal exposure levels in the Laboratory studies to equivalent ambient levels. The table gives both the average and peak level for each exposure pattern.

Table 3. Comparison of personal ozone exposures used in the Adams, Schlegle et al. and Kim et al. studies with equivalent ambient-monitor concentrations

Laboratory personal ozone exposure protocols Equivalent ambient-monitor ozone concentration

Exposure Pattern 6.6-hour Average Personal Ozone Exposure Concentration Peak-Hour Personal Ozone Exposure Concentration 6.6-hour Average Concentration Peak-Hour Concentration

Filtered Air 0 0 0 0

Triangular 40 50 66 84

Square 60 60 100 100

Triangular 60 90 100 150

Triangular 70 90 117 150

Square 80 80 134 134

Triangular 80 150 134 250

Notes: All values are in parts per billion (ppb). Bold entries signify ozone exposures that exceeded the 8-hour, 75 ppb or 85 ppb ambient standards. Italicized entries signify exposures that also exceeded even the old 1-hour, 125 ppb standard. A “square” exposure pattern means that subjects breathed a constant ozone concentration for the 6.6-hour experiment. A “triangular” exposure pattern means subjects breathed ozone that rose to a peak during the first half of the exposure period and then fell during the second half. EPA is comparing apples to oranges when it assumes the effects of, say, 60 ppb ozone in the laboratory provides information on the health effects of 60 ppb ozone measured at an ambient compliance monitor. In fact, 60 ppb in the laboratory is equivalent to 100 ppb as measured at an ambient monitor. After converting the personal exposures in Adams (2006) to equivalent ambient levels, we can see that the effective ozone exposures in Adams (2006) were actually much greater than EPA assumes. For example, to get a personal exposure of 60 ppb, the ambient concentration would need to be at least 100 ppb. If anything, Adams (2006) and more recent similar studies (Kim et al. 2011, Schlegle et al. 2009) show that even ozone levels substantially greater than the 8-hour, 75 or 85 ppb standards have little or no effect on people’s lung function.

EPA is aware of the difference between ozone concentrations measured at ambient monitors and actual personal exposure concentrations, but ignores this difference in interpreting laboratory studies of the effects of low ozone levels. In its Ozone Criteria Document (EPA 2006) EPA devotes pp. 3-56 to 3-76 to a discussion of personal exposure vs. ambient concentration and cites most of the articles we cite above in the bullet points. However, EPA cites these papers to support the (correct) claim that personal exposures and ambient-monitor levels are correlated, meaning that personal exposures tend to rise and fall in concert with ambient-monitor levels. EPA notes this correlation to support the contention that ambient monitors provide a valid measure of ozone exposure for the purposes of observational epidemiology studies. However, EPA omits the fact that these same studies also show that personal exposures, even while outdoors, are much lower than ozone levels measured at ambient monitors.

There is, however, one instance where EPA explicitly compares outdoor personal exposures to outdoor ambient-monitor levels. In this case, EPA notes that Brauer and Brook (1997) reported that the personal ozone exposure of farm workers in the lower Fraser Valley (Canada), who spent all of their time outdoors, was only 4 percent lower than ambient monitor levels (Environmental Protection Agency 2006, 3–74), implying that personal exposure it not much lower than ambient-monitor levels.

EPA’s characterization is misleading in three ways. First, Brauer and Brook themselves point out that their personal ozone measurements have a large error and likely a positive bias as well. Second, ambient ozone levels were extremely low in this study—about 15 to 30 ppb on most days and never greater than 50 ppb (as measured at ambient monitors). Third, difference between personal exposure and ambient-monitor ozone was greatest on days with the highest ozone. For example, the five highest-ozone days ranged from 39 to 50 ppb (all other days ranged from 8 to 34 ppb) personal exposure averaged 22 percent lower than ambient-monitor levels (compared with 4 percent lower overall).

In summary EPA mentions the difference between ambient and personal ozone levels when doing so helps EPA make a case for the validity of the observational epidemiology studies (i.e., when EPA notes the correlation between personal and ambient ozone), but generally ignores the personal vs. ambient difference when doing so would vitiate EPA’s case for harm from low-level ozone (i.e., EPA ignores the

		fact the outdoor personal ozone exposures are much lower than ambient-monitor levels when interpreting the results of the Adams laboratory studies). Furthermore, in the one case where EPA does compare personal to ambient ozone levels, EPA cites only a single outlier study (in which the study authors themselves cast doubt on the validity of the measurements) to create a false impression that there is little difference between personal and ambient ozone levels. ii. Even without accounting for the personal exposure-to-ambient monitor ozone ratio, the laboratory results suggest that ozone does not have adverse effects below 85 ppb EPA glosses over is how difficult it is to induce even the small ozone effects observed in the laboratory studies, despite the fact that the ozone levels in these studies were effectively much greater than the original 8-hour ozone standard and even the old 1-hour standard. It is true, as EPA notes, that a couple of subjects experienced FEV1 declines greater than 10 percent at the 60 ppb exposure in the Adams studies. Figures 10 and 11 display individual results for, respectively, men and women, at the 60 ppb triangular exposure. As the graphs show, one man experienced an FEV1 decline of 12 percent after 6.6 hours, and one woman experienced a decline of 21%. Figure 10. Adams (2006) data for menSource: Data provided by William Adams, Professor Emeritus, UC Davis.Figure 11. Adams (2006) data for womenSource: Data provided by William Adams, Professor Emeritus, UC Davis.First, note once again that the ozone exposure was equivalent to at least 100 ppm when translated into ambient-monitor terms, and was therefore effectively at least 18 percent greater than an 8-hour ozone standard of 85 ppb. Thus, even these effects required a relatively high ozone exposure. It certainly does not provide evidence of any effects at ozone levels below an ambient monitor level of 85 ppb. Second, note that it took more than five hours of continuous ozone exposure before even the most sensitive people began to show any FEV1 reduction. The subjects spent 50 minutes of every hour performing relatively vigorous aerobic exercise on a treadmill or stationary bicycle. Each 50-minute bout was roughly equivalent to a gym workout. The full 6.6-hour exercise regimen was similar to going on an all-day hike or going to the gym six times in a row in one day. This level of exercise was necessary to raise people's respiration rate high enough so that they would breathe in enough ozone to affect their FEV1. In other words, it took an unrealistically lengthy bout of relatively vigorous exercise even to achieve the small effects that were observed at the 60 ppb personal exposure. To see how unrealistic, the breathing rates in the laboratory studies can be compared with real-world breathing rate data for the general population from Brochu (2006). In the three laboratory studies, the subjects inhaled air at a rate of 20 liters per minute per square meter of body surface area. This translates into inhalation rates of about 55 cubic meters or air per day (m3/day) for men and 46 m3/day for women. In the Brochu (2006) data, the 99th percentile of inhalation rate for any age group is 24 m3/day for men and 19 m3/day for women (both for ages 18 to 30). Since ozone dose is proportional to air inhalation rate, this demonstrates that the ozone doses used in the Adams, Schlegle et al., and Kim et al. studies are much higher than real-world humans would ever experience. And even so, these studies were able to elicit minimal effects on lung function and symptoms.					

There is an additional reason why this issue of lengthy exercise is important. The Adams study was performed with physically fit exercise physiology majors from UC Davis. The Schlegle et al. and Kim et al. studies were performed with similar physically fit young adults. EPA claims that these people, being healthy, are less likely to experience significant effects of ozone and that children and the elderly would be more sensitive to ozone's effects. As a result, EPA claims, these laboratory studies place only a lower limit on the effects of low ozone exposures. But this claim ignores the fact that children, the elderly, and those with respiratory diseases are not capable of exercising vigorously for the hours in a row necessary to elicit even the small ozone effects reported by Adams. Indeed, as the Brochu (2006) data show, for children and the elderly, 99th percentile inhalation rates are much lower than for the 18 to 30 age group: 12 m3/day for children ages 3 to 10, and 18 m3/day for adults over 60. Thus, contrary to EPA's claim, the results of Adams, Schlegle et al., and Kim et al. apply even less to children and the elderly than to young adults.

Conclusion

EPA's ozone modeling is based on 1990s ozone-precursor emissions, making it invalid for assessing the effects of climate warming on ozone levels in the future, when ozone-precursor emissions will be far lower. Indeed, even current ozone-precursor emissions are only about half the levels used in EPA's studies.

Research based on more realistic levels of future ozone-precursor emissions shows that ozone levels will be much lower in the future, regardless of warming, and that the effect of warming on ozone—the "climate penalty"—has already been greatly reduced. Since ozone-precursor emissions are dropping rapidly, whatever climate penalty remains will likely disappear within a decade or two, as most remaining ozone-precursor emissions are eliminated by already-adopted measures.

Taken together the weight of the evidence indicates that EPA has exaggerated future ozone levels, the effects of warming on ozone levels, and the health risks from any given level of ozone. In reality, future ozone levels will be below a level of concern for human health, regardless of whether the climate warms.

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Jonathan	Wu	Organization and clarification of the eighth, fifteenth, and sixteenth chapters (the chapters I have read) would be beneficial. By making the chapter more readable and focused to the key messages in the beginning of the chapter; it allows the public to better understand the content in the NCADAC report. Also it is difficult for the public to encounter, unless one is specifically looking for it. The public should be better informed of this resource. Thank you					Thank you for your comment. The electronic format of the final report should help the public greatly to discover the information within the report.
Michele	Crim	Climate change presents uniquely challenging issues for cities, and particularly the country’s compact urban areas. As identified in the National Climate Assessment, cities face the challenge of needing to serve expanding populations with complex infrastructure systems that are 1) typically stressed from operating near maximum capacity, and 2) deteriorating and already at risk of failure due to age and deferred maintenance. The City of Portland, Oregon is pleased to see a focus on the impacts of climate change to people in the Assessment. In particular, the focus on the disproportionate impacts to vulnerable populations, including communities of color and low-income communities, is laudable. It is clear that addressing longstanding inequalities that currently exist in our cities is critical to ensuring that all members of our communities are able to prepare for and respond to a changing climate in the future. The City of Portland appreciates the attention to the challenges facing cities in the Assessment, particularly in Chapter 9 (Human Health), Chapter 11 (Urban Systems) and in many of the Regional chapters. The economic and social impacts of climate change on our urban centers are substantial--in some cases potentially catastrophic--and are deserving of special attention in the Assessment. Some scientists and policymakers have asserted or implied that people are able to adapt more readily to physical changes in the environment, and therefore climate adaptation efforts should focus on natural systems that are less able to adapt quickly. However, the viable adaptation options available to	9. Human Health				This comment does not seem to raise any question or suggest any revision.

		most cities are significantly constrained due to: · Lack of funding to make needed infrastructure improvements and strengthen social safety nets; · Physical realities, such as the enormous challenge of relocating parts of the city out of harms way, or the monumental difficulty in moving a river or stabilizing a landslide zone; · Limited financial resources of our vulnerable communities to prepare for (e.g., air conditioning) and recover from (e.g., flooded basement) climate change impacts; and · A lack of regionally specific data on climate trends and impacts in the urban environment to assist decision-makers. Humans are an impressively adaptable species, but the factors identified above significantly constrain adaptation options in urban environments. Under any scenario they present major economic and social costs to cities, residents, and businesses.We believe the focus on the socio-economic impacts to people living in urban centers--particularly vulnerable populations already facing deep social inequalities such as communities of color and low-income communities--should be elevated and made more explicit in the Assessment. We encourage the NCADAC and the chapter authors to consider additional opportunities to elevate the attention given to urban areas in the Assessment, particularly in the Regional chapters (including the Northwest (Chapter 21)), and in the Research Agenda for Climate Change Science (Chapter 29). Thank you for the opportunity to comment.					
Michele	Crim	Climate change presents uniquely challenging issues for cities, and particularly the country's compact urban areas. As identified in the National Climate Assessment, cities face the challenge of needing to serve expanding populations with complex infrastructure systems that are 1) typically stressed from operating near maximum capacity, and 2) deteriorating and already at risk of failure due to age and deferred maintenance. The City of Portland, Oregon is pleased to see a focus on the impacts of climate change to people in the Assessment. In particular, the focus on the disproportionate impacts to vulnerable populations, including communities of color and low-income communities, is laudable. It is clear that addressing longstanding inequalities that currently exist in our cities is critical to ensuring that all members of our communities are able to prepare for and respond to a changing climate in the future. The City of Portland appreciates the attention to the challenges facing cities in the Assessment, particularly in Chapter 9 (Human Health), Chapter 11 (Urban Systems) and in many of the Regional chapters. The economic and social impacts of climate change on our urban centers are substantial--in some cases potentially catastrophic--and are deserving of special attention in the Assessment. Some scientists and policymakers have asserted or implied that people are able to adapt more readily to physical changes in the environment, and therefore climate adaptation efforts should focus on natural systems that are less able to adapt quickly. However, the viable adaptation options available to most cities are significantly constrained due to: · Lack of funding to make needed infrastructure improvements and strengthen social safety nets; · Physical realities, such as the enormous challenge of relocating parts of the city out of harms way, or the monumental difficulty in moving a river or stabilizing a landslide zone; · Limited financial resources of our vulnerable communities to prepare for (e.g., air conditioning) and recover from (e.g., flooded basement) climate change impacts; and	11. Urban Systems, Infrastructure, and Vulnerability				Thank you for the thoughtful comment and we concur with your suggestions.

		· A lack of regionally specific data on climate trends and impacts in the urban environment to assist decision-makers. Humans are an impressively adaptable species, but the factors identified above significantly constrain adaptation options in urban environments. Under any scenario they present major economic and social costs to cities, residents, and businesses.The focus on the socio-economic impacts to people living in urban centers--particularly vulnerable populations already facing deep social inequalities such as communities of color and low-income communities--should be elevated and made more explicit in the Assessment. We encourage the NCADAC and the chapter authors to consider additional opportunities to elevate the attention given to urban areas in the Assessment, particularly in the Regional chapters (including the Northwest (Chapter 21)), and in the Research Agenda for Climate Change Science (Chapter 29). Thank you for the opportunity to comment.					
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		Climate Change Science (Chapter 29). Thank you for the opportunity to comment.					
Michele	Crim	Climate change presents uniquely challenging issues for cities, and particularly the country's compact urban areas. As identified in the National Climate Assessment, cities face the challenge of needing to serve expanding populations with complex infrastructure systems that are 1) typically stressed from operating near maximum capacity, and 2) deteriorating and already at risk of failure due to age and deferred maintenance. The City of Portland, Oregon is pleased to see a focus on the impacts of climate change to people in the Assessment. In particular, the focus on the disproportionate impacts to vulnerable populations, including communities of color and low-income communities, is laudable. It is clear that addressing longstanding inequalities that currently exist in our cities is critical to ensuring that all members of our communities are able to prepare for and respond to a changing climate in the future. The City of Portland appreciates the attention to the challenges facing cities in the Assessment, particularly in Chapter 9 (Human Health), Chapter 11 (Urban Systems) and in many of the Regional chapters. The economic and social impacts of climate change on our urban centers are substantial--in some cases potentially catastrophic--and are deserving of special attention in the Assessment. Some scientists and policymakers have asserted or implied that people are able to adapt more readily to physical changes in the environment, and therefore climate adaptation efforts should focus on natural systems that are less able to adapt quickly. However, the viable adaptation options available to most cities are significantly constrained due to: · Lack of funding to make needed infrastructure improvements and strengthen social safety nets; · Physical realities, such as the enormous challenge of relocating parts of the city out of harms way, or the monumental difficulty in moving a river or stabilizing a landslide zone; · Limited financial resources of our vulnerable communities to prepare for (e.g., air conditioning) and recover from (e.g., flooded basement) climate change impacts; and · A lack of regionally specific data on climate trends and impacts in the urban environment to assist decision-makers. Humans are an impressively adaptable species, but the factors identified above significantly constrain adaptation options in urban environments. Under any scenario they present major economic and social costs to cities, residents, and businesses.The focus on the socio-economic impacts to people living in urban centers--particularly vulnerable populations already facing deep social inequalities such as communities of color and low-income communities--should be elevated and made more explicit in the Assessment. We encourage the NCADAC and the chapter authors to consider additional opportunities to elevate the attention given to urban areas in the Assessment, particularly in the Research Agenda for Climate Change Science (Chapter 29), as well as in the regional chapter (Chapter 21). Thank you for the opportunity to comment.	29. Research Agenda for Climate Change Science				Much more has been added on multistress systems and impacts as a research goal including in the urban context.
Amanda	Campbell	The Letter is very good. Include some language about 'what is new' about this climate assessment and the previous one, either in this chapter or the introduction.	Introduction: Letter to the American People				This is a good suggestion, there is now some language to this effect in the framing section of the Introduction.
Amanda	Campbell	Although the figures are helpful, it is confusing that there are two different models. Either only include only the best model, or introduce the models as two possible findings. Explain the difference between	2. Our Changing		44	2	There are many climate models involved in these projections. The two

		the two models and their projections for precipitation, label the figures accordingly.	Climate				sets of maps illustrate two different generations of scenarios. There is no best future scenario. Each is considered equally likely. Due to constraints imposed by the NCADAC, the CMIP3 projections must be presented to support later chapters. The supporting text for Supplemental Message 5 in the Climate Science Appendix illustrates a more recent and broadened range of possible futures.
Amanda	Campbell	This section would be effective as online content on a webpage.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z				The entire report, including this chapter, will be available online.
Amanda	Campbell	The interpretation of the vertical access is not clear. Does it refer to change in number of events per decade compared to the century average?	2. Our Changing Climate	2.14	48		We have changed the units to percent. This has the straightforward interpretation that there were 40% more events in the decade of the 2000s compared to the average number during the reference period of 1901-1960.
Thomas Sawyer	Hopkins	Acidification of the ocean is only one of the Impacts. More relevant to the atmosphere is the ocean circulation particularly in northern Atlantic and Polar sea. These areas can control the atmospheric horizontal and vertical circulations. Furthermore, the production of deep water in the polar regions plays a large role in sequestering atmospheric carbon and storing it in the deep oceans.	1. Executive Summary		10	19	This is a good point, but the intent of the report findings is to highlight the highest level conclusions, not to repeat all of the findings in the chapters.
James	Taylor	Heartland Institute Comments on 2013 Draft National Climate AssessmentIntroductionThe National Climate Assessment and Development Advisory Committee's (NCADAC) 2013 Draft National Climate Assessment tackles many important climate-related questions but consistently reaches overly pessimistic conclusions. The Draft National Climate Assessment presents many asserted climatic change impacts – some real, some contradicted by the weight of scientific evidence – and paints a picture of a nation and world severely and negatively affected by human-induced climate change. By contrast, the weight of scientific evidence suggests only modest recent climate change by historical standards. Importantly, the weight of scientific evidence suggests the Draft Assessment overstates asserted recent harms and overlooks the fact that recent climatic changes are creating net benefits to plants, animals, and human welfare rather than net harm.The following Comments reflect and refer to more than 400 pages of scientific evidence presented in Climate Change Reconsidered: 2011 Interim Report of the Nongovernmental International Panel on Climate Change (CCR 2011).(1) Climate experts Craig D. Idso, Robert M. Carter, and S. Fred Singer served as Lead Authors of CCR 2011. Contributing	1. Executive Summary				The authors are fully aware of the natural variability within the climate system that has occurred over millenia, and is familiar with the past climate history documentation. They have also carefully reviewed the temperature data in recent decades and some clarifications have been added in response to your comments related to recent temperature variability. The authors have concluded that ongoing variability in the climate system needs to be

		scientists included Susan Crockford, Joseph D'Aleo, Indur Goklany, Sherwood Idso, Madhav Khandekar, Anthony Lupo, Willie Soon, and Mitch Taylor. CCR 2011 in turn builds upon more than 800 pages of scientific evidence presented in Climate Change Reconsidered: The 2009 Report of the Nongovernmental International Panel on Climate Change (CCR 2009).(2) CCR 2009 and CCR 2011 present more than one thousand citations to peer-reviewed scientific literature. Citations to CCR reports are provided within these Comments.The following Comments also draw upon additional data and studies. Citations to these data and studies are also provided within the Comments.We ask the NCADAC to consider the scientific evidence presented in these Comments, CCR 2009 (http://www.nipccreport.org/reports/2009/2009report.html) and CCR 2011 (http://www.nipccreport.org/reports/2011/2011report.html), and the additional cited data and studies. We further ask the NCADAC to reconsider several conclusions presented in the NCADAC 2013 Draft Assessment.Executive SummaryThe Earth's climate is always changing. These ongoing changes are evident in a wide variety of time scales, including decade-to-decade, century-to-century, and millennium-to-millennium. Care must be taken to examine and consider the full context of temperature trends, climatic changes, and individual weather events. Heat waves, cold spells, droughts, floods, wildfires, hurricanes, tornadoes, etc., occurred for millennia before the rise and spread of human civilization. The Earth has a dynamic climate and many different climate regions, resulting in climate and weather events that may at first blush appear to be exceptional. Exceptional events, however, are the norm with diverse and dynamic climatic systems. Many scientists suspect human emissions of greenhouse gases are contributing to recent climate change. Scientific challenges include determining to what extent humans may be contributing to global warming, identifying which if any weather and climate trends are linked to human activity, properly weighing the positive and negative impacts of human-induced climate change, and accurately projecting future climate change and impacts. The key to assessing whether humans are creating substantially harmful climate changes is to identify, understand, and apply proper context to recent climate and weather developments. The scientific evidence does not indicate humans are creating climate and weather changes that entail substantial net harm to plants, animals, or human welfare. Scientific evidence indicates many asserted changes in climate and weather appear to be well within natural variability and historical context. To the extent some climate and weather trends may bear a human signature, the net benefits of these trends appear to outweigh the net harms.These Comments will address the 11 specific Report Findings presented in the Draft National Climate Assessment, providing references to more than 1,200 pages of supporting scientific materials.Report FindingsThe NCADAC Draft Assessment presents 11 Report Findings summarizing the larger document. We address each Finding as presented:Draft Assessment Finding #1Global climate is changing, and this is apparent across the U.S. in a wide range of observations. The climate change of the past 50 years is due primarily to human activities, predominantly the burning of fossil fuels.U.S. average temperature has increased by about 1.5°F since 1895, with more than 80% of this increase occurring since 1980. The most recent decade was the nation's warmest on record. Because human-induced warming is superimposed on a naturally varying climate, rising temperatures are not evenly distributed across the country or over time.CommentsGlobal climate, as well as climate in the U.S., is indeed changing, but it is always changing. Such changes are not per se evidence of a human effect on climate, of something that is necessarily bad for human civilization or wildlife, or of something that can somehow be stopped by human intervention. All three assertions are unproven and in fact contradicted by available scientific understanding.(3) Sharp climate changes have occurred during such events as the end of the last ice age epoch, the onset of the Early Holocene Warm Period, the onset of the Roman Warm Period, and the onset of the Medieval Warm Period.(4) Plants,(5) animals,(6) and people(7) ave survived and thrived during and after these sharp climate changes, especially during and after such climate changes that brought warmer temperatures.The U.S. average temperature has risen much less than the Draft				distinguished from changes that are now occurring in the underlying climate system that are driven by anthropogenic forcing. A new section on variability vs trends has been added to the Context and Background section. Report finding #2 - the authors have been careful to distinguish which kinds of extreme events are linked to anthropogenic changes in the climate system, hence the language "Some" extreme weather and climate events have increased.. Report finding #3 - Based on their assessment of the literature and their own scientific expertise, the authors disagree with your conclusions about the utility of climate models and the connections between emissions of heat-trapping gases and climate change. Report finding #4: There are unquestionably benefits associated with climate change within some regions and sectors. However, evidence of the impacts of climate change is visible in virtually every region of the US, and on balance, the authors have concluded that the negative impacts outweigh the benefits. The authors have evaluated the evidence and concluded that there are increasing health threats in the context of climate change. Report finding #6 - There is ample evidence of the increasing cost of extreme events, particularly on infrastructure in coastal areas. The costs come from a combination of factors, including human decisions to invest in areas that are prone to coastal flooding and storm impacts. However, it is clear that rising sea levels and an increase in intensity, if not in number, of hurricanes is related to this increase in cost. Despite interannual and decadal variability,

		Assessment claims. Most of the asserted warming is not found in the raw temperature data and is instead the result of manipulation of adjustments to the surface station temperature record.(8) Temperature readings from satellite instruments show temperatures have risen only 0.3°C (0.6°F) since 1980.(9) U.S. temperatures have risen far less than 1.2°F since 1980, which means either the Draft Assessment temperature claims since 1895 are wrong or far less than 80% of the warming occurred after 1980. Objective scientific evidence calls into the question the assertion that the most recent decade was the warmest on record in the United States.(10) Even if it were, that record only goes back a little more than 100 years. The Earth in 1895 was just emerging from the Little Ice Age, a prolonged period of exceptionally cold weather that marked the coldest temperatures since the last ice age epoch ended 11,000 years ago. Current temperatures are still relatively cool in the context of the 11,000 years since the last ice age epoch ended.(11) Draft Assessment Finding #2Some extreme weather and climate events have increased in recent decades, and there is new and stronger evidence that many of these increases are related to human activities.Changes in extreme events are the primary way in which most people experience climate change. Human-induced climate change has already increased the frequency and intensity of some extremes. Over the last 50 years, much of the U.S. has seen an increase in prolonged stretches of excessively high temperatures, more heavy downpours, and in some regions more severe droughts.CommentsThe scientific evidence is very clear that there has been no increase in extreme weather events during recent decades. To the contrary, scientific evidence suggests extreme weather events are becoming less frequent and less severe.(12) During the last 50 years, the U.S. has experienced fewer hurricane strikes,(13) fewer strong tornadoes,(14) less severe drought,(15) and fewer extreme temperature events.(16) If human activities are affecting climate events – and it is highly unlikely they are -- the effect must be to reduce rather than increase the number of extreme weather events. Draft Assessment Finding #3Human-induced climate change is projected to continue and accelerate significantly if emissions of heat-trapping gases continue to increase.Heat-trapping gases already in the atmosphere have committed us to a hotter future with more climate-related impacts over the next few decades. The magnitude of climate change beyond the next few decades depends primarily on the amount of heat-trapping gases emitted globally, now and in the future.CommentsThis finding is speculative and completely unsupported by the scientific literature. Past changes in climate have not been shown to be due to human emissions of carbon dioxide or other so-called “heat-trapping gases,” and consequently no reliable predictions can be made about future changes. The entire exercise of making forecasts using climate models and simulations has been shown to have been an unsuccessful and expensive mistake.Manmade emissions of carbon dioxide and other greenhouse gases have exceeded most projections during recent decades(17) despite ongoing reductions in U.S. emissions,(18) and yet temperatures have risen only modestly or (during some time intervals) not at all.(19) The disconnect between emissions and temperatures reveals a lower climate sensitivity to carbon dioxide and other greenhouse gases than previously assumed by frequently cited climate models.(20) Draft Assessment Finding #4Impacts related to climate change are already evident in many sectors and are expected to become increasingly challenging across the nation throughout this century and beyond.Climate change is already affecting human health, infrastructure, water resources, agriculture, energy, the natural environment, and other factors – locally, nationally, and internationally. Climate change interacts with other environmental and societal factors in a variety of ways that either moderate or exacerbate the ultimate impacts. The types and magnitudes of these effects vary across the nation and through time. Several populations – including children, the elderly, the sick, the poor, tribes and other indigenous people – are especially vulnerable to one or more aspects of climate change. There is mounting evidence that the costs to the nation are already high and will increase very substantially in the future, unless global emissions of heat-trapping gases are strongly reduced.CommentsClimate change undoubtedly influences human health and many of the other things the Draft Assessment mentions. Climate has always had these effects and always will. The Draft				long term temperatures in the Arctic continue to rise. Report Finding 7 - There are major regional differences in the changes in precipitation patterns, and although there is more rain overall in the northerly portions of the US, the intersection of temperature increases with changes in seasonality of precipitation, as well as changes in snowmelt timing, are the most significant threats to water supply reliability. Report finding #8 There are now multiple studies that indicate that though the growing season is longer and CO2 fertilization has positive effects on some crops, there are offsetting effects from increases in heat and extreme events that are expected to limit productivity in the not too distant future. Report finding 10 (ecosystems) - there is evidence of escalating rates of loss of biodiversity, and large numbers of species migrating northwards outside of their historic range. Many of the claims made in this comment are simply inconsistent with observations and the vast majority of publications. Report finding 11 (oceans) - The authors are not claiming that the oceans have a negative pH, but rather that the pH is reducing as CO2 is absorbed into them. There is no evidence that increases in CO2 or temperatures in oceans are benefitting marine ecosystems. Report finding 12 (adaptation and mitigation) - This report makes no specific recommendations regarding adaptation or mitigation efforts or who should be involved in conducting them. It merely assesses the current state of adaptation and mitigation activities relative to the need for such activities from the perspective of experts in the field.

		Assessment fails to tell us how many of these influences are due to manmade emissions and how many are entirely natural variations apparent in the historical record. If there is a human effect, what is the net effect on the peoples of the U.S.? Scientific evidence says the effect is small or nonexistent, and the net effect of global warming, should it occur, would be positive rather than negative.Mortality data in the United States and other nations show cold weather and related impacts kill more people than warm weather and related impacts.(21) In the United States and elsewhere, mortality spikes during the cold winter months and eases during the warm summer months.(22) Recent climate change is benefiting agriculture as longer growing seasons, more prevalent rainfall (especially during the summer and fall drought seasons),(23) increasing soil moisture,(24) and the fertilizing benefits of atmospheric carbon dioxide(25) are creating more ideal growing conditions and resulting in record crop yields.(26) The beneficial effects also facilitate land conservation, as higher crop yields allow farmers to produce more food on less land.Climate change is similarly benefiting water resources. Northern Hemisphere snow cover extent shows little change during recent years.(27) More prevalent rainfall throughout the year, particularly during the summer and fall drought seasons, provides more water availability after snowmelt season and beyond the immediate vicinity of bodies of water fed by snow melt.(28) In short, there is insufficient evidence to suggest that negative impacts attributable to human emissions of greenhouse gases are occurring. In fact, available evidence points to the opposite: recent climate changes are producing more benefits than harms.Draft Assessment Finding #5Climate change threatens human health and well-being in many ways, including impacts from increased extreme weather events, wildfire, decreased air quality, diseases transmitted by insects, food, and water, and threats to mental health.Climate change is increasing the risks of heat stress, respiratory stress from poor air quality, and the spread of waterborne diseases. Food security is emerging as an issue of concern, both within the U.S. and across the globe, and is affected by climate change. Large-scale changes in the environment due to climate change and extreme weather events are also increasing the risk of the emergence or reemergence of unfamiliar health threats.CommentsThis finding repeats and exaggerates the previous finding, and is wrong for the same reasons.The modest warming of the late twentieth century benefited human health in many ways. Extreme weather events became less frequent and severe,(29) air quality improved,(30) and respiratory illnesses and other human health stresses have become less severe.(31) The risks of cold stress, which kill far more people than heat stress, are decreasing because recent warming occurred more in the cold winter months than the warm summer months. By moderating the coldest winter months, climate change is mitigating cold-weather deaths. While some heat-related deaths may increase, a warming climate is likely to avert a much greater number of cold-related deaths.(32) Recent changes in the environment due to climate change are largely beneficial, including a decline in the frequency and severity of extreme weather events.(33) By producing more ideal agricultural conditions and reducing the frequency and severity of extreme weather events, climate change is saving human lives in a more indirect manner as well.(34) Draft Assessment Finding #6Infrastructure across the U.S. is being adversely affected by phenomena associated with climate change, including sea level rise, storm surge, heavy downpours, and extreme heat.Sea level rise and storm surges, in combination with the pattern of heavy development in coastal areas, are already resulting in damage to infrastructure such as roads, buildings, ports, and energy facilities. Infrastructure associated with military installations is also at risk from climate change impacts. Floods along the nation’s rivers, inside cities, and on lakes following heavy downpours, prolonged rains, and rapid melting of snowpack are damaging infrastructure in towns and cities, farmlands, and a variety of other places across the nations. Extreme heat is damaging transportation infrastructure such as roads, rail lines, and airport runways. Rapid warming in Alaska has resulted in infrastructure impacts due to thawing of permafrost and the loss of coastal sea ice that once protected shorelines from storms and wave-driven erosion.CommentsMany of the factual claims in this finding are simply false. Extreme weather events have been becoming less frequent and less severe in recent decades. As a					

		result, infrastructure is being beneficially impacted by recent climate change.(35) Multiple peer-reviewed studies reveal no increase in flooding events in predominantly natural-flow rivers.(36) An increase in flooding events is evident regarding rivers and streams receiving greater amounts of human-diverted storm water, but predominantly natural rivers and streams show no such increase. Reports of increasing flood events are tied to changes in human land use patterns rather than climate change.(37) The latest research shows sea levels are rising at essentially the same rate as they did before human activity could have affected them. The rate of increase is so slow that it is easily accommodated, as it has been in decades and centuries past. Since a warmer world has resulted in fewer hurricanes and tropical storms, the net effect on infrastructure in coastal areas is positive rather than negative.(38) Even if extreme weather events were intensifying, the cost of hardening infrastructure to withstand the assault would be modest compared to the cost of reducing greenhouse gas emissions. Adaptation to future climate change – whether that change is due to natural or manmade causes – is far cheaper than attempting to control climate by reducing emissions.The reference to “rapid warming in Alaska” is out-of-date and contrary to the latest trend. Alaska temperatures are experiencing pronounced recent cooling, not warming.(39) Draft Assessment Finding #7Reliability of water supplies is being reduced by climate change in a variety of ways that affect ecosystems and livelihoods in many regions, particularly the Southwest, the Great Plains, the Southeast, and the islands of the Caribbean and the Pacific, including the state of Hawai’i.Surface and groundwater supplies in many regions are already stressed by increasing demand for water as well as declining runoff and groundwater recharge. In many regions, climate change increases the likelihood of water shortages and competition for water among agricultural, municipal, and environmental uses. The western U.S. relies heavily on mountain snowpack for water storage, and spring snowpack is declining in most of the West. There is an increasing risk of seasonal water shortages in many parts of the U.S., even where total precipitation is projected to increase. Water quality challenges are also increasing, particularly sediment and containment concentrations after heavy downpours.CommentsWater supplies in the U.S. have been becoming more reliable and abundant during recent decades. Rainfall is becoming more prevalent, especially during the summer and fall drought seasons, and soil moisture is improving in the United States and most of the world.(40) Because of the Earth’s large size, multiple climate zones, and dynamic weather, extreme weather events will always occur. They are a natural part of the Earth’s climate. While some regions may be experiencing water stresses in recent years, there are always regions experiencing water stresses under natural climate conditions. Importantly, precipitation and soil moisture are increasing globally and in the United States.(41) Northern Hemisphere snow cover shows little change during recent years. More prevalent rainfall throughout the year, particularly during the summer and fall drought seasons, provides more water availability after snowmelt season and beyond the immediate vicinity of bodies of water fed by snow melt.(42) Draft Assessment Finding #8Adverse impacts to crops and livestock over the next 100 years are expected. Over the next 25 years or so, the agriculture sector is projected to be relatively resilient, even though there will be increasing disruptions from extreme heat, drought, and heavy downpours. U.S. food security and farm incomes will also depend on how agricultural systems adapt to climate changes in other regions of the world.Near-term resilience of U.S. agriculture is enhanced by adaptive actions, including expansion of irrigated acreage in response to drought, regional shifts in crops and cropped acreage, continued technological developments, and other adjustments. By mid-century, however, when temperature increases and precipitation extremes are further intensified, yields of major U.S. crops are expected to decline, threatening both U.S. and international food security. The U.S. food system also depends on imports, so food security and commodity pricing will be affected by agricultural adaptation to climate changes and other conditions around the world.CommentsAgriculture in the U.S. is benefiting from natural climate change, not because it is “relatively resilient” but because recent climate change is creating longer growing seasons, more					

prevalent rainfall (especially during the summer and fall drought seasons), and increasing soil moisture. Also, the fertilizing benefits of atmospheric carbon dioxide are resulting in record crop yields.(43) A warmer climate has always benefited crop production and will likely continue to do so. Crop yields have grown dramatically during our recent warming. Growing seasons are longer, unseasonal frost events are becoming less frequent, atmospheric carbon dioxide fertilizes crops, and human-caused warming occurs disproportionately during the cold winter months.(44) Precipitation changes are also benefiting crop production, as precipitation is increasing substantially during the summer and fall drought seasons while showing little change during the wet winter and spring seasons.(45) The Draft Assessment speculates that temperatures will rise so much and precipitation will change so much sometime in the far future that agriculture will be harmed. Perhaps it would be, but climate science cannot make reliable forecasts so far into the future, and even its short-term forecasts have been disproven by actual events. The best forecast of the impact of climate change on agriculture is to project recent real-world trends and not to rely on computer models. Recent trends show positive, not negative, effects of climate change on agriculture.Draft Assessment Finding #9Natural ecosystems are being directly affected by climate change, including changes in biodiversity and location of species. As a result, the capacity of ecosystems to moderate the consequences of disturbances such as droughts, floods, and severe storms is being diminished.In addition to climate changes that directly affect habitats, events such as droughts, floods, wildfires, and pest outbreaks associated with climate change are already disrupting ecosystem structures and functions in a variety of direct and indirect ways. These changes limit the capacity of ecosystems such as forests, barrier beaches, and coastal- and freshwater-wetlands to adapt and continue to play important roles in reducing the impacts of these extreme events on infrastructure, human communities, and other valued resources.CommentsThis finding is based on the false assumption, shared by many environmental activists, that any change to climate will necessarily be harmful to wildlife and the ecosystems that sustain them. This is counterfactual since climate is constantly changing and wildlife has evolved in the presence of this change. Ecosystems are resilient because adapting to climate change is a natural process that has taken place countless times over millions of years.Natural ecosystems are benefiting from the more benign recent climate. Forests are expanding and becoming denser. Deserts are shrinking throughout the world. Satellites are measuring a robust greening of the earth.(46) Human emissions and higher atmospheric carbon dioxide levels are benefiting plant life to such a significant extent that plant life is creating more substantial carbon sinks than many scientists expected.(47) Similarly, recent climate change is expanding species ranges, creating more biodiversity and expanded location of species.(48) Natural ecosystems are also benefiting from less frequent and less severe droughts, wildfires, and extreme weather events.(49) Draft Assessment Finding #10Life in the oceans is changing as ocean waters become warmer and more acidic.Warming ocean waters and ocean acidification across the globe and within U.S. marine territories are broadly affecting marine life. Warmer and more acidic waters are changing the distribution of fish and other mobile sea life, and stressing those, such as corals, that cannot move. Warmer and more acidic ocean waters combine with other stresses, such as overfishing and coastal and marine pollution, to negatively affect marine-based food production and fishing communities.CommentsOcean waters are not acidic, and the decrease in alkalinity has been neither unusual nor harmful. Higher carbon dioxide concentrations are benefiting marine life. Higher carbon dioxide levels in ocean waters are stimulating plant and animal life in the oceans much the same way higher carbon dioxide levels are stimulating terrestrial plant and animal life.(50) Cold weather events bring striking devastation to coral reefs, and a warming climate will reduce the frequency and severity of devastating cold weather events on coral reefs.(51) Draft Assessment Finding #11Planning for adaptation (to address and prepare for impacts) and mitigation (to reduce emissions) is increasing, but progress with implementation is limited.In recent years, climate adaptation and mitigation activities have begun to emerge in many sectors and at all levels of government; however barriers to

implementation of these activities are significant. The level of current efforts is insufficient to avoid increasingly serious impacts of climate change that have large social, environmental, and economic consequences. Well-planned and implemented actions to limit emissions and increase resilience to impacts that are unavoidable can improve public health, economic development opportunities, natural system protection, and overall quality of life.CommentsBillions of dollars are being spent in the name of climate change either in a vain attempt to prevent it from happening or wasteful efforts to adapt to false predictions about its impacts. Planning efforts and investments in infrastructure have not failed to match the size or certainty of the global warming “problem” but in fact have been too large, have been attempted before the science was settled, and have been and continue to be wasted.Investments to harden infrastructure and mitigate the effects of natural climate change and extreme weather events have always been made by governments and private interests in the United States, and they can, should, and will continue to be made. This is largely unrelated to the question of whether human emissions of greenhouse gases ought to be restricted, since as reported earlier, the best available evidence says human emissions have little or no effect on climate. Whereas centralized government planning efforts historically have failed to solve real problems in cost-effective ways, individual people and entrepreneurs have succeeded in responding to changing conditions. U.S. carbon dioxide emissions have declined by 10 percent since the year 2000 thanks overwhelmingly to private rather than public efforts.(52) The shale gas revolution – entirely the result of private-sector innovations, risk-taking, and investment -- promises to do more to reduce greenhouse emissions in the U.S. than any government policy adopted to date or likely to be adopted.(53) There is no need for more spending on averting or coping with climate change. Atmospheric methane is leveling off, with current levels below United Nations Intergovernmental Panel on Climate Change projections.(54) Global temperatures themselves are rising more slowly than IPCC predictions, with no measurable temperature increase occurring for more than a decade.(55) 1. Climate Change Reconsidered: 2011 Interim Report of the Nongovernmental International Panel on Climate Change (CCR 2011), http://www.nipccreport.org/reports/2011/2011report.html 2. Climate Change Reconsidered: The 2009 Report of the Nongovernmental International Panel on Climate Change (CCR 2009), http://www.nipccreport.org/reports/2009/2009report.html 3. CCR 2011, Chapter 1: Climate Models and Their Limitations, http://www.nipccreport.org/reports/2011/2011report.html; Chapter 2: Forcings and Feedbacks, http://www.nipccreport.org/reports/2011/2011report.html; and Chapter 3: Paleoclimate and Recent Temperature, http://www.nipccreport.org/reports/2011/2011report.html4. Loehle, C., “A 2000-Year Global Temperature Reconstruction Based on Non-Tree Ring Proxies,” Energy & Environment (2007), http://www.drroyspencer.com/wp-content/uploads/Loehle-2000-year-non-treering-temp-reconstruction-Energy-and-Environment.pdf; CCR 2011, Chapter 3: Paleoclimate and Recent Temperatures, http://www.nipccreport.org/reports/2011/2011report.html; and CCR 2009; Chapter 3: Observations: Temperature Records, http://www.nipccreport.org/reports/2009/2009report.html5. CCR 2011, Chapter 7: Terrestrial Plants and Soils, http://www.nipccreport.org/reports/2011/2011report.html6. CCR 2011, Chapter 6: Terrestrial Animals, http://www.nipccreport.org/reports/2011/2011report.html7. CCR 2011, Chapter 9: Human Health Effects, http://www.nipccreport.org/reports/2011/2011report.html8. Watts, A., http://wattsupwiththat.com/2012/08/19/july-was-also-the-329th-consecutive-month-of-positive-upwards-adjustment-to-the-u-s-temperature-record-by-noaancdc/ and http://wattsupwiththat.com/2012/08/08/dear-noaa-and-seth-which-1930s-were-you-referring-to-when-you-say-july-is-the-record-warmest/ 9. University of Alabama in Huntsville Satellite-Based Temperature of the Global Lower Atmoshpere, http://www.drroyspencer.com/latest-global-temperatures/ 10. Watts, A., http://wattsupwiththat.com/2012/08/19/july-was-also-the-329th-consecutive-month-of-positive-upwards-adjustment-to-the-u-s-temperature-record-by-noaancdc/ and http://wattsupwiththat.com/2012/08/08/dear-noaa-and-seth-which-1930s-were-you-referring-to-

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		http://www.nipccreport.org/reports/2011/2011report.html; and CCR 2009, Chapters 4 and 5, http://www.nipccreport.org/reports/2009/2009report.html42. Andreadis, K., "Trends in 20th century drought over the continental United States," Geophysical Research Letters, http://onlinelibrary.wiley.com/doi/10.1029/2006GL025711/abstract; Huntington, T., "Evidence for intensification of the global water cycle: Review and synthesis," Journal of Hydrology, 2006, http://www.sciencedirect.com/science/article/pii/S0022169405003215; CCR 2011, Chapters 4 and 5, http://www.nipccreport.org/reports/2011/2011report.html; and CCR 2009, Chapters 4 and 5, http://www.nipccreport.org/reports/2009/2009report.html43. "Crop Production Annual Summary," United States Department of Agriculture, http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1047; "World: production of crops in metric tons," Geohive, http://www.geohive.com/charts/ag_crops.aspx; CCR 2011, Chapter 7: Terrestrial Plants and Soils, http://www.nipccreport.org/reports/2011/2011report.html and CCR 2009, Chapter 7: Biological Effects of Carbon Dioxide Enrichment, http://www.nipccreport.org/reports/2009/2009report.html44. "Crop Production Annual Summary," United States Department of Agriculture, http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1047; "World: production of crops in metric tons," Geohive, http://www.geohive.com/charts/ag_crops.aspx; CCR 2011, Chapter 7: Terrestrial Plants and Soils, http://www.nipccreport.org/reports/2011/2011report.html and CCR 2009, Chapter 7: Biological Effects of Carbon Dioxide Enrichment, http://www.nipccreport.org/reports/2009/2009report.html45. Andreadis, K., "Trends in 20th century drought over the continental United States," Geophysical Research Letters, http://onlinelibrary.wiley.com/doi/10.1029/2006GL025711/abstract; Huntington, T., "Evidence for intensification of the global water cycle: Review and synthesis," Journal of Hydrology, 2006, http://www.sciencedirect.com/science/article/pii/S0022169405003215; CCR 2011, Chapters 4 and 5, http://www.nipccreport.org/reports/2011/2011report.html; and CCR 2009, Chapters 4 and 5, http://www.nipccreport.org/reports/2009/2009report.html46. CCR 2011, Chapter 7: Terrestrial Plants and Soils, http://www.nipccreport.org/reports/2011/2011report.html and CCR 2009, Chapter 7: Biological Effects of Carbon Dioxide Enrichment, http://www.nipccreport.org/reports/2009/2009report.html47. Hansen, J., "Climate forcing growth rates: doubling down on our Faustian bargain," Environmental Research Letters (2013), http://iopscience.iop.org/1748-9326/8/1/01100648. CCR 2011, Chapter 6: Terrestrial Animals, http://www.nipccreport.org/reports/2011/2011report.html and CCR 2009, Chapter 8: Species Extinction, http://www.nipccreport.org/reports/2009/2009report.html49. CCR 2011, Chapter 5: Observations and Projections: Extreme Weather, http://www.nipccreport.org/reports/2011/2011report.html and CCR 2009, Chapter 6: Observations: Extreme Weather, http://www.nipccreport.org/reports/2009/2009report.html50. CCR 2011, Chapter 8: Aquatic Life, http://www.nipccreport.org/reports/2011/2011report.html and CCR 2009, Chapter 8: Species Extinction, http://www.nipccreport.org/reports/2009/2009report.html51. "Florida Cold Snap Devastated Coral Reefs," Live Science, Aug. 26, 2011, http://www.livescience.com/15799-florida-cold-devastated-coral-reefs.html 52. "Energy-related carbon dioxide emissions declined in 2012," U.S. Energy Information Administration, http://www.eia.gov/todayinenergy/detail.cfm?id=1069153. "Shale boom has led to lower U.S. carbon dioxide emissions," Houston Business Journal, May 24, 2012, http://www.bizjournals.com/houston/morning_call/2012/05/shale-boom-has-led-to-lower-us.html 54. Hansen, J., "Climate forcing growth rates: doubling down on our Faustian bargain," Environmental Research Letters (2013), http://iopscience.iop.org/1748-9326/8/1/01100655. Michaels, P., "The UN's Global Warming Forecasts Are Performing Very, Very Badly," Forbes.com, Dec. 18, 2012, http://www.forbes.com/sites/patrickmichaels/2012/12/18/the-uns-global-warming-forecasts-are-performing-very-very-badly/					

Amanda	Campbell	This figure, while containing a wealth of information, is challenging to read. How does this graphic portray heavy precipitation events differently than Figure 2.16? For example, in the Northeast, Figure 2.15 shows a 45% increase for the Northeast, and the other depicts a 74% increase. Is this due to the differences in time scales, the baseline against which the data is compared, or differences in the definition of 1% heaviest events?	2. Our Changing Climate	2.15	49		The differences are due to differences in baseline. This figure shows the differences between decadal average values relative to a baseline of 1901-1960. Fig. 2.18 (Observed Change in Very Heavy Precipitation) shows the change (endpoint to endpoint) over the period of 1958-2012. Most of the figures in this report use a baseline of 1901-1960 for showing historical trends. Fig. 2.18 is an update of a figure used in the 2009 national climate assessment report and was included here (even though it does not use the same baseline as the other graphics) to illustrate the continuity in findings on this issue from the 2009 report. Additional text has been added to the Fig. 2.18 caption to explain the differences.
hugh	macmillan	The Executive Summary of the draft report states:“Voluntary efforts, the recent shift from coal to natural gas for electricity generation, and governmental actions in city, state, regional, and federal programs under way and [sic] have contributed to reducing U.S. emissions [of heat-trapping gases] in the last few years.“The draft report would be strengthened if such claims of overall climate benefits from the use of natural gas were supported. In particular, the distinction between CO2 emissions and other greenhouse gas emissions should be accounted for in such claims. As discussed in the 2013 Annual Report of the Council of Economic Advisors, recent reductions in CO2 emissions, relative to a counterfactual (“business as usual”) emissions trend, can be decomposed in order to provide a sense of role that fuel switching has played. Assuming a counterfactual beginning in 2007, when CO2 began the current trend of decline, the President’s Council of Economic Advisor’s finds that “actual 2012 carbon [dioxide] emissions are approximately 17 percent below the ‘business as usual’ baseline.” Of this 17 percent hypothetical reduction, over half is attributed to the recession and the subsequently slow recovery and about 40 percent is attributed to the use of natural gas and renewable energy resources. Food & Water Watch believes the draft report would be improved if a more elaborate decomposition was performed, one that distinguishes the respective roles of natural gas and renewable energy resources, and one that distinguishes hypothetical changes, from the business as usual case, in both CO2 emissions and overall greenhouse gas emissions. With respect to the latter distinction, it would be useful, from a policy and educational standpoint, if the finalized report included different timeframes over which the global warming potential of emissions of different greenhouse gases is calculated and if the finalized report quantified uncertainty regarding the actual amount of methane emissions from natural gas systems.	1. Executive Summary		6	22	This topic is discussed further in the mitigation chapter; this level of detail is not appropriate here.
Amanda	Campbell	The title of this figure might be more clear as: ‘percentage change in amount of precipitation in heaviest events’.	2. Our Changing Climate	2.16	50		This is explicitly stated in the caption and we feel that is sufficient.
hugh	macmillan	In Chapter 10, page 399, the draft report reveals the reasoning behind the implicit endorsement of natural gas as a bridge fuel (which appears in Chapter 27 on page 965 line 22):"Natural gas provides a fossil fuel alternative to coal production with reduced carbon dioxide emissions….The U.S. Energy	10. Water, Energy,		399	26	The text has been revised to incorporate this perspective. Information on emissions has been

		Information Administration projects a 29% increase in U.S. natural gas production by 2035, with lower CO2 emissions where natural gas displaces other fossil fuels (EIA 2012). A natural gas combined-cycle power plan emits about 50% less CO2 than does a modern coal plant. The projected increases in natural gas production would lead to a significant reduction in U.S. greenhouse gas emissions over other fossil fuel alternatives." However, given large uncertainty over the full lifecycle greenhouse gas impact of natural gas consumption for various end uses, and given the enormous challenge of greatly reducing fugitive methane emissions from natural gas systems (See Bradbury et al. WRI, April 2013), Food & Water Watch maintains that while there would be a significant reduction in CO2 emissions, it remains to be seen if, in fact, there would be a significant reduction in U.S. greenhouse gas reductions. The draft report would be improved if this distinction were made. It may not actually be possible to realize the purported climate benefit of switching from coal to natural gas for electricity or the even smaller purported climate benefit of switching from oil to natural gas for transportation, when accounting for full lifecycle greenhouse gas emissions.	and Land use				added to the natural gas discussion.
Amanda	Campbell	Precipitation changes are perhaps the most difficult to convey. This figure should define what is a 'rare heavy precipitation event'.	2. Our Changing Climate	2.17	51		This is explicitly stated in the caption.
USACE	Army Civil Works	Recommend removing "Since 1992, the rate of global sea level rise measured by satellites has been roughly twice the rate observed over the last century." for two reasons: 1) satellite altimetry began in January 1993, and 2) because there is not consensus in the scientific community that the altimetry alone should be used. Also, altimetry is addressed elsewhere and does not need to be discussed in the executive summary, where it detracts from the sea level rise discussion.	1. Executive Summary		4	28	The authors are comfortable with the existing language, which reflects the state of knowledge…this is a topic that received substantial discussion in the development of the NCA and deserves attention in the Executive Summary.
USACE	Army Civil Works	Editorial comment: Reference Held and Soden , 2008 not in references cited.	2. Our Changing Climate		43	13	Reference added as suggested.
USACE	Army Civil Works	Editorial comment: phrase "small details" implies trivial; can achieve the same meaning by saying "than in local ones."	2. Our Changing Climate		43	19	The text has been revised to incorporate this suggestion.
USACE	Army Civil Works	Editorial comment: "everywhere, except for the Southwest, Northwest and Hawaii" contrasts with p. 47, line 9, "except Hawaii"	2. Our Changing Climate		49	5	The text has been revised to be consistent.
USACE	Army Civil Works	Editorial comment: Delete semicolon before period.	2. Our Changing Climate		59	28	The text has been revised to incorporate this suggestion.
USACE	Army Civil Works	Editorial comment: Evapotranspiration is often abbreviated as ET. Consider the use of this common abbrevation in the text.	3. Water Resources		110	9	The text has been revised to incorporate this suggestion.
USACE	Army Civil Works	Editorial comment: Evaporation is not just water from soil, but also from bodies of water, please include bodies of water when referring to evaporation sources.	3. Water Resources		110	9	We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information to include.
USACE	Army Civil Works	The reference (Watson, 2009) applies only to the Wind River basin, which represents barely 1% of the Missouri River basin. Extrapolating the results of this study as indicative of the entire basin is dubious, given the differences in runoff processes (snowmelt dominated vs rainfall runoff dominated) over such a large area. Some watersheds within the Missouri River basin are more variable than others, so this	3. Water Resources		111	31	We have revised the discussions in question to more explicitly refer to just the Wind River basin, with respect to the Watkson 2009 findings. The Wind

		small area does not necessarily represent the variability found over the entire basin in terms of runoff. Recommend removing this sentence, or replacing with another example that does not rely upon such large extrapolation.					River result is explicitly recognized as one of several examples of the fact that the 20th century has been a period of less volatile hydroclimates than many periods in the preceding 2000 years in many basins in the West, including the Central Valley, Colorado River basin, and the southeast U.S.
USACE	Army Civil Works	Editorial comment: Text references illustration as below, but in actuality is on following page, please correct.	3. Water Resources		111	34	This will be addressed during final layout of the report.
USACE	Army Civil Works	Most of the sites shown in Figure 3.2 are heavily regulated and subject to intense agricultural consumptive use, resulting in volume and timing of streamflow that differs significantly from the volume and timing of the runoff above the sites shown. Previous page references runoff. Suggest "streamflow" be replaced by "runoff" in the figure caption to be consistent.	3. Water Resources	3.2	112		This wording is consistent with the source for Fig. 3.2 so we have retained the existing text.
USACE	Army Civil Works	Recommend that the last part of the sentence ("as the existing management systems have been designed to operate within the historical range of variability.") be deleted. This statement gives the impression that existing management systems are dependent solely on historical range of variability when in fact, Reclamation and USACE designed their dams to operate well outside the range of observed variability in streamflow. In fact, the source cited states "...designed to operate within envelopes of hydrologic variability", and does not say that these are based on historic variability alone. A number of dams (but not all) have been designed with the tacit acknowledgement that the observed period may not represent the "true" variability of climatic factors, and designs take that into account.	3. Water Resources		113	7	Thank you for the comment. The text has been revised to clarify and incorporate this perspective.
USACE	Army Civil Works	Please clarify the use of the term "increased" - if droughts are going to intensify (as stated on p. 113), wouldn't we expect a decrease in low (base) flows?	3. Water Resources		117	3	The text has been revised to incorporate this suggestion.
USACE	Army Civil Works	Changes in sediment transport have the potential to impact water resources management. Recommend changing the second to last sentence to "Changes in sediment transport will vary regionally and by land-use type, but may increase by 25% to 55% over the next century (Nearing et al. 2005), resulting in alterations to reservoir storage and channel morphology, impacting flooding, navigation, water supply, and dredging. "	3. Water Resources		117	3	We revised the text to incorporate this perspective.
USACE	Army Civil Works	It should be noted that climate change-induced water cycle changes are not the only factors altering the dynamics of availabilty of and competition for water resources (increasing population, increased demand for industrial/ag, requirements for minimum in-stream flows for fish and wildlife, etc).	3. Water Resources		118	2	After consideration of this point, we still feel it is adequately addressed.
USACE	Army Civil Works	It should be noted that these uses by sector vary significantly by region in the US (This point is brought out in Ch. 10, to some degree, but should be stated here as well).	3. Water Resources		120	1	The text has been clarified to incorporate this perspective.
USACE	Army Civil Works	The text should note that water availability constraints can be offset, to some degree, through use of more efficient turbines, as well as ability to more cost-effectively utilize small-scale hydropower in some locations.	3. Water Resources		124	9	We revised the text to reflect this suggestion.
USACE	Army Civil Works	Recommend changing sentence to read "Droughts have already been shown to decrease reliability of flows or channel depth, adversely impacting navigation."	3. Water Resources		124	25	The text has been revised to incorporate this suggestion.
USACE	Army Civil	It's not difficult to have high confidence that groundwater supplies will be impacted by climate change, but what about the magnitude and in which direction will the impact go? Recommend that these	3. Water Resource		137	3	We appreciate this comment. In response, we have significantly revised

	Works	important questions be addressed. If the confidence is low, please state so, but the reader should not be left guessing what the impact might be.	s				the Key Message and supporting text on groundwater.
USACE	Army Civil Works	Editorial comment: It appears that USBR 2011a and 2011b are the same document. If so, please eliminate the redundancy in the references and in the text where they are mentioned (p. 113).	3. Water Resources		162	14	We appreciate the comment, but these are different sources.
USACE	Army Civil Works	Editorial comment: Text at end of line (the this) needs to be cleaned up, either delete 'the', or insert a potentially missing phrase between the two words.	3. Water Resources		112	9	The text has been revised to incorporate this suggestion.
USACE	Army Civil Works	Recommend clarifying at the beginning of Box 2 that Sandy is not attributed to climate change. Suggest changing the first sentence to read "On October 29, 2012, Hurricane Sandy dealt the transportation systems of New Jersey and New York and environs a massive blow. Though not attributable to climate change, the results of the storm were much in line with vulnerability assessments conducted over 11 of the past four years (Jacob et al. 2008; New York State 2011; New York State Sea Level Rise 12 Task Force 2010; Zimmerman and Faris 2010). "	5. Transportation		203	9	We have modified the text to incorporate this suggestion.
USACE	Army Civil Works	This section along with the chapter on climate change discusses impacts of heavy precipitation and drought on agriculture. Taking into consideration the high demand on surface water and ground water resources, there is a definite need for our country to begin water conservation.	6. Agriculture		238	34	Thanks for the comment. Water management is addressed in Chapter 3: Water Resources.
USACE	Army Civil Works	Editorial comment: Spelling of 'Hawaii' varies even within some chapters. "Hawai?i or Hawaii".					The final report has been edited for consistency.
USACE	Army Civil Works	Climate changesimpacts on health appear to include data only from northern portions of the US and not issues that face the southern portion of the country. Also not included are impacts due to the proliferation and territorial expansion of detrimental invasive species, although insect and ARBO diseases are briefly mentioned .	9. Human Health				We have included data on health effects that impact all parts of the US. For example, the treatment of pollen data takes into account the latitudinal gradient of lengthening pollen season/exposure. We also have provided a discussion of geographical expansion of certain disease vectors, but do not discuss "invasive species" which would most likely be addressed in the agricultural chapter.
USACE	Army Civil Works	Fig 9.2 & Caption. The conclusion that the largest increases in pollen production have been observed in the north is not supported by this figure, in which only one southern location was included (Tx) and no Southeastern sites were included. Recommend changing the wording or include more diverse sampling areas.	9. Human Health				This figure has been edited.
USACE	Army Civil Works	This concern about allocation of corn between feed and energy source is not limited to drought periods; drought merely intensifies the concern. Recommend the sentence be changed to reflect this reality.	10. Water, Energy, and Land use		388	40	The text has been revised to incorporate this perspective.
USACE	Army Civil Works	Recommend more clarity is needed in the discussion of the text and this figure - was 2011 extraordinary for the number of locations with 100-degree days, or was it extraordinary for the intensity in a relatively concentrated area? Certainly there are years that have a much greater geographic distribution of 100-degree days.	10. Water, Energy, and Land use	10.1	390		The caption has been edited to explain the purpose of the figure.

USACE	Army Civil Works	It should be acknowledged that parts of the US had record rainfall and flooding during the same period mentioned in the text. As written it sounds like drought across the entire country will become the norm.	10. Water, Energy, and Land use		390	4	We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include. This figure caption is only about drought conditions. Additional information has been added elsewhere in the chapter on the impacts of flooding.
USACE	Army Civil Works	Recommend removal of the line in the graph of Figure 10.2 suggesting a linear relationship.	10. Water, Energy, and Land use	10.2	391		We thank the reviewer for the helpful suggestion, which has been incorporated into the figure.
USACE	Army Civil Works	Editorial comment: Should 'diesel' be 'biodiesel'? Diesel fuel is a petroleum product, not a biofuel.	10. Water, Energy, and Land use		403	30	The text has been revised to clarify.
USACE	Army Civil Works	The additional land to be brought under cultivation may lead to increased erosion losses, potentially leading to higher sediment loads in streams, which could reduce water quality and increase turbidity, which in turn could reduce the supply of non-impaired waterways.	10. Water, Energy, and Land use		404	24	The text has been revised to clarify that runoff is also a consideration.
USACE	Army Civil Works	Editorial comment: Please clarify which NRC is referred to here. Nuclear Regulatory Commission? National Research Council? This comment will apply to several other chapters as well in the references. Please be sure all abbreviations used in each chapter are spelled out when there are two or more agencies/groups that can have the same abbreviation.	10. Water, Energy, and Land use		416	5	Reference lists have been clarified throughout the report.
USACE	Army Civil Works	The chapter has a lot of focus on 2011 as an extreme weather event (which it was), but only in the context of the Texas drought. There were major floods on the Mississippi and Missouri Rivers and tributaries, as well as certain tributaries of the Red River of the North in this same year, but there is not one mention of these floods, particularly the flooding occuring in the northern plains, which in many cases was unprecedented in terms of volume and duration. How do these two extremes (drought and extreme flood) play against one another and deserve attention here."	10. Water, Energy, and Land use				The text has been revised to incorporate this perspective. Additional information was added on floods and their impact on energy.
USACE	Army Civil Works	Recommend that the issue of wildfires be addressed in this chapter. Wildfires in Florida have shut down interstates due to visibility issues, have sent dense clouds of smoke as far north as North Carolina, and have burned in the Okeefenokee swamp for years on end. Along with the water issues, these wild fires have a major impact on commerce as well as human health.	17. Southeast and Caribbean				We appreciate this suggestion, but already address this issue in the chapter.
USACE	Army Civil Works	Recommend changing the term "100-Year Return Levels" to "1% Exceedance Level," and change sentence in line 7-8 to read "The amount of flooding due to a storm that has a 1% chance of occurring in any given year is similarly projected to vary by region, as shown in panel c), which is in feet above the mean high water level during the tide gauge record."	25. Coastal Zone Development and	25.3	871		After consideration of the point regarding exceedance levels, we feel the existing text is clear and accurate and that the proposed change would be adding jargon which most lay readers would not understand.

			Ecosystems				
USACE	Army Civil Works	FLFl have expressed interest in taking this to the next level, by projecting future sea level rise scenarios to see the change in flood zone and effects on infrastructure. Further research into other climatic factors such as change in precipitation versus river or lake levels may also change the flood zones.	25. Coastal Zone Development and Ecosystems		880	1	Thank you for your input. While this sounds potentially interesting, unfortunately the comment is too unspecific for us to respond. Since this appears to be a plan, not yet realized, it will need to be integrated into future assessments.
USACE	Army Civil Works	It will be important to look closely for unintended consequences. The use of food products for energy, corn for example, can reduce the food supply and increase the demand for water, and can potentially also increase nitrogen runoff.	27. Mitigation				A section on costs has been added. The box on interactions between adaptation and mitigation addresses potential unintended consequences.
USACE	Army Civil Works	Many of the topics discussed in "Adaptation" are worthy of consideration when planning projects. It makes sense to use our knowledge of possible changes in climate, temperature, and water availability and demand to address their possible impacts on our population, infrastructure and food supply going into the next century.	28. Adaptation				Thank you for your comment. The authors agree and tried to highlight that point throughout the chapter through the existing text.
hugh	macmillan	Because burning natural gas generates less CO2 than burning coal (for electricity), burning fuel oil (in industrial and residential boilers, for example, for heating), and burning gasoline and diesel (to fuel transportation), natural gas has long been promoted as a “bridge fuel” for the necessary transition to an energy efficient, low-carbon future. It is important to note that when the end use of natural gas requires combustion, significant amounts of CO2 are still emitted. Larger questions surround the amount of methane — the primary component of natural gas — that is also emitted into the atmosphere by the entire natural gas system, beginning during pre-production as a new well is drilled and (for unconventional wells) hydraulically fractured. Methane emissions continue during production at the well site, and during subsequent processing, transmission and distribution. As discussed in the draft report, methane is a potent greenhouse gas, estimated to have at least 25 times the radiative forcing effect of CO2 when integrated over a 100-year timeframe, and about 70 times the radiative forcing effect of CO2 integrating over 20 years (without accounting for potentially even higher radiative forcing effects due to interactions with atmospheric aerosols). In Chapter 27, on page 962, the draft rightly identifies reducing methane emissions, such as from oil and gas development, as one of three primary mitigation options. However, to our knowledge, this is the extent to which this important issue is addressed. In light of widely projected increases in U.S. (as well as global) dependence on unconventional natural gas, Food & Water Watch believes the draft report would be strengthened if it addressed in more depth the climate impacts of methane emissions from natural gas systems.Specifically, several recent studies now show that relying on natural gas as a bridge will not avoid potentially dire increases in global mean temperature, even assuming relatively low estimates for the amount of leaked methane, relative to total natural gas production. Myhrvold et al, for example, use less than 2 percent while some recent studies have estimated methane emissions locally to be as high as 9 percent. The International Energy Agency has estimated that a scenario of increased global dependence on natural gas would increase the global average temperature by 3.5° Celsius, or by about 6.3° Fahrenheit, by 2035. Yet, in Chapter 27, on page 965, the draft report implicitly endorses the notion of natural gas as a bridge fuel without current and substantive justification, stating: “Achieving the B1 [lower greenhouse gas] emissions path would require substantial decarbonization of the global economy by century’s end, implying a fundamental transformation of the global energy system. Details of the energy mix along the way differ among analyses, but the implied involvement by the U.S. can be	10. Water, Energy, and Land use		388	17	The text has been revised to incorporate this suggestion. The supporting text for Key Message 2 has been revised to address emissions associated with natural gas.

		seen in a three-model study carried out under the U.S. Climate Change Science Program (Clarke et al. 2007). In this study, direct burning of coal without carbon capture is essentially excluded from the power system, and the same holds for natural gas toward the end of the century – to be replaced by some combination of coal or gas with carbon capture and storage, nuclear generation, and renewables."The "three-model study" by Clarke et al., referenced in the above quote from page 965, does account for methane emitted as a fraction of natural gas consumed. However, it predates dramatic increases in projected U.S. natural gas production and consumption, and it is based on exceedingly sparse data as to the actual amount of methane emitted from natural gas systems. Food & Water Watch asks that such modeling studies be updated to reflect prevailing uncertainty over the extent and potential climate impact of such methane emissions.					
Amanda	Campbell	Ratios are not that intuitive to the layperson. This figure might be more easily interpreted if it compared the number of record highs to the number of record lows.	2. Our Changing Climate	2.18	53		The figure has been removed due to space limitations. The revised supporting text for the Key Message discusses the numbers of record high and low temperatures, rather than the ratio.
hugh	macmillan	Because burning natural gas generates less CO2 than burning coal (for electricity), burning fuel oil (in industrial and residential boilers, for example, for heating), and burning gasoline and diesel (to fuel transportation), natural gas has long been promoted as a "bridge fuel" for the necessary transition to an energy efficient, low-carbon future. It is important to note that when the end use of natural gas requires combustion, significant amounts of CO2 are still emitted. Larger questions surround the amount of methane — the primary component of natural gas — that is also emitted into the atmosphere by the entire natural gas system, beginning during pre-production as a new well is drilled and (for unconventional wells) hydraulically fractured. Methane emissions continue during production at the well site, and during subsequent processing, transmission and distribution. (See Bradbury et al. WRI. April 2013). As discussed in the draft report, methane is a potent greenhouse gas, estimated to have at least 25 times the radiative forcing effect of CO2 when integrated over a 100-year timeframe, and about 70 times the radiative forcing effect of CO2 integrating over 20 years (without accounting for potentially even higher radiative forcing effects due to interactions with atmospheric aerosols). In Chapter 27, on page 962, the draft rightly identifies reducing methane emissions, such as from oil and gas development, as one of three primary mitigation options. However, to our knowledge, this is the extent to which this important issue is addressed. In light of widely projected increases in U.S. (as well as global) dependence on unconventional natural gas, Food & Water Watch believes the draft report would be strengthened if it addressed in more depth the climate impacts of methane emissions from natural gas systems.Specifically, several recent studies now show that relying on natural gas as a bridge will not avoid potentially dire increases in global mean temperature, even assuming relatively low estimates for the amount of leaked methane, relative to total natural gas production (Myhrvold et al. 2012; Levi 2013). Myhrvold et al, for example, use less than 2 percent while some recent studies have estimated methane emissions locally to be as high as 9 percent. The International Energy Agency has estimated that a scenario of increased global dependence on natural gas would increase the global average temperature by 3.5° Celsius, or by about 6.3° Fahrenheit, by 2035. Yet, in Chapter 27, on page 965, the draft report implicitly endorses the notion of natural gas as a bridge fuel without current and substantive justification, stating: "Achieving the B1 [lower greenhouse gas] emissions path would require substantial decarbonization of the global economy by century's end, implying a fundamental transformation of the global energy system. Details of the energy mix along the way differ among analyses, but the implied involvement by the U.S. can be seen in a three-model study carried out under the U.S. Climate Change Science Program (Clarke et al. 2007). In this study, direct burning of coal	10. Water, Energy, and Land use		965	17	The text has been revised to incorporate this perspective. Information on emissions has been added to the natural gas discussion.

		without carbon capture is essentially excluded from the power system, and the same holds for natural gas toward the end of the century – to be replaced by some combination of coal or gas with carbon capture and storage, nuclear generation, and renewables."The "three-model study" by Clarke et al., referenced in the above quote from page 965, does account for methane emitted as a fraction of natural gas consumed. However, it predates dramatic increases in projected U.S. natural gas production and consumption, and it is based on exceedingly sparse data as to the actual amount of methane emitted from natural gas systems. Food & Water Watch asks that such modeling studies be updated to reflect prevailing uncertainty over the extent and potential climate impact of such methane emissions.					
Ryan	Colker	As indicated throughout the document, there are both challenges and opportunities specifically associated with buildings--both in the public and private sector. However, it would be a significant benefit for the building community to have access to a single source of information to understand their role. Such a section could include coverage of the energy and water use within buildings, the role of energy codes in reducing GHGs/energy use, the challenges with existing buildings, push toward net-zero energy buildings, the emergence of green buildings, the value of mitigation through building codes and other efforts (Multihazard Mitigation Council report), challenges with adaptation, growth of on-site renewables with potential for distributed generation and the associated resilience, challenges with fragmentation of the industry, exposure to extreme events, impacts of urbanization, zoning/land use choices, need for integrated planning/decisionmaking with other issues (safety and security, productivity, health, cost effectiveness, etc.), uncertainty in future design requirements, role of insurance, role of occupants, changes in workplaces (telecommuting, hoteling, etc.), role of building materials, etc.					Thank you for your comment. The electronic format of the final report should help greatly with discovery of relevant information across the report.
John	Posey	I suggest that you consider street trees as an adaptation option. Increasing the urban canopy can reduce the heat island effect and reduce stormwater runoff. These effects make transportation systems more resilient by reducing heat stress on pavements and expansion joints, and by reducing temporary flooding of roadways.Citations:Dexter H. Locke, J. Morgan Grove, Jacqueline W.T. Lu, Austin Troy, Jarlath P.M. O'Neil-Dunne, and Brian D. Beck. Prioritizing Preferable Locations for Increasing Urban Tree Canopy in New York City. Cities and the Environment 2010 Volume 3, Issue 1 Article 4 pp. 1-18E. Gregory McPherson,∗, James R. Simpson, Qingfu Xiaob, Chunxia Wub Million trees Los Angeles canopy cover and benefit assessment Landscape and Urban Planning 99 (2011) pp. 40–50	5. Transportation				We agree and have added text to incorporate this suggestion under the section, "Costs and Adaptation Options."
Amanda	Campbell	The information in this graphic is important. The figure would be easier to interpret if it centered on a region and depicted numbers instead of percentage difference from average. The Caption should state the universe. If the figure is daily average temperature across the US, it may mask regional variations.	4. Energy Supply and Use	4.2	170		The data set for this figure contains information for each U.S. state, given space limitations, we only had room for one figure. The figure is for the U.S. as a whole.
Heather	Payne	April 12, 2013Center for Law, Environment, Adaptation and Resources The University of North Carolina School of Law Van Hecke-Wettach Hall, C.B. 3380					Thank you very much for your comments. However, policy issues are beyond the defined scope of the National Climate Assessment, a scientific document that provides the basis for decision making, but does not

		Chapel Hill, NC 27599-3380National Climate Assessment and Development Advisory Committee U.S. Global Change Research Program, Ste. 250 1717 Pennsylvania Ave., NW Washington, D.C. 20006Ladies and Gentlemen:Thank you for the opportunity to comment on the Draft National Climate Assessment Report ("Draft Assessment"). We are filing a comment on behalf of the Center for Law, Environment, Adaptation and Resources (CLEAR) at the University of North Carolina School of Law at Chapel Hill. CLEAR addresses emerging environmental law issues, particularly serving as a leader on the laws related to climate change adaptation. The center helps inform policymakers, leaders, and practitioners about the circumstances brought about by environmental disruption, options for legal change given this disruption, and it provides a forum for educating the North Carolina and national legal and business communities about opportunities related to these changes.We would first like to express our support for the Draft Assessment and the conclusions contained within it. The Draft Assessment utilizes well documented scientific observations and accepted models, leading to scientifically sound conclusions. Based upon CLEAR's expertise, our comments focus primarily on Chapter 28, Adaptation. We agree with all Key Messages, but will specifically address Key Message #2 and Key Message #4.Key Message #2 addresses legal impediments to implementation of adaptation actions. The impact of law on private sector adaption was addressed in a briefing paper co-authored by CLEAR Director Victor Flatt and available at http://www.law.unc.edu/documents/clear/adaptprivatesector.pdf. The Draft Assessment, while mentioning "that a growing number of companies are beginning to actively address risks from climate change," p. 994, could more fully explore and systematically examine the ways legal and regulatory barriers prohibit the private sector from responding to market signals which would encourage adaptation. While one cannot totally depend on the private sector for all needed climate adaptation, it is important that the interaction between the law and private sector adaptation be examined in order to further adaptive goals.Key Message #4 stresses that adaptive actions fulfill other societal goals. This is especially true around disaster mitigation, preparedness, response, and recovery. While the Draft Assessment mentions the role of the states, p. 989, and that "many actions are not specifically designed to address climate change" and are focused on planning, disaster recovery plans – how communities will recover, especially after catastrophic events - are one component of this planning that should be discussed in more detail. Rather than rebuilding in the same places with the same hazards, states can take adaptive actions during disaster recovery. A CLEAR co-sponsored research paper on the systematic analysis of state disaster recovery plans is at http://www.law.unc.edu/documents/clear/staterecoveryplananalysissandler2011.pdf. While the Draft Assessment also notes that federal agencies can facilitate adaptive action by providing financial support, p. 989, more consideration of federal programs to provide funding to states to increase administrative capacity to plan for climate change and climate change disruption, including disaster recovery, is warranted. Federal funding could be predicated on states using best practices to adapt, including involvement of all communities in planning, hazard mitigation, and reducing barriers to private sector adaptation. A similar model is found in the Coastal Zone Management Act, 16 U.S.C. § 1451, et seq.We agree strongly with Research Goal 2, located in Chapter 29, Research Agenda for Climate Change Science on p. 1037-38, especially that research needs to be conducted on alternative institutional strategies to support adaptation, including revisions to legal codes and policy practices. Systematic review of legal and regulatory controls in light of new needs is an important tool, which CLEAR has helped implement in North Carolina, and examined nationally in the construct of the private sector. We, as an organization, would be willing to help with this critically important work.We also					address policy or legal issues.

		would like to briefly comment on some of the factual documentation as, at least in the context of North Carolina, it may not provide a complete picture of the current adaptation situation. On pages 591 (Southeast Region) and 875 (Coastal Zone Development and Ecosystems), the authors mention that the North Carolina Department of Transportation is raising the roadbed of U.S. Hwy. 64 by four feet, which includes18 inches to allow for higher future sea levels. While this is accurate, the North Carolina Department of Transportation is contemplating other actions which contradict the recommendations of the report. The most significant of these is the replacement of Bonner Bridge (on the Outer Banks) at its current location.As the Draft Assessment recognizes on p. 867, coastal infrastructure and evacuation routes are increasingly vulnerable to higher sea levels and storm surges. In North Carolina, Hwy. 12, a highway that spans the outer banks from north to south, continues to be washed out by ever smaller storms due to the landward movement of the barrier islands upon which it rests. Given the likelihood of continued and even more powerful storms, this situation will only get worse. As noted on p. 876, inflexibility of bridges can make landward relocation difficult. However, rather than address these issues now by using an alternate bridge design, the North Carolina Department of Transportation is moving forward with simply replacing the bridge in the same location. Based on the costs associated with bridge relocation, this not only ensures this bridge will not relocate, but that the connecting highway will remain in a suboptimal location to deal with climate change and rising sea levels. The Draft Assessment should note that, unlike the example in coastal Louisiana given on p. 877, states such as North Carolina are not proactively addressing coastal highway and bridge issues.The reason given for this lack of long-term vision is fiscal; building a more climate change suitable bridge, which would connect to Hwy. 12 at a location where the barrier islands are more stable, would be more expensive. However, as noted in the Southeast chapter on p. 590, most of North Carolina is ranked “very high” on the sea level rise vulnerability map. The lack of political will to acknowledge this, much less address it, should be more fully discussed in the Southeast chapter. The passage of H.B. 819 (N.C. Sess. Laws 2012-202), which requires the Coastal Resources Commission and the Department of Environment and Natural Resources not to define rates of sea level change until at least 2016, provides another example of how states are choosing, for political reasons, not to take adaptive actions now. While we realize this report is not a political document, a discussion of how political choices could bring larger costs should be information to which states have access.Thank you again for the ability to comment.Regards,Victor B. Flatt Tom & Elizabeth Taft Distinguished Professor of Environmental Law Director, CLEAR UNC School of LawHeather Payne Fellow, CLEAR UNC School of Law					
Kyle	Dittmer	p. 444, line 1. “U.S. census,” needs to be in caps (formal name: U.S. Census). Should be “U.S. Census,”p. 445, line 26. “metrological” is misspelled. Should be “meteorological.”p. 447, lines 15-18. The Climate Change (CC) effects on streamflow are often different for the snow-melt dominate basins east of the Cascade Mountains vs. the rainfall dominate basins west of the Cascades. Columbia Basin tribes have more to worry about because of the past 100-years of warming temperatures has been changing the hydrologic regime much faster than basins west of the Cascades. This would be a good area to cite my new work; how CC is changing the streamflow in the Columbia Basin (eastern PNW) based on historical 1900-2009 streamflow data and its impacts on salmon as a species and tribal food source: Kyle Dittmer	12. Impacts of Climate Change on Tribal, Indigenous, and				The text has been revised to incorporate these suggestions. We changed "census" to "Census", capitalizing the word as suggested, and corrected the spelling to read "meteorological". Dittmer (2013) was added in both suggested places in the text, with an

		(2013). Changing Streamflow on Columbia Basin Tribal Lands- Climate Change and Salmon. Climatic Change. DOI# 10.1007/s10584-013-0745-0Here is the abstract from my paper: Abstract: "Over the last 100 years, linear trends of tributary streamflow have changed on Columbia River Basin tribal reservations and historical lands ceded by tribes in treaties with the United States. Analysis of independent flow measures (Seasonal Flow Fraction, Center Timing, Spring Flow Onset, High Flow, Low Flow) using the Student t test and Mann-Kendall trend test suggests evidence for climate change trends for many of the 32 study basins. The trends exist despite interannual climate variability driven by the El Niño–Southern Oscillation and Pacific Decadal Oscillation. The average April-July flow volume declined by 16 %. The median runoff volume date has moved earlier by 5.8 days. The Spring Flow Onset date has shifted earlier by 5.7 days. The trend of the flow standard deviation (i.e., weather variability) increased 3 % to 11 %. The 100-year November floods increased 49 %. The mid-Columbia 7Q10 low flows have decreased by 5 % to 38 %. Continuation of these climatic and hydrological trends may seriously challenge the future of salmon, their critical habitats, and the tribal peoples who depend upon these resources for their traditional livelihood, subsistence, and ceremonial purposes."This area would be also good to cite my contribution about PNW CC impacts from:Karen Cozzetto (2013), K. Chief, K. Dittmer, M. Brubaker, R. Gough, K. Souza, F. Ettawageshik, S. Wotkyns, S. Opitz-Stapleton, S. Duren, and P. Chavan. Impacts of Climate Changes on the Water Resources of American Indians and Alaska Natives in the U.S. Climatic Change. DOI# 10.1007/s10584-013-0737-0This work is where I give a more detailed assessment of PNW impacts, including basins west/east of the Cascade Mountains. Here is my contribution from the Cozzetto et.al. paper:4.2 Pacific Northwest "The Pacific Northwest (PNW) is home to over 40 tribes. The Cascade Mountains run north-south through the region dividing it into a coastal zone west of the Cascades and a continental zone east of the mountains. The region has an October-March wet season. Much of this precipitation is stored in the mountain snowpack and then released during the freshet, which is the annual April-July snowmelt period. The PNW has a network of rivers hosting several salmon species, which are cultural keystones for many PNW tribes. Salmon are coldwater fish that start life in fresh, headwater streams as eggs. The juveniles are flushed to a lower river estuary to acclimate to saltwater, then migrate out to the ocean for up to several years before returning upriver as fully grown adults to spawn and die (Crozier et al. 2008). Salmon have been in decline and, consequently, tribes have become vested in salmon restoration projects. Water supplies are important for tribal salmon hatcheries, salmon reintroduction efforts (CRITFC 2010), riparian restoration, forestry, agriculture, small-scale hydropower, and municipal uses. Key climate change impacts are related to effects on salmon and shellfish, coastal erosion, and the exercise of treaty rights.Storm intensities during the early part of the wet season are increasing (CIG 2012) and can lead to increased flooding, habitat scouring, and washing away of buried salmon eggs. Warming air temperatures can shift freshet timing to earlier in the spring, which may lead to lower flows and unfavorably warm summer water temperatures (Dittmer 2013). Salmon may respond by migrating downstream earlier; however, this change in migration timing may be mismatched with downstream conditions (Crozier et al. 2008). Warmer summer water temperatures are already affecting the migration of returning adult salmon. In summer 2003, for instance, salmon paused their upstream migration, remaining below the Bonneville Dam on the Columbia River for several weeks until water temperatures cooled. West of the Cascades, changes in coastal processes are also affecting tribes. In addition to salmon, the Swinomish (WA) depend on various shellfish as important staples of food and culture. The tribe identified inundation from sea level rise and flooding from storm surges as major threats to its estuaries, which provide critical habitat for shellfish and juvenile salmon (SITC 2010). Ocean acidification can disrupt the calcification process involved in shell development and affect the reproduction and growth of marine organisms (Ingram et al. 2012). Traditional foods like roots and	Native Lands and Resources				additional sentence of explanation added as well. The Cozzetto et al. (2013) suggestion was not added because it was not published before April 15, 2013, the cut-off point for including material in this assessment report. We added the three conferences as suggested, plus one additional one: (November 18-21, 2009) Native Peoples-Native Homelands Climate Change Workshop II. Mystic Lake, Minnesota. Sponsored by NASA.

		berries are suffering from increased soil salinization due to sea-level rise (Papiez 2009). For the Quileute Nation and Hoh Tribe (WA), increased winter storms are coinciding with high tides at the Quileute and Hoh River mouths to create high storm surges that threaten salmon habitat and, that together with sea level rise, are washing away tribal lands. The Quileute are considering relocation, and the Hoh are in the process of relocating to National Park Service land (ITEP 2012a). Species migration out of traditional hunting/gathering areas appears to be increasing (Papiez 2009). Treaty-protected rights to hunt, fish, and gather are typically linked to reservation locations or customary areas on public lands. Tribes like the Tulalip are concerned that, as species move, their distributions may become mismatched with locations of access."It should be noted that both of the above works are part of a Special Issue of the journal, Climatic Change, on “Climate Change and Indigenous Peoples in the United States: Impacts, Experiences, and Actions” edited by Julie Koppel Maldonado, Rajul E. Pandya, and Benedict J. Colombi. This Special Issue is in the production stage of publication and should go public any day now.p. 447, lines 26-28. My work (Dittmer 2013) provides such a “baseline” of CC. There is great value in doing a retrospective study to document what climate change has already occurred, so one can gauge the sensitivity of future climate changes to a basin. My study methodology can be replicated to other regions of the U.S. to assess hydrologic vulnerabilities.p. 454, lines 3-15. There were three key CC conferences here in the PNW that were not listed but are worthy and should be included:2008 (May 29-30), "Climate Change in the Northwest." Hosted by Affiliated Tribes of Northwest Indians at the Seattle Public Library. Sponsored by the BIA and USFWS. This conference was the first time that the PNW tribes all got together to discuss the technical, policy, and legal issues of CC.2008 (Aug. 19-20), "Adaptive Governance and Climate Change." Hosted by the Confederated Tribes of the Umatilla Indian Reservation Dept. of Science and Engineering at the Wildhorse Resort and Convention Center, Pendleton, Oregon.2008 (Dec. 10), "Developing a Northwest Tribal Climate Change Strategy." Hosted by the Columbia River Inter-Tribal Fish Commission and Affiliated Tribes of Northwest Indians at Portland State University. Proceedings Link: http://172.16.0.9/tech/climate/cc_workshop.htmlp. 454. Cite Cozzeto et.al. (2013) for “Description of evidence base.”p. 456. Cite Dittmer (2013) and above three conferences for “Description of evidence base.”					
Thomas Sawyer	Hopkins	There are three types decision-making for responding to problems: i.e. adaptive, mitigative, and preventive. The preventive type has been excluded, probably confused with mitigative, which is generally a stop-gap measure to reduce the problem. For example, increasing gas mileage may reduce emissions but not eliminate them. A preventive response would be to eliminate fossil-fuel combustion or would reduce it to such a point that the atmosphere can return to some equilibrium with respect to CO2. Decision-making should evaluate all three types and if it cannot implement a preventive solution, it should utilize ramp-up strategy by making making incremental upgrades to a preventive solution. This does not exclude making adaptive decisions for impacts that are presently occurring.	1. Executive Summary		6	8	Thanks for your comment. You are correct, but this distinction does not seem critical in the context of this general overview of the NCA report.
Amanda	Campbell	Since this table incorporates several different types of data, it would be clearer if the number of days and percentage increase in cooling degree days was in separate columns. It might be advantageous to break this into two tables, one for electricity/cooling and one for gas/heating. Repeating the units might also assist the reader (ex. +10 days over 95F; +23 days over 95F). It might be helpful to clarify that this information is per year or per summer/winter.	4. Energy Supply and Use	4.1	173		The National Climate Assessment's page length limitations led the authors to condense the information into one table. "Annual" is implied, but not explicitly stated. We have added an explicit statement of annual changes to the table.
Ryan	Colker	Recommend including a discussion on opportunities for distributed generation and micro grids and how they can contribute to resilience and adaptation.	4. Energy Supply and Use		183	23	Distributed generation is identified in Table 4.2 as potential adaptation actions to build resiliency. Due to page

							length limitations in the National Climate Assessment overall, it is not possible to expand discussion of this or the other potential adaptation actions.
Ryan	Colker	Recommend addressing in further detail the role of urbanization and their associated transportation networks in potentially decreasing impact of transportation. Cross reference to Human health chapter pg. 355 (4-10).	5. Transportation		196	29	Thank you for your comment. We have added text on reducing the heat island effect and heat stress on pavement under the section, “Costs and Adaptation.” The referenced text in the Human Health Chapter does not fit the context of our chapter. Given the size of this topic and chapter space limitations, we are not able to expand on this topic. The author team has deliberated and agreed on the most important information to include.
Ryan	Colker	Recommend examining the role of green roofs, bioswales and other efforts within the building industry to reduce runoff and associated pollution.	8. Ecosystems, Biodiversity, and Ecosystem Services		292	34	No change. While the comment suggests a good specific example, the authors feel the existing examples are appropriate.
Harry	McWreath	It's fantastic that the cross-sectoral chapters are included, but the messages from those chapters are not well-represented in the Exec Summary.	1. Executive Summary				A new report finding has been added to the executive summary to emphasize findings from the Tribal chapter, which is one of the cross sectoral chapters.
Ryan	Colker	Point out the dual benefit of protection and moving citizens from vulnerable areas.	8. Ecosystems, Biodiversity, and Ecosystem Services		296	3	No change. While the comment suggests a good specific example, the authors feel the existing examples are appropriate.
Thomas Sawyer	Hopkins	In report #10, you should include impact comments on ocean circulation, CO2 storage capability, and feedback loops with the atmosphere.	1. Executive Summary		10	12	This is a good point, but the intent of the report findings is to highlight the highest level conclusions, not to repeat all of the findings in the chapters.
Harry	McWreath	In reviewing this chapter, I felt that there were some disconnects between some of the figures and the text. Please ensure that the figures in this chapter are representative of the text. Overall, great job!	3. Water Resources				We thank the reviewer for the helpful suggestion, which has been addressed.
Harry	McWre	In reviewing this chapter, I felt that there were some disconnects between some of the figures and the	8.				Thanks for the nice comment!

	ath	text. Please ensure that the figures in this chapter are representative of the text. Overall, great job!	Ecosystems, Biodiversity, and Ecosystem Services				Hopefully our responses to specific comments about the figures will address these disconnects.
Ryan	Colker	Also include the importance of indoor environmental quality in human health and it's intersection with energy use (for ventilation).	9. Human Health		334	16	The importance of indoor air quality with respect to molds is covered on page 335, lines 19-21; and on p.343, lines 26-28. The issue of IAQ and ventilation is more appropriately addressed as a health co-benefit or coharm of climate mitigation and adaptation, as in Wilkinson 2009. Text in 'Responses Have Multiple Benefits' section has been revised accordingly.
Harry	McWreath	In reviewing this chapter, I felt that there were some disconnects between some of the figures and the text. Please ensure that the figures in this chapter are representative of the text. Overall, great job!	11. Urban Systems, Infrastructure, and Vulnerability				Thank you for your accolade. We have reviewed the figures to insure that they are relevant to the main points being made.
Harry	McWreath	In reviewing this chapter, I felt that there were some disconnects between some of the figures and the text. Please ensure that the figures in this chapter are representative of the text. Overall, great job!	13. Land Use and Land Cover Change				We clarified some of these linkages., and we greatly appreciate your positive comment.
Harry	McWreath	In reviewing this chapter, I felt that there were some disconnects between some of the figures and the text. Please ensure that the figures in this chapter are representative of the text. Overall, great job!	15. Interactions of Climate Change and Biogeochemical Cycles				Thank you for your comment. References have been updated.
Lauren	Baum	The NCA should take note of the NRDC/POW study, "Climate Impacts on the Winter Tourism Economy in the United States." The study concludes: The downhill ski resort industry is estimated to have lost $1.07 billion in aggregated revenue between low and high snow fall years over the last decade (November 1999 - April 2010).The resulting employment impact is a loss of between 13,000 to 27,000 jobs (6 to 13 percent employment change), with the 6 percent jobs difference corresponding to over 15 million fewer skier visits.The largest changes in the estimated number of skier visits between high and low snowfall years (over 1 million) occurred in: Colorado (-7.7 percent), Washington (-28 percent),	20. Southwest				We have reviewed the source of information suggested by the Comment and find that is does not meet the Guidance on Information Quality Assurance to Chapter Authors of the National Climate Assessment: Question Tools (2/21/2012), which is

		Wisconsin (-36 percent), California (-4.7 percent) , Utah (-14 percent), and Oregon (-31 percent). The resulting difference in economic value added to the state economy ranged from -$117 million to -$38 million.In the Eastern region of the U.S. the states with the largest estimated changes in skier visits between low and high snowfall years were: Vermont (-9.5 percent), Pennsylvania (-12 percent), New Hampshire (-17 percent), and New York (-10 percent). The resulting difference in economic value added to the state economy ranged from -$51 million to -$40 million.LINK: http://www.nrdc.org/globalwarming/files/climate-impacts-winter-tourism-report.pdf					used by the NCADAC to assure for each source used in the NCA Report: (1) utility, (2) transparency and traceability, (3) objectivity, and (4) Integrity and security.
Harry	McWreath	In reviewing this chapter, I felt that there were some disconnects between some of the figures and the text. Please ensure that the figures in this chapter are representative of the text. Overall, great job!	28. Adaptation				Thank you for your comment. Changes have been made to connect text and graphics.
Amanda	Campbell	This figure is informative in illuminating the regional causes and extent of forest disturbances. Does this figure represent forest disturbances reported and/or existing in 2012? Do the percentages signify for example that 65%-100% of the forest is affected, or 65% -100% tree mortality? How big are the pixels? 30 meter? Does each pixel represent the area of the disturbance or one incidence of disturbance?	7. Forestry	7.1	265		The text has been revised to add the dates over which the disturbance index was estimated (2005-2009) so this index does not incorporate disturbances in 2012. The text has also been revised to add information on the nature of the disturbance index. The chapter foucses on broad trends for this topic. We refer those interested in a deeper treatment of the disturbances across forests to the provided citation, Goetz et al. 2012.
Harry	McWreath	In reviewing the draft report, I felt that there were some disconnects between some of the chapter figures and the text. Please ensure that the figures in all of the chapters are representative of the text. Overall, great job!					Thank you for the positive comment. Editorial details have been resolved in the final version.
Harry	McWreath	In reviewing the draft report, I felt that there were some disconnects between some of the chapter figures and the text. Please ensure that the figures in all of the chapters are representative of the text. Overall, great job!	1. Executive Summary				Thanks for the comments. The final version references the figures in the text.
Lauren	Baum	The NCA should take note of the recent study that found that in the last decade, about 30% of ocean warming has occurred below 700 m, contributing significantly to an acceleration of the warming trend.Abstract: The elusive nature of the post-2004 upper ocean warming has exposed uncertainties in the ocean's role in the Earth's energy budget and transient climate sensitivity. Here we present the time evolution of the global ocean heat content for 1958 through 2009 from a new observational-based reanalysis of the ocean. Volcanic eruptions and El Niño events are identified as sharp cooling events punctuating a long-term ocean warming trend, while heating continues during the recent upper-ocean-warming hiatus, but the heat is absorbed in the deeper ocean. In the last decade, about 30% of the warming has occurred below 700 m, contributing significantly to an acceleration of the warming trend. The warming below 700 m remains even when the Argo observing system is withdrawn although the trends are reduced. Sensitivity experiments illustrate that surface wind variability is largely responsible for the changing ocean heat vertical distribution.CITATION: Balmaseda, M., Trenberth, K. and Kallen, E. (2013). Distinctive climate signals in reanalysis of global ocean heat content. Geophysical Research Letters. Doi: 10.1002/grl.50382. Link: http://onlinelibrary.wiley.com/doi/10.1002/grl.50382/abstract	24. Oceans and Marine Resources				The text has been revised to incorporate this suggestion.
Thomas	Hopkins	You need to include cost-benefit analyses that include:	1.		13	1	Although it would be ideal to include

Sawyer		• both short-term and long-term effects (without) future discounting, • use the product of the probability of occurring times the cost (and benefit) of not responding to the problem - to avoid type I or II errors • social and environmental assessments should be made with recent methodologies. In addition, your simulations of policy options should be done with most recent simulation software and the results should be made public in order that it be informed of the risks and costs this decision making process.	Executive Summary				such information, the NCA findings cannot go beyond the state of current knowledge, and there is little information on these topics. The need for more work in this areas is noted in the new section on future assessments in the Context and Background section.
Amanda	Campbell	This figure should specify whether it depicts increases in the average number of days per year.	16. Northeast	16.3	552		The text has been revised to incorporate this suggestion.
Jenny	Jones	Why no mention of a carbon tax?	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				The chapter focuses on decision support not specific policy instruments such as a carbon tax. Many of the tools discussed are relevant for evaluating policies such as a carbon tax.
Claudia	Langford	Figure may not adequately portray the health elements discussed in the text. Consider changing the figure and caption to better portray the health-relevant effects of extreme precipitation in US regions and nationally.(Health Author Team Comment)	9. Human Health	9.9	346		We are using a new graphic for this figure: two maps from the updated Ch.2: Our Changing Climate.
Amanda	Campbell	Photographic images of land cover change can be very powerful. These two images, however, are difficult to compare due to the color schemes. It is hard to visually distinguish the land, water, and wetlands.	17. Southeast and Caribbean	17.2	586		The figure and the caption have been improved as requested.
Thomas Sawyer	Hopkins	You need an item paragraph on 'Planning for infrastructure changes to accommodate the use of alternative fuels and energy distributions'. This is essential to complement any policy requiring a transition away from fossil fuel combustion for transport or electric power production.	1. Executive Summary		8	1	It is not possible to cover every topic in this report; this is not a conclusion made in any of the chapters.
Thomas Sawyer	Hopkins	You have omitted the salinization of coastal ground water as a result of sea-level rise.	5. Transportation		200		Thank you for your comment. Saltwater intrusion in coastal aquifers is discussed in Chapter 25: Coastal Zone Development and Ecosystems.
Claudia	Langford	Please consider these updated literature citations for the Human Health chapter section on Temperature Extremes:Barriopedro D, Fischer EM, Luterbacher J, Trigo RM, García-Herrera R. The hot	9. Human		342	1	We included the following citations, since they support assessments of

		summer of 2010, redrawing the temperature record map of Europe. Science 2011;332:220–4.Hajat, S. & Kosatsky, T. Heat-related mortality: A review and exploration of heterogeneity. J. Epidemiol. Community Health 64, 753–760 (2010).Hajat S, Sheridan SC, Allen MJ, Pascal M, Laaidi K, Yagouti A, et al. Heat–health warning systems: a comparison of the predictive capacity of different approaches to identifying dangerously hot days. Am J Public Health 2010;100(6):1137–44.Huang, C, Barnett AG, Wang X, Tong S. 2012. The impact of temperature on years of life lost in Brisbane, Australia. Nature Climate Change 2: 265–270. Kinney PL, Pascal M, Vautard R, Laaidi K. 2012. Winter mortality in a changing climate: will it go down? BEH (Bulletin epidemiologique hebdomadaire, English version) 12-13:5-7 (20 March 2012). Available at: http://www.invs.sante.fr/en.Kinney, P. L., O'Neill, M. S., Bell, M. L. & Schwartz, J. Approaches for estimating effects of climate change on heat-related deaths: Challenges and opportunities. Environ. Sci. Policy 11, 87–96 (2008).Kinney PL. 2012. Health: a new measure of health effects. Nature Climate Change 2:233-234.Matthies F, Menne B. Prevention and management of health hazards related to heat waves. Int J Circumpolar Health 2009;68(1):8-22.Metzger KB, Ito K, Matte TD. Summer heat and mortality in New York city, how hot is too hot? Environ Health Perspect 2010;118(1):80–6.Peng RD, Bobb JF, Tebaldi C, McDaniel L, Bell ML, Dominici F. 2011. Toward a quantitative estimate of future heat wave mortality under global climate change. Environ Health Perspect 119: 701-706 doi: 10.1289/ehp.1002430. Zhang K, Rood RB, Michailidis G, Oswald EM, Schwartz JD, Zanobetti A, Ebi KL, O'Neill MS. Comparing exposure metrics for classifying 'dangerous heat' in heat wave and health warning systems. 2012. Environment International 46:23-29.(Health Author Team Comment)	Health				heat impacts in the U.S., into our traceable accounts literature:Kinney, P. L., O'Neill, M. S., Bell, M. L. & Schwartz, J. Approaches for estimating effects of climate change on heat-related deaths: Challenges and opportunities. Environ. Sci. Policy 11, 87-96 (2008); Kinney PL. 2012. Health: a new measure of health effects. Nature Climate Change 2:233-234; Metzger KB, Ito K, Matte TD. Summer heat and mortality in New York city, how hot is too hot? Environ Health Perspect 2010;118(1):80-6; Peng RD, Bobb JF, Tebaldi C, McDaniel L, Bell ML, Dominici F. 2011. Toward a quantitative estimate of future heat wave mortality under global climate change. Environ Health Perspect 119: 701-706 doi: 10.1289/ehp.1002430.
Kyle	Dittmer	p. 405, lines 16-42. Federal-State-Tribal Fishery managers are interested in modified rule curves for Columbia Basin reservoirs. Increasing weather variability may cause early winter snowmelt or an extended dry period in winter. In such cases, the expected water does not materialize, and a reservoir is may then be overdrafted, and expected water does not materialize. Planned in-season fish flows drafted from the reservoir may not occur. This is of concern to PNW tribes with respect to salmon. New optimized reservoir rule curves (Lee et al. 2009) can give operators more ability to buffer against increasing climate change/variability, especially in the moisture-rich Pacific Northwest.Lee SY, Hamlet AF, Fitzgerald CJ, Burges J, Lettenmaier DP 2009. Optimized flood control in the Columbia River Basin for a global warming scenario. Journal of Water Resources Planning and Management 135(6): 440-450, doi:10.1061/(ASCE)0733-9496(2009)135:6(440). Available at http://cses.washington.edu/cig/outreach/workshopfiles/kelso06/index.shtml	10. Water, Energy, and Land use				We greatly appreciate this suggestion, but space is limited and we were unable to devote the space needed for a detailed treatment of this topic. We hope that the information in the regional chapters and Climate Science chapter will be useful in making this type of decision.
Amanda	Campbell	Any information on trends in ground-level ozone is important for public health and metropolitan area planning. Does this figure portray average ground-level ozone per summer season, or on a typical warm summer day in these states? Does it incorporate urban heat island and land use changes? Does it assume stricter emissions standards for vehicles and point-sources over time?	17. Southeast and Caribbean	17.10	596		The caption has been clarified about the time frame. The other points raised are beyond the scope of this chapter as the specifics are provided in the accompanying reference.
Claudia	Langford	Please consider these updated literature citations for the Human Health chapter section on Air Pollution, Holloway T, Spak SN, Barker D, Bretl M, Moberg C, Hayhoe K. VanDorn J, Wuebbles D. 2008. Change in ozone air pollution over Chicago associated with global climate change. Journal of Geophysical Research- Atmospheres 113 doi:D22306 10.1029/2007jd009775. (Health Author Team Comment)	9. Human Health		334	21	We appreciate the suggestion, but feel the current references are appropriate and adequate given the chapter's space limitations.
Claudia	Langford	Human Health chapter section on Wildfires, please consider these updated literature citations:Henderson SB, Barauer M, McNab YC, Kennedy SM. 2011. Three measures of forest fire smoke exposure and their associations with respiratory and cardiovascular health outcomes in a population-based cohort. Environ Health Perspect 119:1266-1271. http://dx.doi.org/10.1289/ehp.1002288 [online 09 June 2011]Holstius DM, Reid CE, Jesdale, BM, Morello-Frosch R. Birth weight following pregnancy	9. Human Health		340	1	The team has added these new source citations on Wildfires and health.

		during the 2003 Southern California wildfires. Environ Health Perspect 120(9):1340-1345. doi: 10.1289/ehp.1104515 [online 29 May 2012]Marlier ME, DeFries RS, Voulgarakis, Kinney PL, Randerson JT, Shindell DT, Chen Y, Faluvegi G. 2013. El Nino and health risks from landscape fire emissions in southeast Asia. Nature Climate Change 3:131-136.(Health Author Team Comment)					
Claudia	Langford	Human Health chapter section on Food- and Waterborne Diarrheal Disease, please consider these updated literature citations:Baker-Austin C, Trinanes JA, Taylor NGH, Hartnell R, Siitonen A, Martinez-Urtaza J. 2013. Emerging Vibrio risk at high latitudes in response to ocean warming. Nature Climate Change 3: 73-77. CDC 2008. Centers for Disease Control and Prevention (CDC), Outbreak of Vibrio parahaemolyticus infections associated with eating raw oysters–Pacific Northwest, 1997, Morb. Mort. Week. Rep. 47, 457–462 (2008).(Health Author Team Comment)	9. Human Health		345	9	We have added the suggested citations in our chapter assessment.
Claudia	Langford	Human Health chapter section on Allergens, please consider this updated citation from the recent literature:Darrow LA, Hess J, Rogers CA, Tolbert P, Klein M, Sarnat SE. 2012. Ambient pollen concentrations and emergency department visits for asthma and wheeze. J Allergy Clin Immunol 130(3): 630-638 (Sept 2012).(Health Author Team Comment)	9. Human Health		335	11	We have added the suggested citation to the text.
Claudia	Langford	Existing citation should read:Sheffield PE, Weinberger KR, Ito K, Matte TD, Matthes RW, Robinson GS, Kinney PL. 2011. The association of tree pollen concentration peaks and allergy medication sales in New York City: 2003-2008. ISRN Allergy, 2011 doi:10/5402/2011/537194.(Health Author Team Comment)	9. Human Health		381	30	Thank you for your suggestion. We have revised the reference to incorporate the changes you identified.
Jennifer	Botsford	Consider adding "(COPD)" after" chronic obstructive pulmonary disease," because the lay person may only recognize the condition by its abbreviation.	9. Human Health		340	9	We agree with your suggestion and have added the acronym, "COPD."
Claudia	Langford	Human Health chapter, section on “Most Vulnerable at Most Risk,” please consider these updated citations from the recent literature:Bell ML, K Ebisu. 2012. Environmental inequality in exposures to airborne particulate matter components in the United States. Environmental Health Perspectives 120(12), p. 1699-1704.Gamble JL, Hurley NJ, Schultz PA, Jaglom WS, Krishnan N, Harris M. 2013. Climate change and older Americans: state of the science. Environ Health Perspect 121:15-22.(Health Author Team Comment)	9. Human Health		351	1	Thank you. We have added the suggested citations to the text.
Jennifer	Botsford	Consider adding a statement about the increased risk of power outages during wildfires, and the connection to the impact on risk from heat-related illnessess and other power outage-related health effects, i.e. access to water, food safety, private wells. In AZ, most wildfires are during the summer. Therefore, we are concerned with power outages during wildfires, since the fire can damage the power grid.	9. Human Health		340		We added text in the chapter to mention, "loss of electrical power during a heat wave or wildfires, which can reduce food and water safety."
Amanda	Campbell	This level of detail is very helpful for characterizing changes in risks over time. Depicting a & b together, and in a separate figure, showing c & d with different symbology, would make the differences in the information portrayed more clear. A lot of the dots are on top of each other, making it hard to read at the regional level--perhaps a zoomed-in version could be available in an appendix. The graphics' titles should clearly state the timeframe of the projections (i.e. to 2100 or 2050).	17. Southeast and Caribbean	25.3	871		The figure has been revised to incorporate this perspective. The shape of the symbols for c) and d) have been changed to be different from the symbols for a) and b). This comment refers to Figure 25.3: Projected Sea Level Rise and Flooding by 2050. The figure is in the Coasts chapter.
Amanda	Campbell	This report’s usefulness and strength is greatly increased by the inclusion of more case studies of current adaptation practices. It is also helpful that the report begins to assess nation’s preparedness, and to identify adaptation strategies needed. The report effectively balances the inclusion of a high level of detail with the need for simplicity and brevity. Other positive changes include:					Thank you very much for the positive comments. We hope you find the final report to be useful.

		• More emphasis on equity, social vulnerability • More emphasis on placing climate change in the context of other drivers (natural cycles, urban heat island, land use change, etc.) • Several new sections including Urban, Rural, Biogeochemical Cycles, Water/Energy/Land Use, Decision Support, Mitigation, Adaptation Metropolitan Washington Council of Governments Department of Environmental Programs looks forward to the additional tools and resources developed through the NCADAC process.					
Jennifer	Botsford	This sentence may be unclear to the reader, and can be interpreted multiple ways. The reader may think you are trying to say that morbidity and mortality have diminished. Surveillance shows that in AZ rates of heat-related illnesses are increasing. Consider rewording the sentence.	9. Human Health		343	1	The text has been revised to incorporate this suggestion.
Jennifer	Botsford	This sentence is unclear. Please rewrite.	9. Human Health		344	6	The text has been revised to incorporate this suggestion. The text in question now reads, "Climate change effects on the geographical distribution and incidence of vector-borne diseases in other countries where these diseases are already found can also affect North Americans, considering increasing trade with, and travel to, tropical and subtropical areas (McGregor 2011; Wilson 2009)."
Jennifer	Botsford	Not everyone reading the document is familliar with beach closures. Please consider adding an explanation/reasoning behind beach closures.	9. Human Health		345	24	The text has been revised to incorporate this suggestion. We added, "beach closures resulting from changes in the magnitude of recent precipitation (within the past 24 hours) and lake temperature…"
Jennifer	Botsford	Not all suicides are caused by depression. Consider adding "and other mental illnesses" to the end of the sentence.	9. Human Health		349	25	We agree and have adopted this change.
Amanda	Campbell	Decision Support Chapter The Decision Support Chapter is an excellent start towards bringing pertinent climate information to decision makers. The 2013 National Climate Assessment provides more case studies and outlines more policy solutions than the previous report, which makes this report potentially more effective and more useful. MWCOG has been working with local, regional, and national leaders across the National Capital Region on climate change for several years and has some additional recommendations that are based on feedback from stakeholders in the National Capital Region. In 2008, the COG Board adopted the National Capital Region Climate Change Report, which identified goals for climate mitigation and adaptation. In 2009, the Climate, Energy and Environment Committee (CEEPC) was established to help move the region toward meeting the goals of the Climate Change Report. The CEEPC Action Plan identifies short term mitigation- and adaptation-related targets and strategies to facilitate movement	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a				Additional discussion on communication was included in this chapter as well as examples, but the suggestions about the climate adaptation planning needs would be better suited for consideration in the Adaptation Chapter. Included research priority related to development of decision support tools/database as part of sustained assessment.

		to achieving the long-term goals. CEEPC is currently redeveloping the Action Plan. In the discussions regarding the draft Action Plan, local jurisdictions have pointed out decision support tools that they need to assist them in implementing climate adaptation strategies, including: • Information on costs and benefits of different strategies • Costs of inaction in general or in specific cases • Near-term economic, societal, and environmental co-benefits of adaptation and mitigation actionsAs a next step to developing decision-support tools it is recommended that national statistics, case studies, a list of benefits for best practices, and additional cost related support tools be developed to assist local jurisdictions in their decision making processes and that the Decision Support Section reflect the need for these tools. National guidance that consists of tools such as a simple set of facts, figures, rules of thumb, and analogies could help make the case to the public and decision makers for the need to analyze and address climate change and climate impacts, and integrate climate considerations in standard operating procedures. The MWCOG Air and Climate Public Advisory Committee (ACPAC) advises CEEPC on issues related to climate and energy and consists of citizen, non-profit, and business stakeholders from northern Virginia, District of Columbia, and suburban Maryland. In March 2013, ACPAC heard an overview presentation of the NCA and evaluated the report in terms of the type of traction the report will have with policy makers. The group advised that in communicating the need for action, it is important to keep in mind that elected decision makers respond first to their constituents. It was pointed out that how the information is communicated is key and that policy makers want to hear about the solutions rather than the problems. Committee members observed that people do not relate to negative messaging and discussing long-term scenarios; it is more effective to discuss short-term objectives, co-benefits, and win-win options. Based on this feedback, it would be useful to add a section to the NCA Decision Support Chapter that discusses how to communicate to policy makers and the public to gain support for implementation of strategies. In 2010, MWCOG applied for and received technical assistance through the EPA Smart Growth Implementation Assistance Program. An EPA guidebook is expected to be published in 2013 that provides an overview of climate adaptation approaches that are relevant to four sectors: buildings, land use, transportation and water. Over 200 local, regional, and federal leaders representing the four sectors were educated/ trained on climate impacts and adaptation, vulnerability assessments, and best practices throughout this project. Examples of participants include DC Water, Metropolitan Washington Transit Authority (WMATA), U.S. General Services Administration (GSA), University of Maryland climate scientists as well as local government energy managers, transportation planners, and more. Beyond what was learned during this adaptation planning process, participants have identified the following needs for climate adaptation/impacts planning: • The need for regional-scale data that is in the same units and scale that engineers are using in current plans • The need for the identification of funding streams • The need to integrate climate resilience with current work, including meeting current environmental regulations • The need to communicate climate information to the public and to policymakers in an understandable fashion	Climate Change Context				

		• The need for specific technical approaches to adapting to the impacts of climate change in specific sites and under specific conditions Based on our experience with stakeholders, we recommend that you develop decision support tools to assist with their needs and that the Decision Support Chapter identifies the need for these tools.					
Jennifer	Botsford	Consider adding "of multiple system failures" after "...one example."	9. Human Health		351	25	We thank the reviewer for the helpful suggestion, which has been incorporated in the text.
Thomas Sawyer	Hopkins	This chapter is weak with regard to the energy transition now going on. There is little mention of Solar and Wind as sources and their support needed for their use. There is a complete omission of hydrogen as energy source for both power and transport. This is considered as the perfect solution to the geopolitical and pollution problems connected with fossil fuels sources. Already, hydrogen vehicle are entering the market, e.g. BMW (combustion) and Hyundai (fuel cell). The use of carbon already in circulation is not promoted. Biofuel is a good technology, but it consumes agricultural land and fossil fuel to produce it, and it should be discouraged. On the contrary, our organic waste stream could and should be utilized of CH4 production, which can also be a source of hydrogen. Sewage to electricity is being practiced some European cities and on some American farms.	4. Energy Supply and Use				The charter of this chapter is to assess the potential physical impacts of climate change on the U.S. Energy System with a 25 and 100- year time horizon. The current portfolio of energy sources in the U.S. is primarily based on fossil fuels and that is predicted to continue in the 25-year horizon especially as U.S. production of oil and gas from shales increases. As discussed in Key Message 5, it is not possible to accurately predict the diversity of energy supplies of 100 years in the future. Due to page length limitations in the National Climate Assessment overall, the emphasis of the chapter is on commercial technologies including a discussion of solar and wind energy in proportion to their percent of Energy supply in the U.S.
Jennifer	Botsford	Pregnant women are exposed to increased stress following an extreme weather event such as a natural disaster like Hurricane Katrina. Increased stressors during pregnancy are associated with adverse birth outcomes. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2635112/, http://www.ncbi.nlm.nih.gov/pubmed/20002425.	9. Human Health		349		Agreed. Suggest adding, at the end of the paragraph (p 349 line 26) the following: "These outcomes may have secondary health consequences such as on birth outcomes (Xiong et al. 2008; Harville et al. 2009)." The references are: Xiong, X., E.W. Harville, D.R. Mattison, K. Elkind-Hirsch, G. Pridjian, and P. Buekens (2008). Exposure to Hurricane Katrina, Post-Traumatic Stress Disorder and Birth Outcomes. Am J Med Sci.336(2): 111–115. Harville, E.W., X. Xiong, and P. Buekens (2009). Hurricane Katrina and perinatal health. Birth 36(4):325-31
Jennifer	Botsfor	Consider adding a brief description of Chikungunya for those that are not familliar with it or how it is	9.		353	20	Thank you for your suggestion,

	d	impacted by climate.	Human Health				however this text has been removed.
Jennifer	Botsford	Please consider adding citations to these conclusions.	9. Human Health		353	29	We appreciate the suggestion and have added citations to support these conclusions in our chapter assessment.
Kelly	Keen	The National Climate Assessment (Assessment) is very broad in scale, which may limit its effectiveness for decision makers seeking guidance when designing adaptation policies at the state and local level; however, studies are referenced throughout the Assessment that may help inform decisions at different scales. A database of these studies, including their geographic extent and area of focus, may be helpful as an appendix for federal, state, and local agencies, as well as other interested parties, to reference depending on their needs and jurisdictions.					Thank you for the comments. The electronic version of the final report will greatly help readers with discovery of relevant information.
Jennifer	Botsford	The phrase "health insurance coverage has been declining" may be outdated by the time this document is published. Consider that the Affordable Care Act (ACA) aims to increase health insurance coverage for Americans. So, maybe add a sentence after the phrase that mentions the ACA implementation goals.	9. Human Health		354	8	A sentence was added to line 10 about the future shortages of health care and public health professionals that have been projected: It is hoped that the Affordable Care Act will be an opportunity to address these trends.
Kelly	Keen	One of the benefits of conducting a national-level assessment is the opportunity to learn about how other resource agencies are adapting to climate change. The map describing sea level rise adaptation measures on page 875 is especially helpful for staff at the California State Lands Commission. Consider expanding on the adaptation efforts mentioned in the graphic with additional in-depth information on selected efforts in each region.	25. Coastal Zone Development and Ecosystems	25.4 (d)	875		Thank you. The figure in its final form is interactive and includes additional information on each of the bullets, including links and references for those interested.
Jennifer	Botsford	The "Responses Have Multiple Benefits" section seems has awkward flow and seems out of place. Please consider adding these paragraphs to sections to related chapters within the assessment or adding subtitles. Lines 33-35 on page 355 seem like an opinion/recommendation for a policy document and not a statement that would fit in an assessment document.	9. Human Health		354	24	Agree that lines 33-35 are out of place and have no literature to support them. Suggest deletion. Disagree that section should be broken up as there are no related chapters making the point about co-benefits. Agree that the tone and writing of this section need to be revisited to assure that the literature is being reviewed and a political point of view is not the main thrust.
Amanda	Campbell	The water utilities and water resource manager stakeholders in the Washington region are very interested in information regarding the impacts of climate change to the water sector. Participants in a workshop on Extreme Weather Events and the Water sector that MWCOG hosted in December, 2012 in partnership with WERF, NOAA, DC Water, and EPA pointed to the fact that emergency preparedness and emergency planning is more feasible to undertake than long-term adaptation planning for a number of reasons. This Chapter effectively describes the expected additional climate change impacts in context of the necessity for water infrastructure and water supply, increasing demands, aging infrastructure, and the need to meet regulatory requirements. Climate impacts to the water sector need to be addressed holistically, balancing environmental,	3. Water Resources				The text has been revised to incorporate the suggestion,

		economic, and social trade-offs; however, from our work, we've observed that the current regulatory environment operates in separate silos. For example, stormwater volume is handled separately from quality, and water supply is handled separately from flood control. The Water Resources Chapter would be improved by noting the need for integrated planning and regulations, and the need to align incentives to promote strategies that balance multiple objectives. In addition, water sector stakeholders have identified the need for more comprehensive regional downscaled data.					
Jennifer	Botsford	Under Key message #2/4, in 'the sick' category, the second paragraph is identical to the second paragraph under 'the poor' category on page 361. Please consider deleting as it seems more appropriate under 'the poor' category on page 361. Not all people who are sick are also poor.	9. Human Health	2	360		We thank the reviewer for the helpful suggestion, which has been incorporated into the draft.
Jennifer	Botsford	In the table for Key message #3/4 in the last paragraph of the description of evidence base section, did you mean European "Heat" Wave instead of European Wave?	9. Human Health	3	363		Thank you for your comment. The text has been revised to clarify that the authors are referring to the European "heat" wave.
Raymond	Najjar	Saltwater intrusion comes up a lot in this chapter but there is no peer-reviewed study mentioned on saltwater intrusion into estuaries. The only study I am aware of is that by Hilton et al. (2008), which analyzed long-term salinity records in the Chesapeake Bay. I think this paper should be cited, perhaps on page 870, line 1, where saltwater intrusion into estuaries is mentioned. Though Burkett and Davidson (2012) is cited there, that report does not contain any references to saltwater intrusion into estuaries.Hilton, T.W., Najjar, R.G., Zhong, L., Li, M., 2008. Is there a signal of sea-level rise in Chesapeake Bay salinity? Journal of Geophysical Research 113, C09002, doi:10.1029/2007JC004247.	25. Coastal Zone Development and Ecosystems				We have already cited several references on saltwater intrusion throughout the report (climate drivers and infrastructure sections), in particular we discuss its impact on coastal infrastructure. We have added the suggested reference and another new reference, and generally amended that discussion in response to several comments. With that, we feel we have adequately addressed the issue here without stepping on the Water chapter's territory (with whom we previously agreed upon division of labor on this issue). Reference to the Water chapter is also included. Our saltwater intrusion discussion has moved to one place toward the end in the infrastructure section now for clearer discussion.
Jennifer	Botsford	Much of the narrative has focused on examples throughout the United States; however, there are no examples for the Southwest United States. Are there any other appropriate examples that you could use in the SW to be representative for the whole United States?	9. Human Health				The selection of examples was not intended to be geographically comprehensive; space limitations preclude that.
Angela	Dyjack	April 12, 2013VIA ELECTRONIC SUBMISSIONEmily Therese Cloyd Public Participation and Engagement Coordinator National Climate Assessment US Global Change Research Program 1717 Pennsylvania Ave. NW, Suite 250					Thank you for the detailed comments on the Health chapter. The chapter has been revised in response to many of these comments.

		Washington, DC 20006ecloyd@usgcrp.govDear Ms. Cloyd: The American Public Health Association, a diverse community of public health professionals who have championed the health of all people and communities around the world for more than 140 years, appreciates the opportunity to provide comments on the Draft National Climate Assessment. Although our comments focus primarily on Chapter 9, Human Health, health does not seem to be adequately addressed in the Research Agenda Chapter.APHA is pleased with the attention to human health in Chapter 9, the evidence that is presented on the impacts to health now and in the future, and in particular the sections on vulnerable populations, mental health and prevention, provides protection. However, we have some general and several more specific concerns and comments.General Comments • The report is well cited and evidence based however since the draft assessment was released, several new studies have been published that are of importance to human health. We request these studies, which are cited in several of the specific comments, be considered for inclusion. • The current caption headings are lengthy and contain information beyond the content of the figure. To increase readability, suggest shortening the captions to describe the figure and to present the additional information in text boxes. • Although there is an entire chapter on water, we suggest adding a section on water scarcity and quality to this chapter since these issues are so important to human health. Specific Comments Key Messages • Page 333, lines 26 through 28. Consider adding “water scarcity and decreased availability of potable water” after decreased air quality. • Page 333, line 40. Suggest adding “economic benefits” to the last part of this sentence with societal benefits. • Page 334, lines 14 and 15. Consider adding “Great Plains and deserts” to places.Wide Ranging Health Impacts Air Pollution Allergens • Figure 9.3. While figure 9.3 is a good figure, it is older than the previous national assessment, and seems outdated. Although the information that increased CO2 leads to higher allergens is discussed in the figure, this is not stated in the corresponding paragraph. • Figures 9.4 and 9.5 may be eliminated if document space is limited. Wildfires • Page 340, line 11. Johnston et al 2012 differs from the other papers cited in that the global burden estimates are based on risk assessment where all the other papers are epidemiological. Suggest either distinguishing the difference or not citing this paper. • Page 340, lines 13 and 14. The McDonald et al. 2009 and Shea et al. 2008 papers are about allergens, not wildfire. Suggest moving these citations to the allergens section.					

		• Page 341, line 7. Should be “affect” not “effect”. • Page 351, line 6. Should be “physiological” not “physiology”.Most Vulnerable at Most Risk • Page 351, overall. Consider adding vulnerability mapping studies (mostly focused on heat) (Reid et al 2009; Buscali et al 2012; Harlan et al 2012; Johnson et al 2012; Sister et al 2009; Wilhelmi and Hayden 2010; and Reid et al 2012) to this section or the section on Protection Provides Prevention as a helpful tool in identifying and prioritizing vulnerable populations. • Page 352, lines 16 through 21. Hurricane Katrina is a striking example of the health impacts of an extreme event, inclusion of other examples would benefit this section. Another source of information on environmental justice and climate change is the Climate Gap report http://dornsife.usc.edu/pere/documents/The_Climate_Gap_Full_Report_FINAL.pdf. If available, information from Hurricane Sandy would be ideal. • Page 354, lines 16 through 22. Suggest adding a list of the public health programs that are mentioned in this section.Responses Have Multiple Benefits • Suggest adding a paragraph on the co-benefits associated with federal agency (EPA and CDC) mitigation and adaptation activities. • Page 355, lines 19 through 25. Consider adding the health benefits of reducing short-lived green house gas pollutants (as presented in Smith et al 2009). • Page 355, lines 33 through 35. Suggest adding the benefit of policies to reduce climate change on water scarcity and food security especially for vulnerable populations to this section.In summary, APHA is pleased with this chapter and the focus on human health - and supports efforts to address the impacts of climate change on the public's health. Thank you for the opportunity to review and provide comment on this important assessment.Sincerely,Georges C. Benjamin, MD, FACP, FNAPA, FACEP (E), Hon FRSPH Executive DirectorWorks Cited:Buscali C, Upegui E, Viel JF. 2012. Mapping heatwave health risk at the community level for public health action. Int J Health Geogr 11:38.Harlan SL, Declet-Barreto JH, Stefanov WL, Petitti DB. 2012. Neighborhood effects on heat deaths: Social and environmental predictors of vulnerability in Maricopa county, Arizona. Environ Health Perspect.Johnson DP, Stanforth A, Lulla V, Luber G. 2012. Developing an applied extreme heat vulnerability index utilizing socioeconomic and environmental data. Applied Geography 35:23-31.Kershaw SE, Millward AA. 2012. A spatio-temporal index for heat vulnerability assessment. Environ Monit Assess.Loughnan ME, Nicholls N, Tapper NJ. 2009. A spatial vulnerability analysis of urban populations to extreme heat events in Melbourne Australia. Melbourne, Australia: Victorian Department of Health.Reid CE, Mann JK, Alfasso R, English PB, King GC, Lincoln RA, et al. 2012. Evaluation of a heat vulnerability index on abnormally hot days: An environmental public health tracking study. Environ Health Perspect 120:715-720.Rinner C, Patychuk D, Jakubek D, Nasr S, Bassil KL, Campbell M, et al. 2009. Development of a Toronto-specific, spatially explicit heat vulnerability assessment: Phase i. Toronto, Canada: Toronto Public Health.Sister CE, Boone CG, Golden JS, Hartz D, Chuang WC. Mapping social vulnerability to heat wave in Chicago. In: Proceedings of the Fourth Symposium on Policy and Socio—Economic Research at The 89th American Meteorological Society Annual Meeting, 2009. Phoenix, AZ.Smith KR, Jerrett M, Anderson HR, Burnett					

		RT, Stone V, Derwent R, et al. 2009. Public health benefits of strategies to reduce greenhouse-gas emissions: Health implications of short-lived greenhouse pollutants. The Lancet 374:2091-2103.Wilhelmi O, Hayden M. 2010. Connecting people and place: A new framework for reducing urban vulnerability to extreme heat. Environmental Research Letters 5:014021.					
Raymond	Najjar	A few more details about the Chesapeake Bay's response to climate change would be helpful here, including facts such as it being the largest US estuary and having water quality and living resource problems similar to many estuaries in the US. These problems include dramatic historical declines in oxygen, water clarity, seagrass beds, and shellfish. A reference supporting the statements in this box would be helpful, too. There is a detailed Chesapeake Bay case study presented in Appendix A of the Technical Input by Burkett and Davidson (2012), entitled "Coastal Impacts, Adaptation, and Vulnerabilities." The appendix was written by Susan Julius and is based heavily on the work of me and my colleagues, specifically Najjar et al. (2010), which is a comprehensive analysis of the potential impacts of climate change on this system.Najjar, R.G., Pyke, C.R., Adams, M.B., Breitburg, D., Hershner, C., Kemp, M., Howarth, R., Mulholland, M., Paolisso, M., Secor, D., Sellner, K., Wardrop, D., Wood, R., 2010. Potential climate-change impacts on the Chesapeake Bay. Estuarine, Coastal and Shelf Science 86, 1-20.	16. Northeast		561	36	The text has been revised to incorporate this suggestion.
Nicholas	Sundt	As soon as the report starts mentioning specific regions, it needs to define the extent of those regions. At a minimum, this requires a map that includes the outlines of every state. I suggest going one step further and providing a table that lists every state (vertical axis) and every region including the coastal region and page number for each region. Using this table, every reader should immediately be able to figure out what region their state is in. That way, when the report subsequently mentions any specific region, the readers know what area the report refers to.	Introduction: Letter to the American People		1	37	Because this report will be submitted electronically, the regional map will be a mouse-click away so that people can verify which states are in which regions.
Francesco	Femia	The Draft Climate Assessment Report offers a timely and important look at the role of climate change in the United States. However, the draft report does not include the relationship between climate change and U.S. national security, either domestic or international. This is an important omission - one that ultimately limits the ability of the Assessment to reach its overarching goal of enhancing the capacity of the United States to anticipate, mitigate and adapt to changes in the global environment. It is strongly recommended that an assessment of the links between climate change and U.S. national security be included in the final version of the National Climate Assessment report.					Description of this topic and its level of inclusion in the report has been added to the Executive Summary.
Graham	McCahan	April 12, 2013U.S. Global Change Research Program 1717 Pennsylvania Ave., NW, Suite 250 Washington, D.C. 20006 Submitted at review.globalchange.govRe: The 2013 Draft National Climate AssessmentDear National Climate Assessment and Development Advisory Committee:Thank you for this opportunity to comment on the critically important draft National Climate Assessment (NCA). Environmental Defense Fund (EDF) is a non-partisan environmental organization with more than 750,000 members nationwide. EDF is dedicated to working towards innovative, cost-effective solutions to environmental problems, building on a foundation of rigorous science, economics, and law. EDF respectfully urges the National Climate Assessment Development and Advisory Committee (NCADAC), and the participating federal agencies to include, in the final NCA, a more complete assessment of the profound economic burden of climate change using currently-available data and information. EDF also recognizes the impending June deadline for the final NCA to be submitted to Congress and the President, and respectfully urges the NCADAC to comply with that statutory deadline so American citizens, political leaders, and policymakers have this vital information as they address the clear and present danger of climate					Thank you for the comments. Additional description of economic aspects has been added to the Executive Summary. While the authors attempted to include economic information where possible, for this report, economic information is limited to what could be developed from case studies and reports in particular sectors and regions. The ongoing sustained assessment process developed around this Third NCA report can hopefully contribute to an improved assessment of the valuation of climate impacts, mitigation, and adaptation. As in the development of the current report, there will be numerous opportunities for members

		change. A central purpose of the Global Change Research Act of 1990 (GCRA) is to "provide for development and coordination of a comprehensive and integrated United States research program which will assist the Nation and the world to understand, assess, predict, and respond to human-induced and natural processes of global change." See 15 U.S.C. § 2931(b). In addition to other research activities, the GCRA requires the designated federal council, through the NCADAC, to prepare and submit to the President and Congress, at least once every four years, an assessment which "analyzes the effects of global change on the natural environment, agriculture, energy production and use, land and water resources, transportation, human health and welfare, human social systems, and biological diversity." See 15 U.S.C. § 2936(2). We urge the NCADAC, consonant with its statutory obligations, to include an assessment of the extensive economic costs associated with a changing climate in the NCA. Any complete analysis of the effects of climate change on "human health and welfare" and "human social systems" must include a rigorous and quantitative analysis of the economic costs of climate impacts. The analysis should include, for example, the costs and fiscal impact on government resources from disaster relief, effects on insurance programs, and infrastructure repair and updating, as well as the costs borne by American communities due to the effects of extreme weather events such as drought, severe storms, and flooding.The drafters of the previous version and current draft of the NCA found that it was important (indeed essential) to include adaptation costs in the assessment. The 2009 NCA stated, "[t]here is currently limited knowledge about the ability of communities, regions, and sectors to adapt to future climate change. It is important to improve understanding of how to enhance society's capacity to adapt to a changing climate in the context of other environmental stresses . . . A major difficulty in the analysis of adaptation strategies in this report has been the lack of information about the potential costs of adaptation measures . . . ." See 2009 NCA at 156. Regrettably, the 2013 Draft NCA identifies the same information gap. It states that "emerging areas of needed research include: Costs and Benefits of Adaptation. Methodologies to evaluate the relevant costs of adaptation costs, as well as the costs of inaction, need to be developed." See 2013 Draft NCA at 1007. The failure to document the economic costs of climate change, both impacts and adaptation, in the 2013 draft is untenable in light of the express finding in the 2009 report calling for such analysis, and especially so in light of the extensive and widely available information on the costs of climate change. We urge the NCADAC to correct this deficiency promptly, and to include an assessment of economic costs in the final 2013 NCA. This is necessary to carry out an assessment consistent with the law and to ensure that our nation's policymakers and our citizens are provided with information to fully "understand, predict, and respond to" the clear and present danger of climate change. In addition to including a more complete assessment of economic costs in the final 2013 NCA, it is imperative that the GCRA's designated federal council, through the NCADAC, complete and timely submit the final 2013 NCA to the President and Congress in accordance with the GCRA's four-year deadline. See 15 U.S.C. § 2936. The last NCA was released on June 16, 2009. Therefore, the next assessment is due on or before June 16, 2013. In the event that the final 2013 NCA is not timely completed and submitted to the President and Congress, then the designated federal council and the NCADAC will be in violation of their mandatory statutory duty and will be subject to legal action to enforce that duty. I. Currently Available Information on the Costs of Climate ChangeAs the extensive scientific studies and findings in the Draft NCA demonstrate, the effects of climate change are already being seen and felt throughout the United States. These effects include more intense storm events, increased frequency and intensity of wildfires and droughts, and stress on critical infrastructure. The Draft NCA, however, does not adequately present the very real and mounting economic costs that a changing climate imposes upon rural and urban communities, government at all levels, and wide swaths of the American economy. The Draft NCA contains some references to these real and mounting costs, but these references should be highlighted, presented more systematically, and augmented with currently-available data from the public and private sectors.For instance, a recent report by the independent, nonpartisan, U.S.					of the public to contribute technical expertise. As individual events can not be attributed to climate change, costs of individual events can not either.

		Government Accountability Office (GAO) warned that climate change "presents a significant financial risk to the federal government" in four key areas: 1) Damage to federal property and infrastructure, and associated adaptation costs. 2) Rising costs for federal insurance programs. For instance, the federal government's crop insurance costs have increased from an average of $3.1 billion per year from 2000 through 2006 to an average of $7.6 billion per year from 2007 through 2012, and these costs are projected to increase further. 3) Costs related to providing assistance to state and local governments to respond to local climate impacts. 4) Rising costs of climate disaster relief. For example, federal disaster declarations have increased in recent decades, and the Federal Emergency Management Agency (FEMA) obligated over $80 billion in assistance for disasters from 2004 through 2011. In addition, in December 2012, the U.S. Office of Management and Budget requested $60.4 billion in federal resources for Hurricane Sandy recovery efforts. The growing number of disaster declarations—a record 98 in fiscal year 2011 compared with 65 in 2004—has contributed to increased federal disaster costs. U.S. Government Accountability Office, High-Risk Series: An Update (Feb. 2013), GAO-13-283.Of course, federal disaster relief and insurance programs do not cover all economic losses that occur because of climate change. The private insurance industry has also warned of the mounting insured and uninsured losses linked with climate change. In a recent report, the world's largest reinsurance company, Munich Re, analyzed the costs of severe weather in North America. Munich Re, Severe Weather in North America (2012). See also October 17, 2012 Press Release, available at http://www.munichre.com/en/media_relations/press_releases/2012/2012_10_17_press_release.aspx. The report found that the number of natural catastrophes escalated from 1980 through 2011, as did the losses (both insured and uninsured) for weather-related events during the same time period. See Munich Re, Severe Weather, Executive Summary at 3. The overall losses from weather catastrophes during that time period exceeded $1.06 trillion, of which $510 billion were insured losses. Munich Re, Severe Weather at 20. In addition to these very significant economic losses, there has been a profound loss of life from severe weather events in recent decades that cannot be adequately captured by economic or other statistics. Around 30,000 lives have been lost to weather catastrophes in North America since 1980. Id. at 21. Heat waves in 1980 and 1988 alone caused more than 15,000 deaths in the U.S. Id. The deadliest single storm event in that time period was Hurricane Katrina, from which 1,300 people died. More recently, Hurricane Sandy caused 131 deaths in October 2012. National Atmospheric and Oceanic Administration, Billion-Dollar Weather/Climate Disasters, accessed at http://www.ncdc.noaa.gov/billions/events. The loss of life is the most profound and irreplaceable loss that we face from severe weather events, and should be foremost in the minds of political leaders, policymakers, and citizens as they address climate change. The federal government has also compiled data on the frequency and high costs of extreme weather events. In its annual Billion-Dollar Extreme Weather/Climate Events report, the U.S. National Oceanic and Atmospheric Administration (NOAA) compiles a list of weather events that impose both insured and uninsured losses greater than $1 billion. Accessed at http://www.ncdc.noaa.gov/billions/overview. According to NOAA, since 1980, the U.S. has sustained 144 weather/climate events where overall damages/costs exceeded $1 billion (including a Consumer Price Index adjustment to 2012 dollars), and over 17% of these events occurred in the last two years. Id. There were eleven "billion-dollar events" in 2012 and fourteen such events in 2011. NOAA estimates that the aggregate cost for the fourteen extreme events in 2011 was over $60 billion					

		dollars, and that 2012's eleven extreme events will surpass 2011's in terms of total costs. Id.; see also Smith, A., and R. Katz, U.S. Billion-dollar Weather and Climate Disasters: Data Sources, Trends, Accuracy and Biases (2013). Natural Hazards, DOI 10.1007/s11069-013-0566-5. The data on 2011 events shows that losses were spread across the U.S. For instance, the 2011 drought and heat wave in the Southern Plains and Southwest resulted in over $12 billion in damages, Hurricane Irene caused $10 billion in damages in the Mid-Atlantic and Northeast, and a tornado outbreak in the Southeast and Midwest caused over $9 billion in damages. In addition to the high costs from storms and drought, wildfires also imposed significant costs in 2011—fires in Texas, New Mexico, and Arizona resulted in $1 billion in damages (note that this last figure greatly exceeds the $1.9 million cost estimate shown on pages 296, 308, and 309 of the Draft NCA, which may be a typographical error). II. ConclusionThe National Climate Assessment presents a critical opportunity once every four years for some of the country's top scientists and other experts to analyze the effects of climate change on the health and welfare of all Americans. This should include a robust presentation of the profound economic costs that we currently bear and will continue to bear so long as we forestall serious action to mitigate climate change. Therefore, EDF respectfully urges the NCADAC to timely complete its statutory obligations and include a more complete assessment of the costs of climate change in the final NCA.Sincerely, Graham G. McCahan Attorney U.S. Climate and Clean Air – Legal & Regulatory Environmental Defense Fund 2060 Broadway, Suite 300 Boulder, CO 80302 gmccahan@edf.org					
Amanda	Staudt	[NWF] All references to "federal, state and local governments" should be changed to "federal, state, local and tribal governments" where appropriate. All citations to Chapter 12 should use the correct title: "Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources"					Thank you, the suggested edits have been made wherever appropriate.
Amanda	Staudt	[NWF] All regional chapters should incorporate a reference to the tribal chapter (Ch. 12), which addresses impacts on tribal lands and resources across the country. All regional chapters should state the number of tribes within the region and summary of key impacts on native communities. We suggest as a model of best practices that the authors of each regional chapter refer to how the authors of the Alaska/Arctic Chapter and Great Plains Chapter include references to tribes.					Thank you, the suggested edits have been made wherever appropriate.
Amanda	Staudt	[NWF] This chapter has an imbalance between discussion of societal relevance and of climate impacts on ecosystems and biodiversity. The Ecosystems, Biodiversity, and Ecosystem Services chapter has a strong emphasis on societal relevance. It is certainly important to connect ecosystems and biodiversity with the services and value they provide to humans. This chapter does a better job of making these connections and attaching economic value to these services than previous National Climate Assessment reports. Nonetheless, we feel that the impacts on ecosystems and biodiversity have not been fully or clearly described in the chapter or elsewhere in the report. This is the one place in the entire report where the impacts on plants, fish, and wildlife should be front and center; however, much of the discussion in the chapter focuses on human systems and often doesn't even describe how	8. Ecosystems, Biodiversity, and Ecosystem Services				We feel that our responses to a number of the comments received address the concerns of this reviewer. We struggled to maintain a balance between ecosystems, biodiversity and ecosystem services and the different potential readers of the chapter. The addition of the paragraph about species that are currenly listed under

		natural systems are being affected by climate change. As such, it is questionable whether the draft report fully meets the requirement in the Global Change Research Act for the assessment to address impacts on natural systems and biodiversity. For example, the introductory paragraphs, which provide the framing for much of the chapter, only discuss ecosystem services. The example provided on p. 292, lines 7-11 focuses on how changes in precipitation affect water flow and in turn water availability for farms and cities. The impact of changing water flow on fish, riparian habitats, and waterfowl are not mentioned. One problem with this approach is that we have much better understanding of the impacts on ecosystems and species than we do of the impacts on ecosystem services. Thus, emphasizing our more limited knowledge on ecosystem services at the expense our better understanding of impacts on ecosystems and biodiversity serves to give the impression that our knowledge is less certain than it is. Another problem is that presuming that the NCA audience only cares about ecosystems for the "services" they provide misses an important opportunity to connect with readers who do care deeply about nature and want to know how climate change is affecting plants, fish, and wildlife. As drafted, this chapter only addresses the interests of hunters, recreational fishers, birdwatchers, wildlife enthusiasts, etc. in passing. Furthermore, starting from the perspective of ecosystem services often makes the sections confusing. In many cases (examples provided in the line-by-line comments), a non-expert reader would struggle to understand the progression from climate change to ecosystem impacts to ecosystem services, largely because these steps are not clearly presented. And, in other cases, the discussion of ecosystem impacts is only a brief mention of generalities or skipped altogether.					the Endgangered Species also serves to give more attention to species and biodviersity as this reviewer seeks.
Amanda	Staudt	[NWF] Chapter relies heavily on examples of terrestrial plants, birds, and freshwater aquatic ecosystems; impacts on mammals, amphibians, and reptiles are largely absent. Little mention is given to impacts on mammals (actually only one sentence that I found on caribou on p. 299, line 2-4). The figure provides additional examples, but is nowhere discussed or even referenced in the narrative. Shockingly, the chapter does not even address the species that have already been identified as threatened by climate change under the Endangered Species Act (i.e., polar bear, ringed seal, wolverine). Amphibians and reptiles are also largely absent from the chapter, except for the figure.	8. Ecosystems, Biodiversity, and Ecosystem Services				A new paragraph inserted about polar bears, seals, and wolverines discusses the species already harmed by climate change.
Amanda	Staudt	[NWF] The discussion of observed versus projected climate change impacts is muddled. The chapter frequently moves back and forth between discussions of observed, past changes and projected, future changes. This tends to make it hard to convey the real scope of changes that have already taken place. For example, Key Message 3 is that "Land- and sea-scapes are changing rapidly and species, […], may disappear from regions where they had been prevalent…", but the discussion starts with vegetation model projections and then switches back to an example of a past impact. Key Message 4 is the "Timing of critical biological events. […], will shift…" but the discussion on p. 298 is largely about all the changes that have already occurred, with almost no discussion of projected future shifts.	8. Ecosystems, Biodiversity, and Ecosystem Services				No change. The diversity of observed verus project climate change impacts discussed arises from the multiple, published sources that were the basis for the chapter.
Amanda	Staudt	[NWF] Figures and case study are not referenced in text or integrated into the discussion.	8. Ecosystems, Biodiversity, and Ecosystem Services				We appreciate the comment. The authors determined where to add in-text references to figures or case studies.
Amanda	Staudt	[NWF] Chapter misses some important aspects of our understanding about how climate change is affecting ecosystems and biodiversity. The Traceable Account indicates that this chapter "summarizes extensive evidence documented in the Ecosystems Technical Input", however many of the key findings of that foundational report are not clearly highlighted in the chapter. These include: (1) "There is	8. Ecosystems, Biodivers				No change. We had to make difficult choices about what we could include due to space limitations.

		increasing evidence of population declines and localized extinctions that can be directly attributed to climate change" and (2) "Changes in winter have big and surprising effects on ecosystems and their services." In addition, the idea of mismatches and new biotic interactions seems somewhat lost in the discussion.	ity, and Ecosystem Services				
Amanda	Staudt	[NWF] Figure 8.1: This figure would seem to fit better in the Water chapter. At a minimum, the caption should be modified to address the relevance to ecosystems.	8. Ecosystems, Biodiversity, and Ecosystem Services	8.1	294		The caption has been edited to address the relevance to ecosystems.
Amanda	Staudt	[NWF] The Ecosystems chapter should do a better job at cross-referencing other related chapters, most notably Forestry, Water Resources, Ocean and Marine Resources, and Coastal Zone Development and Ecosystems. The Ecosystems chapter discusses some forestry aspects in detail, but does not refer the reader to the Forestry chapter (for example, this would be appropriate on p. 297). The Ecosystems, Biodiversity, and Ecosystem Services chapter does not discuss coastal/marine ecosystems and does not refer the reader to Chapters 24 and 25 for that discussion. Those chapters do touch on relevant coastal/marine ecosystem elements – especially the marine chapter, which is quite strong! The Ecosystems chapter has a long discussion of water, which some might argue would fit better in the Water chapter, but only cursory reference to the water chapter as a reference for one statement on p. 292. In general, it is unclear how it was determined which information belongs in the Ecosystems chapter versus these other related chapters, and there seems to be a different boundary applied for the different resources (i.e., lots of info on water resources in the ecosystems chapter and nearly nothing on marine ecosystems).	8. Ecosystems, Biodiversity, and Ecosystem Services				We appreciate the comment. The authors determined where to add cross-references to other chapters.
Amanda	Staudt	[NWF] Suggest cutting this first sentence because it is a broad generality that isn't entirely true. Sometimes climate change affects people directly, for example if they have to suffer through a hotter day or a hurricane forces them to evacuate. In these cases, the ecosystems and biodiversity are either irrelevant or at most a modest modulator (e.g., if you live in a city that has lots of trees that provide cooling during heat waves).	8. Ecosystems, Biodiversity, and Ecosystem Services		291	28	No change. The statement doesn't rule out direct effects; it just highlights that many effects are mediated through changes in ecosystems, biodiversity and ecosystem services.
Amanda	Staudt	"[NWF] Although ecosystems and ecosystem services are what we interact with every day, their linkages to climate change can be elusive…" Yes, but they can also be quite obvious. Seems odd to emphasize one manifestation of the impacts over another. Suggest cutting this sentence.	8. Ecosystems, Biodiversity, and Ecosystem Services		292	1	This sentence has been revised in response to comment #9856.
Amanda	Staudt	[NWF] This example skips the impact of changes water flow on fish, riparian habitats, waterfowl and other wildlife that depend on these ecosystems. It is important to mention that we can and do have good evidence and understanding for these impacts on ecosystems and species.	8. Ecosystems, Biodiversity, and		292	7	Changed as suggested to "farms, cities and habitats . . "

			Ecosystem Services				
Amanda	Staudt	[NWF] Key Message 1: It is unclear why this is the first key finding for the ecosystems chapter and whether such a long discussion of water is appropriate for the chapter at all. The Water chapter has only a cursory treatment of the role of ecosystems in regulating water quality and quantity. Some of this discussion, particularly the parts not that closely related to impacts on ecosystems, should be moved there. In turn, the discussion here should more clearly address how climate change is affecting ecosystems, and how that affect can translate into problems in regulating water quality and quantity.	8. Ecosystems, Biodiversity, and Ecosystem Services		292	14	No change. We had a long discussion about this, and regulation of water quantity and quality is a key ecosystem function and service that should be central to this chapter.
Amanda	Staudt	[NWF] There is a lot of mention of dead zones, eutrophication, and hypoxia in lakes, rivers, and the Gulf of Mexico without any explanation of what this means for plants, fish or wildlife.	8. Ecosystems, Biodiversity, and Ecosystem Services		292	34	No change. The paragraph mentions "commercial fishing, recreationally important fish species such as salmon and trout and fish population sizes."
Amanda	Staudt	[NWF] Should address how is sediment transport is affected by climate change	8. Ecosystems, Biodiversity, and Ecosystem Services		293	6	No change. The paragraph clearly states that links between discharge and sediment transport are well established. We do not have space to go into the details.
Amanda	Staudt	[NWF] Should address the impact of increased DOC on plants, fish, and wildlife	8. Ecosystems, Biodiversity, and Ecosystem Services		293	17	No change. While the comment suggests a good specific example, the authors feel the existing examples are appropriate.
Amanda	Staudt	[NWF] Key Message 2 focuses on how climate change and other stressors are “overwhelming the capacity of ecosystems to buffer the impacts from extreme events.” It is unclear what is meant by “buffer” in this context: is it the inherent ability of ecosystems to bounce back from extreme events? Is it the ability of ecosystems to reduce the impacts of extreme events on communities/agriculture/infrastructure/etc.?	8. Ecosystems, Biodiversity, and Ecosystem Services		295	17	No change. The paragraph goes on to give several specific examples of just what is meant by "buffer" - "Ecosystems play an important role in “buffering” the effects of extreme climate conditions (floods, wildfires, tornados, hurricanes) on the movements of materials and flow of energy (Peters et al. 2011). Climate change and human modifications of ecosystems and landscapes often

							increase their vulnerability to damage from extreme events while at the same time reducing their natural capacity to modulate the impacts of such events. Salt marshes, reefs, mangrove forests, and barrier islands defend coastal ecosystems and infrastructure against storm surges. Their losses – from coastal development, erosion, and sea level rise – render coastal ecosystems and infrastructure more vulnerable to catastrophic damage during or after extreme events (Ch. 25 Coastal Zone; FitzGerald et al. 2008; McGranahan et al. 2007). Floodplain wetlands, although greatly reduced from their historical extent, absorb floodwaters and reduce the impact of high flows on river-margin lands...Extreme weather events that produce sudden increases in water flow and the materials it carries can decrease the natural capacity of ecosystems to process pollutants, both by reducing the amount of time water is in contact with reactive sites and by removing or harming the plants and microbes that remove the pollutants (FitzGerald et al. 2008; McGranahan et al. 2007)."
Amanda	Staudt	[NWF] The extreme events section should include a discussion of how extreme events are affecting ecosystems. For example, extreme climatic events may facilitate biological invasions (Diez, J., et al. 2012. Will extreme climatic events facilitate biological invasions? Front Ecol Environ 2012; 10(5): 249–257).	8. Ecosystems, Biodiversity, and Ecosystem Services		295	17	No change. While the comment suggests a good specific example, the authors feel the existing examples are appropriate.
Amanda	Staudt	[NWF] The extreme events section should address the impacts of extreme heat, drought, and possibly extreme warm nighttime temperatures on ecosystems. For example, reduced river flow and longer droughts is projected to induce native cottonwood-willow forests to convert to exotic tamarisk or other non-native species with higher drought tolerance (Rood et al. 2008, Stromberg et al. 2010).	8. Ecosystems, Biodiversity, and Ecosystem Services		295	17	No change. While the comment suggests a good specific example, the authors feel the existing examples are appropriate.
Amanda	Staudt	[NWF] It's not clear what is meant by “"movements of materials and flow of energy”"	8.		295	21	The sentence has been edited to

			Ecosystems, Biodiversity, and Ecosystem Services				clarify its meaning.
Amanda	Staudt	[NWF] "Climate change and human modifications of ecosystems and landscapes often increase their vulnerability to damage…" whose vulnerability? The ecosystems? The landscapes?	8. Ecosystems, Biodiversity, and Ecosystem Services		295	22	The sentence has been edited to clarify its meaning.
Amanda	Staudt	[NWF] This section needs to be clear about the climate change, the ecosystem impact, and then the affect on ecosystem services. In this case, the major climate impact on ecosystems is sea level rise leading to the inundation of coastal habitats (so not predominantly an extreme event impact). The loss in ecosystem services relates to the combined effect of the loss in habitat with more extreme storms (note that this increase in severity of storms is not actually explicitly mentioned here, but should be).	8. Ecosystems, Biodiversity, and Ecosystem Services		296	1	No change. The focus here is not the impact of sea level rise on coastal habitats, rather it is the effect of the loss of coastal habitats on the vulnerability of coastal ecosystems and infrastructure.
Amanda	Staudt	[NWF] This paragraph should discuss the impacts of changing fire regimes on ecosystems.	8. Ecosystems, Biodiversity, and Ecosystem Services		296	15	No change. The focus here is on extreme events.
Amanda	Staudt	[NWF] Bark beetle infestations should not be discussed in the same paragraph as non-native invasive species. These are largely native species whose cycles have been altered by climate change, leading to ecological thresholds being neared, etc. That is different from new invasive species causing problems. The Forest chapter does a much better job describing the relevant synergisms between the multiple climatic and non-climatic factors affecting forest ecosystems.	8. Ecosystems, Biodiversity, and Ecosystem Services		297	40	No change. The theme of the paragraph is invasive species and there is no reason that this cannot encompass both native and non-native species. It is good and appropriate that this is covered more completely in the forest chapter.
Amanda	Staudt	[NWF] Key message 5 does not accurately reflect either the content of the climate adaptation section from which it presumably was drawn, or the underlying climate adaptation material in the technical input. Although Ecosystem-based management is clearly a useful management approach, and certainly has relevance for adaptation, it is not the same as either “climate adaptation” or “ecosystem-based adaptation” (a term that is discussed in the section). The term “ecosystem-based management” appears nowhere in the text of the “Adaptation” section of the chapter beginning on page 299. Rather, it seems to have been added in or modified after the fact by someone unfamiliar with the contents of	8. Ecosystems, Biodiversity, and Ecosystem		291	25	The wording of this key message has been changed to be more lay-person friendly while maintaining the essence of the key message.

		the adaptation section or technical input.	Services				
Amanda	Staudt	[NWF] This figure is incorrectly labeled and attributed. The figure is based on Figure 6.2 from the Biodiversity, Ecosystems, and Ecosystem Services technical input, and represents a graphical modification with no substantive changes. In the technical input the figure is referred to as a "generalized framework for climate change adaptation planning and implementation."Although this may be a form of "iterative conservation planning" referring to it as such missing the central point of the figure, and its rationale for illustrating a section of the NCA on climate adaptation. Specifically, there are many other "iterative conservation planning" approaches that are entirely silent on climate and adaptation, while this framework is explicit about incorporation of climate considerations. The attribution of this figure is also incorrect. In the technical input text, the figure is attributed to an inter-institutional workgroup convened by the National Wildlife Federation, and in the figure legend specifically attributed to "Stein et al. in prep." In the NCA chapter, the following language was offered "Figure source: Created for this report by Nancy B. Grimm of Arizona State University and by NOAA NCDC. Nancy Grimm was one of the conveners of the overall technical input report, but was not involved in the creation of this figure, nor was she aware that she had been credited in this way in the chapter. I can only imagine that the role of NOAA NCDC was to take the original version of the figure from the technical input and recreate in a more pleasing graphical form. Adhering to scientific standards for attribution, the figure should be referenced instead as "modified from Stein et al.". Two citable sources for this figure now exist: Stein, B. A. and M. R. Shaw. 2013. Biodiversity conservation for a climate-altered future. In S. Moser and M. Boykoff eds. Successful Adaptation: Linking Science and Practice in Managing Climate Change Impacts. New York: Rutledge Press; and Stein, BA, P. Glick, and N. Edelson. 2013. Quick guide to climate-smart conservation. Washington DC: National Wildlife Federation (available at: www.nwf.org/climate-smart-quickguide.	8. Ecosystems, Biodiversity, and Ecosystem Services	8.3	300		Caption and attribution have been corrected for this figure.
Amanda	Staudt	[NWF] The role of tribes is absent from the discussion of the Sustained Assessment. We suggest the following additional content be added to address tribes in regards to the sustained assessment. 1. The impacts of climate change are place-based and as such will impact culture, sovereignty, economies and traditional ways of life among American Indians, Alaska Natives, Native Hawaiians and other indigenous peoples in the United States. 2. Add information describing preferential vulnerability of reservations. "Many reservations, in particular coastal reservations are preferentially vulnerable to climate change and associated sea-level rise/storm surge and will likely be unable to secure replacement lands of equal or better quality for their cultural needs under the present landscape modified by 150 years of western settlement and urbanization." 3. Tribes are not just vulnerable populations or just another stakeholder; tribes are sovereign nations [and "co-managers"] and must have a distinct place in the NCA. There are opportunities for tribal leadership, collaborative co-management and engagement in climate research, assessments, and other initiatives. 4. Traditional knowledge can inform understanding of climate impacts and adaptation strategies. The knowledge is culturally-sensitive and should be protected; but tribes can share what they learn to inform broader assessments, federal processes. 5. Tribes need more information on what the National Climate Assessment is and why it is important for and relevant to tribes to engage in.?	30. The NCA Long-term Process: Vision and Future Development				Mostly redundant to earlier comments 33661 and 34496. See response to comment 33661.
Amanda	Staudt	[NWF] Expand the definition of "nation" more. Who are the stakeholders you are including for vulnerabilities, i.e. city governments, natural resource managers, local communities, coastal managers, tribes, etc. These stakeholders will hopefully guide the ongoing process.	30. The NCA Long-term Process: Vision and Future		1047	22	Agree. See the response to comment 33661. Specifically, original line 29 on page 1047 was expanded to read: "…needs of federal agencies, state and local governments, tribes, other decision-makers, and end users…."

			Development				
Amanda	Staudt	[NWF] It would be helpful to include a fourth: 4) continual assessment of how data is being used and applied by the applicable stakeholders.	30. The NCA Long-term Process: Vision and Future Development		1047	27	Agree in part. The suggested addition is too specific for this visionary section; to address this comment, the following text was added at the end of original line 21 on page 1048: "This includes periodically assessing how users are applying such data."
Amanda	Staudt	[NWF] This ongoing process will only truly support decision-makers and end users if outreach and engagement are at all levels of decision-making: local – community level, mid-level governments/institutions, and regional level. Special attention needs to be paid to the local-community level to be comprehensive.	30. The NCA Long-term Process: Vision and Future Development		1048	3	Comment is mostly rhetorical as this is a theme already throughout the chapter and no specific text changes are offered. No changes were made to the chapter in response to this comment.
Amanda	Staudt	[NWF] Additionally, more outreach work needs to be done to ensure that the stakeholders know about the NCA process itself. Many Americans are aware of IPCC reports, but not NCA reports. Ensure that Americans reference NCA as often or more than they do IPCC.	30. The NCA Long-term Process: Vision and Future Development		1048	3	Comment is rhetorical. No changes were made to the chapter in response to this comment.
Amanda	Staudt	[NWF] Is it really the goals of the NCA to develop tools? There are many already out there and in-use. Maybe “Gather tools and inform public on what’s available” is a more appropriate action.	30. The NCA Long-term Process: Vision and Future Development		1048	37	Disagree. The tools further described on original line 37 on page 1048 are not the ones the commentor seemingly is referring to. The tools referred to on line 37 are evaluation tools not vulnerability and assessment impact and adaptation planning tools that the comment seemingly means. No changes were made to the chapter in response to this comment.
Amanda	Staudt	[NWF] If the NCA Town Hall is the model to offer opportunities for input, direction, review and feedback, the opportunities for attendance need to be expanded. The Midwest Town Hall was closed at only 100 attendees, and most of them were academic, not representative of all stakeholders.	30. The NCA Long-term		1050	39	Comment is rhetorical. No changes were made to the chapter in response to this comment.

			Process: Vision and Future Development				
Amanda	Staudt	[NWF] The Midwest and the Great Lakes are very different micro-climates and ecosystems with potentially different projections. To truly get a picture of the Great Lakes, models that integrate the hydrology and ice cover, and that reach beyond our political boundaries are necessary. It would be helpful in future NCAs if the Great Lakes as a system gain more attention, separate from the land of the Midwest.	18. Midwest				We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include.
Amanda	Staudt	[NWF] In general, the chapter provides a quite thorough overview of current and potential stresses on water resources from climate change. However, we do believe breadth and/or depth of coverage on several important issues should be expanded, in particular concerning climate change impacts on the water cycle and water quality impacts.	3. Water Resources				We appreciate this suggestion and have significantly expanded the section on climate change impacts on the water cycle.
Amanda	Staudt	[NWF] The draft provides relatively significant coverage of water cycle impacts in the western U.S., which is of course important. But given the importance of large aquatic ecosystems (and other aquatic resources) in other regions of the country (including the Great Lakes, Chesapeake Bay, and the Gulf of Mexico), it would be helpful to highlight more research from some of these other regions (which could also be emphasized through an additional plot or two). For the Great Lakes, some of that research has been summarized in the Water Resources chapter of the Midwest Technical Input Report (Lofgren and Gronewald, 2012); a cross-walk between this chapter and the Midwest chapter could help ensure that key recent literature on water resources in the region is highlighted, in either one chapter or the other.	3. Water Resources				Thank you for this suggestion, we have added references to the Midwest region in this chapter.
Amanda	Staudt	[NWF] On evapotranspiration (ET), although the authors discuss challenges in estimating ET, it would be helpful to cite other recent efforts, including a recent study on limitations with empirical approaches (e.g. using temperature alone to predict potential ET) (Lofgren, B. M., Hunter, T. S., Wilbarger, J. 2011. Effects of using air temperature as a proxy for potential evapotranspiration in climate change scenarios of Great Lakes basin hydrology. J. Great Lakes Res., 37, doi: 10.1016/j.jglr.2011.09.006). This issue is also discussed briefly in Lofgren and Gronewald (2012).	3. Water Resources				The revised evapotranspiration section includes greater detail on underlying drivers.
Amanda	Staudt	[NWF] Concerning the section Lakes and Rivers at Risk, again, it would be helpful to highlight additional recent relevant research on the Great Lakes. This could include data on recent warming, including in Lake Superior (Austin, J. A., and Colman, S. M., 2007. Lake Superior summer water temperatures are increasing more rapidly than regional air temperatures: A positive ice-albedo feedback. Geophys. Res. Lett., 34, L06604, doi:10.1029/2006GL029021), projections on future warming (e.g. Trumpickas et al. 2009. Forecasting impacts of climate change on Great Lakes surface water temperatures, J. Great Lakes Res., 35:454-463), projections on water level changes (e.g. Angel, J.R., Kunkel, K.E. 2010. The response of Great Lakes water levels to future climate scenarios with an emphasis on Lake Michigan-Huron. Journal of Great Lakes Research, 36: 51-58), and potential changes to stratification (e.g. Croley, T., 2003. Great Lakes Climate Change Hydrologic Impact Assessment, I.J.C. Lake Ontario – St. Lawrence River Regulation Study, NOAA Technical Memorandum GLERL-126.	3. Water Resources		116	6	Thank you for the suggestion. We have included a graphic demonstrating changes in stratification in Lake Superior.
Amanda	Staudt	[NWF] Chapter 3 includes only brief mention of the potential for climate-driven changes to alter nutrient cycling, and no discussion of the broader eutrophication problem in many waters across the U.S., and the potential for climate change to exacerbate eutrophication. Even if this topic is addressed in other chapters, it is clearly an important water resource issue, with phenomena such as harmful algal blooms (HABs) and hypoxia having implications for aquatic organism health as well as numerous human uses. The authors should highlight this issue, with examples including: (1) Great Lakes. An	3. Water Resources				We thank the reviewer for the suggestion. We have included additional references on nutrient cycling alterations and some additional observational trends for Lake Superior.

		increasing number of studies are examining the potential for climate change to exacerbate nutrient-related impacts, including tying spring storm events to extent of HABs in Lake Erie (e.g. Stumpf, R.P. et al. 2012. Interannual variability of cyanobacterial blooms in Lake Erie, PLoS ONE, 7(8):1-11.) (2) Gulf of Mexico. The draft briefly mentions in the Traceable Accounts section (Key Message #6) the connection between changed precipitation patterns and increased nitrogen loads in the Mississippi River, contributing to Gulf of Mexico hypoxia; this issue should also be mentioned in the main text, with consideration of highlighting other recent literature on the topic. (3) Chesapeake Bay. In our review, we see no reference to Chesapeake Bay in the draft (and there is only minimal mention of the Bay in Chapters 16 and 25). As an important large estuarine ecosystem suffering from significant stresses, and for which climate change presents another interacting stress, we believe there should be some mention of recent work concerning climate change and water resources in the Bay. This could include for example Howarth, R. W., Swaney, D. P., Boyer, E. W., Marino, R., Jaworski, N., and Goodale, C., 2006. The influence of climate on average nitrogen export from large watersheds in the Northeastern United States. Biogeochemistry 79, 163-186; and the review report Boesch et al. 2007. Coastal Dead Zones and Climate Change: Ramifications of Climate Change for Chesapeake Bay Hypoxia, available from http://www.c2es.org/docUploads/Regional-Impacts-Chesapeake.pdf.					
Amanda	Staudt	[NWF] While the draft briefly mentions damages from increased coastal flooding, including due to sea level rise (e.g. p. 122), the authors should put more emphasis on potential ecological impacts of sea level rise, including destroyed or altered habitats (e.g. Glick, P. Staudt, A., Nunley, B., 2008. Sea-Level Rise and Coastal Habitats of The Chesapeake Bay: A Summary, (both summary and technical report available from http://www.nwf.org/News-and-Magazines/Media-Center/Reports/Archive/2008/Sea-Level-Rise-Chesapeake-Bay.aspx) and other recent papers/reports). Again, a cross-walk with other chapters (e.g. Chapter 16, 25) would help ensure that these types of issues are adequately summarized in the overall report.	8. Ecosystems, Biodiversity, and Ecosystem Services				No change. While the comment suggests a good specific example, the authors feel the existing examples are appropriate.
Amanda	Staudt	[NWF] Key message 5 does not accurately reflect either the content of the climate adaptation section from which it presumably was drawn, or the underlying climate adaptation material in the technical input. Although Ecosystem-based management is clearly a useful management approach, and certainly has relevance for adaptation, it is not the same as either “climate adaptation” or “ecosystem-based adaptation” (a term that is discussed in the section). The term “ecosystem-based management” appears nowhere in the text of the “Adaptation” section of the chapter beginning on page 299. Rather, it seems to have been added in or modified after the fact by someone unfamiliar with the contents of the adaptation section or technical input.	8. Ecosystems, Biodiversity, and Ecosystem Services		299	6	Key message #5 has been changed.
Amanda	Staudt	[NWF] Wildlife corridors are not really an example of ecosystem-based adaptation, in which the objective is to use ecosystem services as a way to help people adapt to climate change. The intent of wildlife corridors is to help wildlife adapt to climate change.	8. Ecosystems, Biodiversity, and Ecosystem Services		299	25	The text has been edited to clarify that wildlife corridors are used to connect fragments of wildlife habitat.
Amanda	Staudt	[NWF] We are pleased to see that adaptation in the context of biodiversity and natural resource management is addressed in its own section, accurately reflecting the significant advances in the field. The section does include many relevant points, but also misses the mark in some ways. First, the point about "managing change" is not just about the use of adaptive management tools, but much more significantly about a complete realignment in the goals of our conservation activities, away from an emphasis on returning to prior or pristine conditions and towards an emphasis on managing for future conditions. This major adjustment to how we approach conservation and natural resource	8. Ecosystems, Biodiversity, and Ecosystem		299	5	A paragraph was added which discusses the need to alter management objectives, as well as discusses that what works today, may not work in a world with climate change.

		management is not reflected in the narrative. Second, the section muddles the use of "adaptation", "ecosystem-based management", and "ecosystem-based adaptation". The first is about making sure our conservation and natural resource management approaches account for climate change, the second two is about taking an ecosystem approach to management, and the third is about using ecosystem services to address human adaptation needs. Third, the adaptation strategies provided on p. 300 are specifically relevant to conserving biodiversity; however, there are other strategies that are relevant to ecosystem adaptation. These include improving habitat connectivity in a number of ways, addressing/reducing other environmental stressors as a way to increase the overall resilience of a system, and refocusing efforts on conserving ecosystem function/structure rather than individual species.	Services				
Lidia	Delgado	I would like to make a small cosmetic suggestion:The map and it's title do no seem to be centered on the page. If possible it would look more consistent with the other maps if it was centered as Figure Number 14.2 was.Thanks.	14. Rural Communities	14.1	496		Thank you for your suggestion. The National Climate Assessment Technical Support Unit will apply consistent formatting for the graphics in the final electronic version of the assessment.
Lidia	Delgado	I would like to make a small cosmetic suggestion:The maps and the title associate with them do no seem to be centered on the page. If possible it would look more consistent with the other maps if it was centered as Figure Number 14.4 was.Thanks.	14. Rural Communities	14.3	499		Thank you for your suggestion. The National Climate Assessment Technical Support Unit will apply consistent formatting for the graphics in the final electronic version of the assessment.
Laura	Bailey	Global warming is the greatest danger mankind has faced in history. The danger of flooding to coastal regions is real and has accelerated in recent years. Islands have disappeared and millions are in danger of losing their homes. The atmospheric temperature of the Earth has increased as the oceans and seas have stratified. The stratification of the water's surface has reduced the natural upwelling that has historically regulated the oceans' surface temperature. The stratification of the surface's temperature has adversely affected the solubility pump, causing CO2 to be dissolved as carbonic acid. The increase in carbonic acid has increased the acidification of sea water. The acidification has caused the dissolution of coral. The coral reefs around the world are in crisis.The increased acidification has diminished the function of the biological pump. The increased temperature and change in pH of the oceans waters has greatly reduced the amount of phytoplankton, reducing fish stocks and reducing the amount of CO2 being sequestered by the oceans.The greatest CO2 sink has been the southern oceans. The year of 2007 was the first year that the southern oceans began to give off more CO2 than they took in. The purpose of this invention is to regulate the temperature of the oceans' surface to promote CO2 sequestration by encouraging the increased growth of phytoplankton.We have developed a process for use in the sequestration of anthropogenic carbon dioxide. The increased stratification of the world's oceans, due to elevated atmospheric temperatures has diminished the effectiveness of the biological pump.Phytoplankton populations have declined due to changes in temperature and alkalinity, reducing the amount of carbon dioxide being sequestered out of solution. The concentration of carbon dioxide dissolved in ocean water has increased, directly effecting the chemical composition of the oceans. The presence of elevated levels of dissolved carbon dioxide has created a direct corresponding increase in the presence of carbonic acid. The increase in carbonic acid has lead to an increase in the acidification of the world's oceans. Alkalinity effects the growth of phytoplankton and directly controls the solubility of carbon dioxide and how it dissolves into the oceans. The reduced growth of phytoplankton has slowed the sequestration of carbon dioxide. The change in the chemical composition of ocean water has slowed the remediating function of the biological pump to sequester anthropogenic carbon dioxide. The biological pump has, until now, reduced the effects of elevated levels of carbon dioxide, as this process slows, the effects of elevated carbon dioxide will accelerate climate change.We have	24. Oceans and Marine Resources				This comment does not seem to raise any question or suggest any revision.

		developed a process to create a thermocline to increase the sequestration of carbon dioxide in the ocean. The basis of our process is to mechanically pump deep cold water to the surface of the ocean. The process we have includes the use of a pump of our design but does not limit our process from the use of other pump designs. The temperature difference between the surface temperature and the temperature of the water we pump to the surface prevents the two from mixing. The temperature difference between the two masses of water creates a thermocline. The cold water spreads out to create a cold water sheet over the warmer surface water.The thermocline stimulates the growth of phytoplankton. An increased level of phytoplankton increases the sequestration of carbon dioxide. The increased sequestration of carbon dioxide decreases the amount of carbonic acid dissolved in ocean waters which, in turn, lowers the alkalinity of the oceans, further increasing the growth of plankton. The reduction in carbonic acid is directly correlated to an increase of calcium carbonate.Our process causes an increase in the growth of phytoplankton, increasing available oxygen. An increase in dissolved oxygen increases zooplankton growth. Zooplankton sequesters calcium carbonate to the deep ocean. Calcium carbonate, by nature, sinks. Calcium carbonate sequestration eliminates carbon from the atmosphere, potentially for millennia, if it reaches the sea floor.The cold water of the thermocline we produce will create a barrier to tropical storms. Hurricanes need a surface temperature of 80 degrees to sustain their strength. A strategically placed thermocline of sufficient depth would keep Atlantic storms out of the Caribbean and the Gulf of Mexico. A decrease in storm activity would decrease turbidity, increasing the amount of light reaching the euphotic region of the ocean. The decrease in turbidity would increase the amount of light able to penetrate to a greater depth, further increasing phytoplankton growth. The accelerated growth would increase sequestration of carbon dioxide.					
Paul	Torcellini	For many power plants, the key component for the cooling is the dew point temperature, not the dry bulb temperature. This relates to the need for consumptive water for the cooling load. Need to make the argument that increased dry bulb temperatures will impact the dew point.higher temperatures increases the cooling load on buildings which translates to energy consumption (as mentioned), but also adds to the water burden in two ways. (1) most large building systems use cooling towers to dissipate the heat which consumes water and (2) water is consumed at the powerplant for making electricity. see www.nrel.gov/docs/fy04osti/35190.pdf	4. Energy Supply and Use				Table 4.3 identifies increased ambient temperature of air and water as detrimental to thermal power generation through reduced plant efficiency and cooling capacity. Due to page length limitations in the National Climate Assessment overall, it is not possible to explore the technical details behind this physical impact.
Christopher	Landsea	Review of hurricane portions of National Climate Assessment Reviewed by Chris Landsea In general, the sections on hurricanes in the National Climate Assessment are quite incomplete and – in my opinion – misleading. The following are my personal comments on this draft. 1. Page 26, Lines 20-22; page 59, lines 2-4 and 18-19; page 84 (table), page 586, line 15, 587-line 1; page 1076, lines 19-20; page 1118, lines 15-20; page 1166, lines 2-6; page 1168, lines 5-10: The focus on the increases in Atlantic basin hurricane frequency and intensity since the 1970s/early 1980s completely ignores the fact that the activity was very busy during the mid-20th Century as well. The excellent work by Kossin et al. (2007) does provide a homogenous assessment of the basin since the early 1980s, but is unable to compare the current active era versus the last busy period. Such a comparison is crucial to assess whether the recent increases are part of a long-term increase linked to anthropogenic change, or whether the activity is quasi-cyclic with little to no change (or somewhere in between). Fortunately, there have been some recent papers published which providing long-term					Thank you for these detailed comments. The discussion of hurricanes in Chapter 2 and the appendices has been greatly revised. Chapter 2 now include a separate Key Message on hurricanes.

		homogeneous time series for the Atlantic basin. Two independent groups (Chang and Guo, 2007; Vecchi and Knutson, 2008) have attempted to estimate past numbers of missing Atlantic tropical cyclones using historical ship track records, since identification of storms that did not make landfall prior to aircraft and satellite reconnaissance depended on reports from ships of opportunity. Vecchi and Knutson (2008) found that the tropical storm and hurricane count series using their adjustment resulted in a statistically insignificant trend for the period 1878–2006. Furthermore, the trend in storm count in the original Atlantic basin data has been shown to be almost entirely due to an increase in short duration (<2-day) tropical storms (Landsea et al. 2010) — a phenomenon that has been attributable to changes in observing capabilities (Villarini et al. 2011). There is a much smaller increasing trend in storms lasting more than two days and after an estimated adjustment for missing storms via the Vecchi and Knutson (2008) methodology, the resulting long-term trend is also not significant (Landsea et al. 2010). Finally, the same conclusions for lack of long-term trends arise in examining the frequency of hurricanes only (Vecchi and Knutson 2011). Finally, one can go back to about 1900 with nearly complete records of tropical storm and hurricane strikes along the U.S. coastline. These show decadal-scale variability, but no long-term increase in cyclones that have affected the U.S. (Knutson et al. 2010). The bottom line is that there does not exist any upward century-scale trend in tropical cyclone frequency in the Atlantic when a homogenous time series is used. Moreover, these studies also indicate that the present era is just as active as it was in the mid-20th Century with a minimum in activity that occurred in the 1970s to the early-1990s. It is recommended that the discussion include much of the above and that the summary information on page 26, lines 20-22 and page 59, lines 2-4 instead state the following: “The North Atlantic hurricane activity has been busy since the mid-1990s, but a similar busy period was observed during the mid-20th Century.”2. Page 26, lines 22-24; page 59, lines 4-5; page 84 (table); page 587, line 21-23; page 1168, lines 5-21: The predicted increases in intensity for hurricanes need to be quantified. Current best estimates are on the order of 5% stronger by the end of this century, assuming business as usual emissions scenario and significant (~2C) warming of the tropical and subtropical waters (Knutson et al. 2010). Such a small change is not likely to be detectable for several decades to come. The focus upon the Category 4-5 hurricane frequency increase (Bender et al. 2010) is overstated. Simply including Category 3 hurricanes to the Bender et al. analysis indicates that the overall Category 3-5 frequencies will decrease by about 20%. Moreover, their simulation of today’s climate only was able to show about 40% of the number of Category 4-5 hurricanes that actually occur (0.6 per year simulated versus 1.4 per year observed). Obtaining higher percentage changes is easier to accomplish when the baseline is substantially too low. The bottom line is that it is premature to overly focus upon this particular result which is extremely threshold dependent and not very robust. There is little to no discussion of the expected decrease in tropical storm and hurricane frequency. As stated in Knutson et al. (2010), there is a substantial – 6 to 34% - decrease in tropical cyclone numbers projected by the end of this century. The Bender et al. (2010) study specified for the Atlantic that the tropical storm and hurricane frequencies would decrease by about 30%. These frequency decreases need to be included, as they are important to know as well. It is recommended that the discussion section include much of the above and to state the following for the summary information on page 26, lines 22-24 and page 59, lines 4-5: “The intensity of the strongest hurricanes is projected to increase by roughly 5% by the end of the 21st Century as the oceans continue to warm. The frequency of tropical storms and hurricanes is projected to decrease by roughly 20%, but the changes in numbers of major hurricanes are more uncertain.”References					

		Bender, M and colleagues, 2010: Modeled Impact of Anthropogenic Warming on the Frequency of Intense Atlantic Hurricanes, Science, 327, 454-458. Chang, E. K. M., and Y. Guo, 2007: Is the number of North Atlantic tropical cyclones significantly underestimated prior to the availability of satellite observations? Geophys. Res. Lett., 34, L14801, doi:10.1029/2007GL030169. Knutson, T. R., J. L. McBride, J. Chan, K. Emanuel, G. Holland C. Landsea, I. Held, J. P. Kossin, A. K. Srivastava,and M. Sugi, 2010: Tropical Cyclones and Climate Change. Nature Geoscience, Review Article, 21 February 2010, DOI: 10.1038/NGEO779, 7 pp. Landsea,C.W., G.A. Vecchi, L. Bengtsson, and T. R. Knutson, 2010: Impact of Duration Thresholds on Atlantic Tropical Cyclone Counts. Journal of Climate, Vol.23, 15 May 2010, pp. 2508-2519 Vecchi, G.A., and T.R. Knutson (2008). On Estimates of Historical North Atlantic Topical Cyclone Activity. J. Climate, 21(14),3580-3600. Vecchi, Gabriel A., and Thomas R Knutson, March 2011: Estimating annual numbers of Atlantic hurricanes missing from the HURDAT database (1878-1965) using ship track density. Journal of Climate, 24(6), DOI:10.1175/2010JCLI3810.1. Villarini, G., G.A. Vecchi, T.R. Knutson and J.A. Smith (2011): Is the Recorded Increase in Short Duration North Atlantic Tropical Storms Spurious? J. Geophys. Res. doi:10.1029/2010JD015493					
Cynthia	Finley	In the box about the impacts of Hurricane Sandy, wastewater infrastructure should be used as an example of infrastructure that was damaged by the storm, with long-term effects. Even now, five months after the storm, wastewater utilities are still repairing their damaged infrastructure. More resources are needed to increase the resiliency of these systems and to repair them after a devastating natural event, such as Hurricane Sandy.	11. Urban Systems, Infrastructure, and Vulnerability		424		There were lots of examples to select from in terms of infrastructure damage from Hurricane Sandy. We chose only power to concentrate on given the space limitations.
Gary	Graham	Please accept these comments from Western Resource Advocates (WRA) on various chapters of the Federal Advisory Committee Climate Assessment Report (Report). Western Resource Advocates (WRA) is a non-profit environmental law and policy organization based in Boulder, Colorado. With offices and initiatives in seven states (Colorado, Utah, Arizona, Nevada, New Mexico, Wyoming and Idaho), we have developed strategic programs focusing on Water, Energy, Lands, and the climate crisis.WRA is very pleased with the quality of this report and anticipate that it will be widely used by many stakeholders addressing the challenges, impacts and vulnerabilities posed by this climate crisis. We hope that the high quality of the science and finding propel federal and state elected officials to more effectively provide solutions to the climate crisis and in doing so provide the leadership expected of us by the rest of the world. We provide the bulk of our comments for Chapters 10 (Energy-Water-Land) and 13 (Land) but some of those comments could also be included in the separate resource, adaptation, or mitigation chapters. The reason we include them here is that as stated numerous times in the Report the climate issues are cross-cutting and multisectorial. Numerous other WRA staff contributed to our comments. Chapter 3 (Water Resources: Climate Change Impacts on the Water Cycle) The word “water demand” should be added to Key Message 7/10 of Chapter 3 such that Key Message 7/10 reads: “In the Southwest, parts of the Southeast, the Great Plains, and the islands of the	3. Water Resources				Thank you for your suggestion. We have revised the text to incorporate some of your suggestions and have added a key message focused on water demand.

		Caribbean and the Pacific, including the state of Hawai'i, surface and groundwater supplies are already affected and expected to be reduced by declining runoff, groundwater recharge, and water demand trends, increasing the likelihood of water shortages for many off-stream and in-stream water uses."					
Leslie	Dodson	Why isn't the USDA report on fire projections included? Those USDA reports said that wildfires in the U.S. will burn twice as much area by 2050 -- or 20 million acres of burned area each year. The reports are at http://www.usda.gov/oce/climate_change/effects.htm	7. Forestry				The report that you reference is cited many times in the Forest chapter as Vose et al. 2012.
Leslie	Dodson	The report published by the NRDC contains projections on the economic effects on ski areas and regional economies – but the report and its references were not included. The report can be found here: http://www.nrdc.org/globalwarming/files/climate-impacts-winter-tourism-report.pdf.	28. Adaptation				Thank you for your comment. The Natural Resources Defense Council is already cited in the table of organizations providing services. We appreciate the suggestion about referencing an NRDC report but feel the current references are appropriate and adequate given the chapter's space limitations.
Cynthia	Finley	In addition to "roads, buildings, ports, and energy facilities," wastewater treatment facilities should be cited as an example of infrastructure that is affected by seal level rise and storm surges. Wastewater treatment facilities are typically built in low-lying areas, to utilize gravity flow of wastewater from the collection system to the treatment works. They are also usually located near coasts or other water bodies to facilitate discharge of the effluent. This makes wastewater treatment facilities particularly vulnerable to flooding and sea level rise.	1. Executive Summary		9	5	We appreciate the suggestion, but space is limited.
Gary	Graham	Please accept these comments from Western Resource Advocates (WRA) on various chapters of the Federal Advisory Committee Climate Assessment Report (Report). Western Resource Advocates (WRA) is a non-profit environmental law and policy organization based in Boulder, Colorado. With offices and initiatives in seven states (Colorado, Utah, Arizona, Nevada, New Mexico, Wyoming and Idaho), we have developed strategic programs focusing on Water, Energy, Lands, and the climate crisis.WRA is very pleased with the quality of this report and anticipate that it will be widely used by many stakeholders addressing the challenges, impacts and vulnerabilities posed by this climate crisis. We hope that the high quality of the science and finding propel federal and state elected officials to more effectively provide solutions to the climate crisis and in doing so provide the leadership expected of us by the rest of the world. We provide the bulk of our comments for Chapters 10 (Energy-Water-Land) and 13 (Land) but some of those comments could also be included in the separate resource, adaptation, or mitigation chapters. The reason we include them here is that as stated numerous times in the Report the climate issues are cross-cutting and multisectorial. Numerous other WRA staff contributed to our comments.Chapter 10 (Energy-Water-Land) The Energy-Water-Land Chapter provides an important overview of the interconnected nature of energy, water, and land. As noted throughout the chapter, these interactions are complex, and both the nature and magnitude of the interactions vary regionally. The chapter does not, however, effectively capture many of the interactions between climate, energy, water, and land, and does not reflect the breadth and depth of information presented in the technical input report (PNNL, 2012). At a minimum, the Energy-Water-Land chapter should include Table 5.2 from the technical input report, which identifies how mitigation strategies may impact water and land resources, as well as measures to address those impacts. Table 5.2 summarizes the most critical information essential for decision-makers seeking to understand the climate-energy-water-land nexus. In the following paragraphs, Western Resource Advocates provides additional specific recommendations. Chapter 10 assesses the	10. Water, Energy, and Land use				We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include. We have revised the text to incorporate this perspective by adding explanation of the chapter's focus on energy, providing additional information on energy technology options, and adding a figure on land use associated with energy technologies.

		water and land implications of four energy technologies. These technologies – concentrating solar power, natural gas, biofuels, and CCS – may reduce carbon emissions but may have negative impacts on water or land resources. By singling out these four technologies, the chapter ignores many technologies that may mitigate carbon emissions and have limited water or land impacts. For example, energy efficiency can reduce energy demands and greenhouse gas emissions and, in general, has no impact on water or land resources. Numerous other technologies or management strategies can be similarly characterized. By failing to profile all energy technologies or strategies, the NCA report misses an important opportunity to inform climate, energy, water, and land management policies. In addition to the four detailed technology profiles already presented, Western Resource Advocates recommends the NCA report include, at a minimum, a simple table characterizing technologies' relative GHG emissions, water use, and land impacts. I could not print the following tables so that they are easily read in this format. I will be glad to provide them in an email or as a pdf if you will let me know how to do that. The table is not comprehensive, but provides an example: Energy Source GHG emissions Water Use Land Impacts Energy Efficiency None Many efficiency measures may save water (at the power plant or, in the case of efficient appliances such as washing machines and showerheads, at the point of use); some may use water (e.g., evaporative coolers). None Pulverized Coal High Variable, depending on cooling technology At the plant, minimal; for mining and ash disposal, land impacts may be significant. Nuclear None Variable, depending on cooling technology; in the U.S., dry cooling has not been used commercially. At the plant, minimal; for mining and fuel disposal, land impacts may be more significant. Natural Gas (Combined Cycle) Moderate Variable, depending on cooling technology; typically less than water use for coal or nuclear plants At the plant, minimal; for extraction, land impacts may be more significant. Hydropower None Variable; for example, water "use" may be extremely high if reservoir evaporation is attributed to hydropower generation, or very low if hydroelectric turbines are in-conduit. Variable, depending on whether land beneath reservoirs is attributed to hydropower generation. Wind None None Variable; in some cases, turbines are compatible with existing land use (e.g., some agricultural use). Geothermal Minimal Variable, depending on cooling technology. Many geothermal plants use geothermal fluids, which are often high in dissolved solids, for cooling. Variable, depending on the conversion technology, cooling technology, and source of cooling water (many geothermal plants use geothermal fluids for cooling, which are high in TDS and often not of sufficient quality for other uses). Solar PV - distributed None Minimal Minimal, if PV panels are located on built-up land (e.g., rooftops, noise barriers, former landfills, etc.) Solar PV – central station None Minimal High Concentrating Solar None Variable, depending on generation technology and cooling technology. High					

Combined Heat and Power Moderate, though variable depending on fuel source Generally minimal, as no water is used to cool and condense steam. Generally low, as CHP facilities are co-located with other facilities.

Distributed Generation Variable, depending on the technology Generally minimal, as distributed generation does not typically use steam turbines. Variable, depending on the technology; e.g. rooftop PV has no land impacts, whereas other technologies may require land. Distributed generation may reduce land requirements for transmission lines.This type of comparison would provide critical insight into how different energy technology choices impact land and water resources, and is critical to informing climate actions, whether at the national, state, or local level.Chapter 10 focuses primarily on how energy choices (both electricity and biofuels) may have unintended effects on water and land resources. Importantly, the same is true for water management strategies: managing water resources to meet demands under climate change may have unintended effects on land resources, energy demands, and greenhouse gas emissions. As water utilities, state agencies, and federal agencies invest in new water supplies, upgrades to existing infrastructure, or water conservation it is critical that they consider potential energy and land impacts. While those impacts will vary depending on local water supplies and demands, the National Climate Assessment should provide a general characterization of major water supply or management strategies. The chart below is not comprehensive, but provides a representative example:

Water Supply Strategy/Technology Energy Demands Land Impacts

Urban Water Conservation None; some measures may save energy. Changing practices of irrigation or landscaping (e.g., installing Xeriscape) may impact urban land use.

Recycled wastewater Moderate; often higher than treating existing surface water supplies. Variable; treatment plants and distribution systems may require new land or easements.

Desalination High Variable; treatment plants may require new land.

Trans-basin diversions Variable, depending on topography and water pumping needs. Variable; pipelines and storage reservoirs, if needed, would have land impacts. Diversions would reduce flows in the basin of origin, which could, in turn, impact wetlands and reservoir levels.

Agricultural-urban transfers (rotational fallowing and leasing, dry year leases, or permanent transfers) Variable, depending on pumping and treatment needs. Variable; rotational fallowing or dry-year leases may provide land benefits, by allowing cropland to “rest” periodically, while permanent transfers would have adverse impacts on agricultural land.

Expanding or altering management of existing reservoirs Variable, depending in particular on whether changing reservoir management affects hydropower generation. Variable, depending on whether a reservoir is expanded and/or how the management regime changed.Land use practices may mitigate or enhance energy demands, greenhouse gas emissions, and water use. Chapter 10 provides a very limited examination of these interactions, yet land use planning is a critical component of mitigating and adapting to climate change. For example, wise management of public lands can reduce carbon emissions and protect water supplies, while providing important ecosystem services. In the West, managing US Forest Service lands effectively can reduce the risk of severe wildfires, which have

		adversely affected water quality and sedimentation in reservoirs(1). Likewise, effective management of BLM lands can reduce dust-on-snow events that can, in turn, accelerate snowmelt and runoff(2). In urban areas, higher density, mixed-use developments may reduce vehicle miles traveled and demand for transportation fuels, and will likely reduce water used to irrigate landscapes (particularly in arid western cities). It is important to understand how land use strategies may mitigate climate change, greenhouse gas emissions, and water use. (1) Examples include the Hayman Fire (2002) and subsequent flooding and sedimentation of Denver Water's Strontia Springs Reservoir, and the High Park Fire (2012), which continues to affect the Poudre River and Fort Collins' water supplies. (2) See, e.g., Painter, T. H., J. Deems, J. Belnap, A. Hamlet, C. C. Landry, and B. Udall (2010), Response of Colorado River runoff to dust radiative forcing in snow, Proceedings of the National Academy of Sciences, published ahead of print September 20, 2010,doi:10.1073/pnas.0913139107.					
Ashley	Olmeda	The chapter had great potential to link the effects climate change has had on infrastructural systems in urban systems. The idea is there but I feel that there it lacks validity and support; there are several points that could definitely be strengthened. There were several sections throughout the report that gave generic statements without additional explanations. For example on page 421 lines11-12 it states "exposure to particular stressors, their sensitivity to impacts, and their ability to changing conditions." What is not explained in the rest of the paragraph is what these "stressors," "sensitivities," and "changing conditions" actually are. I believe further exploring what these factors are could strengthen the argument presented there. Another example is on page 425 under the Social Vulnerability and Human Well-Being section lines 21-23. The sentence begins by stating "Further, inequalities reflecting differences in gender; age, wealth, […]." Yet it is unclear what exactly are the inequalities referred too. The next paragraph goes on to give an example of how the elderly are affected by heat waves, lines 24-26. I think data or statistics of how many elderly people are checked into the hospital or how many die because of the heat wave would create a more dramatic effect on the reader. Throughout the paper I would really recommend to use more data to support the claims in the paper.I also felt that the overall 'flow' of the paper lacked structure. Since the paper is referring to urban settings then perhaps the paper could be divided into different sections depending of a region. The idea is to create a list of major cities largely affected by climate change and give concrete examples of the multiple infrastructural systems experiencing change. The four key messages were so interrelated that after reading the different sections it felt very repetitive. I suggest making the messages more specific.	11. Urban Systems, Infrastructure, and Vulnerability				Many of the main points are backed up with the scientific literature which includes some of the "data" the reviewer mentions. The authoring team chose to provide a broader review of the issues related to urban systems, vulnerability, and infrastructure rather than specific data tables broken down by region and/or city. Given our space constraints, this seemed more prudent in assessing the current state of knowledge.
Paul	Torcellini	While there is discussion about Carbon sequestration in the forest, which ultimately is in harvested lumber or captured in building the soil, there is no discussion about the potential to sequester carbon in the grasslands using intensive grazing techniques. This enhances the grass as well as creating an agricultural market. It also reduces the need for row crops which reduces the capabilities for carbon storage. Not sure what chapter this goes in, but the analysis for the forests should be repeated for loss of grasslands.	7. Forestry				This suggestion is more appropriate to the Agriculture Chapter.
Ken	Okawa	I feel that this document, which is submitted by a council with the backing of thirteen federal agencies, should be made more accessible to the public and should be used in an environmental public relations campaign. Currently, many Americans do not believe in climate change but if they read a document that they knew came from a credible source, they would be more likely to believe in climate change. In addition to making this paper more friendly to the general public, I would recommend pulling out facts that are specific to certain people and using it in a PR campaign using social networks such as Facebook and making sure that it is clear that the NCADAC stands behind the truthfulness of the information.					Thank you for your positive comment. The final version will be available electronically and will be widely available to the public. There will also be a shorter Highlights document that is easy to read and available in printed form and on the web, as well as handouts and other materials. We also

							think the public will find the FAQ section to be very useful for information about climate change and its impacts.
Beth	Brumbaugh	If it does not make the figure too busy, it may be helpful to the reader if the number of predicted days over 100 F was included above/at the top of the bars that exceed the max value on the y-axis.	9. Human Health	9.7	342		The Technical Support Unit will address this.
John	Nielsen-Gammon	Historical trends in the Great Plains do not suggest more frequent and more intense droughts.	19. Great Plains		657	39	The text has been revised to incorporate this suggestion.
Paul	Torcellini	The explosion in ticks with B. Burgdorferi is a result of the overpopulation of deer because of lack of hunting and lack of habitat of predators for deer. For reproduction ticks need deer, even though rodents can be a host.	9. Human Health		344		These are all important environmental factors in the disease transmission cycle; limited space does not allow us to go into detail on the specifics of transmission for any disease.
Peter	Saundry	For Research Goal 1, I would like to recommend highlight Regional Climate Models (RCM) for particular focus (recognizing that "various downscaling approaches" is raised in Goal 2). It is a particularly critical and challenging area of research, critical to adaptation decision-making, and progress needs to be accelerated.I am particularly pleased to see the focused attention on decision-support. I would like to see a stronger emphasis on "solutions" that recognize social and economic aspects as well as physical and life sciences and engineering which "empower actions" at all levels of decision-making from the local to the international, public and private. In practice, this means encouraging research teams which include broad sets of skills. This does receive some attention now, but the cost and complexity of such approaches means that they do not occur as much as they needed. In stating this, I do recognize that it might be view an included under "coupled human and natural systems", but I think it needs stronger language.I applaud the statement: "Improved and expanded efforts at characterizing the costs and benefits of mitigation and adaptation actions, including economic and non-economic metrics that evaluate the costs of action versus the costs of inaction;" This is critical and prone to controversy. Kudos, for taking it head on.	29. Research Agenda for Climate Change Science				We do not mention RCMs specially but regional modeling and cross-scale issues are now explicitly in RG1.
Beth	Brumbaugh	In line 24 I don't think there needs to be a comma after "buildings" and before "can".	9. Human Health		343	24	Thank you for your correction. We have deleted the comma.
Cynthia	Finley	Although this list of Report Findings addresses the problems associated with climate change and not the solutions, the authors should be aware of potential solutions to the reduction in the reliability of water supplies that is described in point 7. Water reuse provides a potential solution to water shortages, whether treated wastewater is reused directly or recharged into a natural aquifer. Both of these methods are currently used in the U.S. and other countries, and are not emphasized enough in this report.Also, the increasing sediment and contaminant concentrations after heavy downpours can be controlled through the use of green infrastructure, which is cited several times in the report as an example of actions municipalities have taken. Again, the potential of green infrastructure to improve water quality and also mitigate greenhouse gases should be emphasized more in this report.	1. Executive Summary		9	15	These topics are included in various chapters of the report, including the Water and Urban, Infrastructure and Adaptation chapters.
Kenneth	Haapala	Comments on Draft Climate Assessment Report National Climate Assessment and Development Advisory Committee U.S. Global Change Research Program					This comment is inconsistent with the current state of the science on this topic. We considered each of these points and made some minor modifications to the text for clarity.

		1717 Pennsylvania Ave, NW Suite 250, Washington, DC 20006April 12, 2013The Draft Climate Assessment Report contains such a wide range of highly exaggerated and questionable claims, it is difficult to begin. The first 30 lines of the first page of the Executive Summary, p. 3 of the draft, establish a tone of hyperbole that is inimical to science. For example:• “Climate change is already affecting the American people.” The statement is trivial. Climate has been changing for hundreds of millions of years and will continue to do so long after we are gone. It has been affecting the American people since the colonies were started and the country founded during the Little Ice Age.• “Sea levels are rising.” The statement is trivial; sea levels have risen about 400 feet since the maximum extent of the last Ice Age and will continue to rise until the onset of the next ice age. • “Oceans are becoming more acidic.” False. The oceans remain alkaline with a pH above 7. Some studies claim that the pH has declined by a particular amount, but such claims are based more on speculative models than empirical investigation. • “The planet is warming.” This does not establish cause. Actually, the statement is false – see below.• “U.S. average temperature has increased by about 1.5°F since 1895; more than 80% of this increase has occurred since 1980.” False. Much of the warming occurred between 1910 and 1940, with a subsequent cooling, followed by a warming.• “U.S. temperatures will continue to rise, with the next few decades projected to see another 2°F to 4°F of warming in most areas.”This last statement illustrates the shoddy basis of the entire report – projections from climate models. Global climate models have not been scientifically verified and validated. As such, projections (predictions), into the future have no scientific value and are sophisticated speculation. The entire report with its dependence on climate models falls apart with the examination of a few salient facts:1. There has been no surface warming for at least 15 years, even while worldwide carbon dioxide (CO2) emissions continue to rise. Atmospheric data show no warming for at least a decade. On Feb 25, 2010, Phil Jones, Past and Current Director of the Climatic Research Unit, compiler of global surface temperature records admitted no statistically significant surface warming for 15 years. http://www.dailymail.co.uk/news/article-1250872/Climategate-U-turn-Astonishment-scientist-centre-global-warming-email-row-admits-data-organised.html2. The warming that has occurred since December 1978 is regional, not global. An examination of the 34 year satellite record, which is the only data that comprehensively covers the globe, shows the warming is concentrated in the northern part of the Northern Hemisphere, roughly 60 degrees north latitude, with little or no warming elsewhere. There is no corresponding warming of the Antarctic, instead the Antarctic is cooling. Contrary to the models, there is no there is no pronounced warming trend in the atmosphere above the tropics. http://nsstc.uah.edu/climate/2012/november/trend_Dec78_Nov12_alt.pngMany more severe deficiencies can be noted in the draft. Among them, the use of global climate models that have not been validated to project regional changes is grossly misleading. The projection of sea level rise up to four to six feet by 2100 is absurd. Such a rate of sea level rise did not occur during the melting of the great ice sheets that covered much of North America and northern Eurasia as the world came out of the last Ice Age. The most likely increase would be about 7 inches with no acceleration, which is a continuation of the past century. Climate change is real, significant, occurring, and natural. By building cities, draining swamps, irrigating deserts, etc; humans have influenced local and regional climate. But there is no compelling physical evidence that humans are causing dangerous global warming. Americans deserve an honest assessment of climate change based on physical evidence so they can be better prepared for what has occurred and use history as the basis of may occur in the future, rather than use what computer model speculations project may occur.For example, in recent years fewer hurricanes have been hitting the US East Coast than is some other periods. The recent changes in the Pacific Decadal Oscillation and the Atlantic Multidecadal Oscillation indicate that a period of hurricanes					Description of the models used in this report is included in Chapter 2, the climate science appendix, and the scenarios and models appendix. Additional description of the recent slowdown in the rate of increase of globally averaged surface air temperature was added to Chapter 2.

		may be forthcoming and that those living along the coast should be better prepared. This has everything to do with natural climate change and not claimed human caused global warming. Sandy was barely a category one hurricane when it made landfall. In the 19th century major hurricanes, some more significant than Sandy, directly hit New York City in 1815, 1821, and 1893 – long before the fear of human caused global warming. If the 1938 Category 3 hurricane hit New York City, rather than the Hamptons, at the right tide, the storm surge at Battery Park would have exceeded 20 feet compared with Sandy's 14 feet. New York City should be prepared.The current document may be politically important, but it is scientifically trivial. As such, it is politically propaganda that fails to meet the financial reporting standards of corporations, much less the more, hopefully, stringent standards of scientific evaluation. Kenneth Haapala Executive Vice President Science and Environmental Policy Project (SEPP) 9634 Boyett Court Fairfax, VA 22032 703-978-6025 Ken@SEPP.org					
Peter	Saundry	The proposed Sustained National Climate Assessment (Chapter 30) represents an excellent vehicle to provide research-based information for use by decision-makers across the nation, on an ongoing basis, rather than just a quadrennial report. In this regard, a Sustained National Climate Assessment should utilize networks and resources associated with organizations such as the National Council for Science and the Environment, scientific societies, and associations of decision-makers (which exist for both public and private decision-makers) , to both help produce its products and to link to stakeholders.	30. The NCA Long-term Process: Vision and Future Development				Comment is mostly rhetorical. The specifics of the comment already are addressed in the section on "A Network to Foster Partnerships, Encourage Engagement, and Develop Solutions beginning on original line 30 on page 1050. No additional changes were made to the chapter in response to this comment.
Gary	Graham	Please accept these comments from Western Resource Advocates (WRA) on various chapters of the Federal Advisory Committee Climate Assessment Report (Report). Western Resource Advocates (WRA) is a non-profit environmental law and policy organization based in Boulder, Colorado. With offices and initiatives in seven states (Colorado, Utah, Arizona, Nevada, New Mexico, Wyoming and Idaho), we have developed strategic programs focusing on Water, Energy, Lands, and the climate crisis.WRA is very pleased with the quality of this report and anticipate that it will be widely used by many stakeholders addressing the challenges, impacts and vulnerabilities posed by this climate crisis. We hope that the high quality of the science and finding propel federal and state elected officials to more effectively provide solutions to the climate crisis and in doing so provide the leadership expected of us by the rest of the world. We provide the bulk of our comments for Chapters 10 (Energy-Water-Land) and 13 (Land) but some of those comments could also be included in the separate resource, adaptation, or mitigation chapters. The reason we include them here is that as stated numerous times in the Report the climate issues are cross-cutting and multisectorial. Numerous other WRA staff contributed to our comments but of special note is the discussion in Chapter 10 by Stacy Tellinghuisen.Chapter 13 (Lands):	13. Land Use and Land Cover Change				Thank you for the kudos on the report. In revising the report, authors of all chapters emphasized, wherever appropriate, that climate change impacts will occur in a cross-cutting, multi-stressor context.

		The Land Chapter provides an important overview of the land-use and land cover impacts, choices, and opportunities. The message and discussion about how land use and land management offer opportunities to mitigate greenhouse gases (GHG) are particularly important. While the examples of such opportunities in the US were well stated and documented, the overall coverage of the topic omitted two important partial solutions. Expanded energy, residential, and irrigated cropland development have been the principal causes of loss in land cover in the Rocky Mountain region. The Land chapter could benefit from both a more robust discussion of those impacts and possibilities to compensate for those impacts through mitigation. Such compensatory mitigation could include restoration of forest types, sagebrush and grasslands that would assist with removal of carbon from the atmosphere. The discussion should also include the science behind the degree to which each land cover type would absorb carbon during the stages of restoration. It should also include the benefits to biodiversity that this type of restoration would provide. Given that the focus of the Report is national it is somewhat understandable that international land issues are not discussed. There is at least one area, however, that is a serious omission, which is nationally based partnerships with international entities to restore and protect tropical forests for carbon absorption. The Report states that biogeochemical cycles and climate change are inextricably linked and are global but does not fully acknowledge the links between actions in this country with solutions in other countries. There are many examples that demonstrate the link between nongovernment organization (NGO) programs and action in the US with forest conservation in tropical countries. For instance, NGOs can raise funds in the US that help restore deforested landscapes or protect intact forests in tropical countries, which play a major role with carbon absorption. Our national government can forgive portions of foreign debt in exchange for such forest conservation and global climate benefits that obviously are positive for the US since climate is a global phenomenon. And private US corporations with carbon neutrality or sustainability goals can also facilitate carbon uptake and conservation in tropical countries. Importantly, these types of projects have many co-benefits, including local community sustainability, water conservation, and biodiversity protection. An excellent example of this type of climate crisis and conservation solution was just announced by Conservation International (CI) whose headquarter is in Washington, D.C. (http://www.conservation.org/how/ci_in_action/alto-mayo-protected-forest/Pages/implementing-forest-conservation-peru.aspx). Disney partnered with CI in developing a REDD+ (Reducing Emissions from Deforestation and Forest Degradation 'plus' conservation, the sustainable management of forests and enhancement of forest carbon stocks) project in the Alto Mayo mountainous region of northern Peru. This project addresses the main causes of deforestation with incentive-based conservation agreements. It protected forests absorbed almost three million tons of emissions reductions between 2009 and 2012 — the equivalent of taking over 500,000 cars off the road for a year!					
John	Nielsen-Gammon	The name of the community is Spicewood Beach, not just Spicewood.	19. Great Plains		672	17	The related text has been removed due to other revisions in the chapter.
Mia	MacDonald	Comments prepared by Brighter Green (www.brightergreen.org), April 2013 On the United States National Climate Assessment The importance of adapting the US agricultural system to cope with the changing climate should not be understated, but it is also crucial to identify and analyze this system's contributions to the escalation of global climate change. The US agricultural system has considerable global impacts (on climate, environment, human health, equity, and more) that must be understood in order for US policy makers, corporations, food producers, and citizens to begin making changes that will reduce US greenhouse gas emissions and overall energy consumption. When food prices rose during the major drought impacting farmers across the US in the summer of	1. Executive Summary				These comments focus primarily on the agricultural chapter but go far beyond the scope of this NCA report. They also emphasize the complexity of the human/natural systems interactions that are described in the Executive summary. However, these comments are too detailed for inclusion in this report, given space

		2012, they didn't just rise in the United States; the price increase was felt around the world, intensifying issues of food security and hunger, especially in developing countries, those that are already most vulnerable to the impacts of climate change. This is just one example of the US food system's impact on other parts of the world. As a leading innovator of technology, the US is at the forefront of modernization and globalization. With that, the US must devote resources toward developing sustainable solutions for the US agricultural system, which will inevitably serve as a model for global food systems. According to the US Environmental Protection Agency (EPA), the agricultural sector was responsible for 7.2% of the US greenhouse gas emissions in 2011. This does not include emissions from indirect agricultural activities, such as the clearing of grasslands to create farmland or the fuel burned when transporting agricultural products. The EPA attributes almost one quarter of the agricultural sector's methane emissions to cattle production. The Food and Agriculture Organization (FAO) of the United States estimates that 18 percent of global greenhouse gas emissions can be attributed to the world's livestock sector. In the US and abroad, agriculture is a major contributor to climate change. Each year, more than sixty billion animals are raised globally for human consumption. Meat and dairy production already uses 30 percent of Earth's land surface, 70 percent of agricultural land, and accounts for eight percent of the water humans use, mostly to irrigate feed crops. The global livestock industry is, according to the FAO, "probably the largest sectoral source of water pollution," and one of the key agents of deforestation. Some estimates project that the global production of meat will double by 2050, which could mean increasing the number of animals used each year in the food industry to 120 billion. This prediction has serious implications for the continued—and escalating—impacts that industrialized animal agriculture has on the Earth. Almost all of the growth in production of livestock is occurring within the industrial system, not among small operations or local farms. This has created a notable geographic concentration of large-scale farming operations, resulting in a disconnect between the animals raised for food and the animal feed needed to support the industry. Animal feed is purchased internationally, lowest cost being the highest priority, no matter the ecological impacts. These include the clearing of land for crops and the use of fossil fuel-based and often toxic pesticides and fertilizers that pose risks to human health and wildlife populations. Increasing demand for grain and oil- and fish-meals to sustain the growing global livestock population means that more of the planet's surface will have to be converted to cropland to grow food for farmed animals, not people. Notably, these kinds of 'indirect' factors were not included in the EPA's statistics for agriculture's contribution to greenhouse gas emissions. Deforestation as a result of the growth of industrial animal agriculture is a compound problem around the world, reducing available habitat for wildlife, decreasing water quality in streams and rivers, lowering ecosystems' resilience to the effects of climate change, and threatening the livelihoods and rights of indigenous peoples and other forest-dependent communities. Globally, agriculture is estimated to be directly responsible for 80 percent of deforestation. In Latin America, the growth of large-scale cattle ranching is the primary driver of forest loss, threatening Indigenous communities, including communities living in voluntary isolation in the Amazon rainforest, the Gran Chaco, and other major forests. Over half of all life on earth is found in tropical forests, which now cover only 7 percent of the world's surface. This paints a grim picture for the future of Earth's species, both human and animal. The Global Forest Watch asserts that about one fifth of the original forest in the US has been cleared over the past two hundred years. If this trend continues, we will lose the important natural resources and ecosystem services provided by rich, diverse primary forests. Genetically-modified crops, relied upon in the industrial model of agriculture as they have large outputs and are resilient to many pests and weather conditions, pose largely unknown risks to human health. China also purchases nearly 50 percent of the world's soybeans sold in global markets for use as domestic animal feed. This includes large quantities from the U.S., Brazil, and other countries in Latin America. Intensification of animal agriculture means that "the livestock sector enters into more and direct competition for scarce land, water, and other natural resources," according to the					constraints.

		FAO. This, of course, has a significant impact on the prospects for ensuring equity and sustainability globally, along with broad-based prosperity for the world's people. "You could even feed 8 billion [people], maybe you could feed 9 billion," UN Population Fund advisor Michael Herrmann says of the current global food system, but adds that "a large share of the food we produce does not actually end up as food on our plates;" instead it's used as animal feed. Globally, about 98 percent of soy meal (which is created by crushing soy beans) is used as feed for farmed animals. High meat consumption also puts human health at risk, contributing to rising rates of diabetes, heart disease, and increasing occurrence of some cancers. According to the American Diabetes Association, almost 26 million Americans (more than 8 percent of the population) have diabetes, and almost 80 million have pre-diabetes. Meat production itself is a major driver of animal cruelty around the globe, threatening both animal welfare and public health. Meat chickens have been bred to grow so quickly that their bodies cannot support their own weight, and many of them spend their lives in chronic pain, unable to walk or move around. Many also regularly receive antibiotics and hormones to promote rapid growth, contributing to antibiotic resistance, which is an increasing concern of global health professionals. Industrial agriculture is having devastating impacts on the lives, health, lands, territories and ecosystems of peasants, Indigenous Peoples, and other food producers and consumers all over the world, as well as on the lives and habitats of other species. Intensive livestock farming and other forms of large-scale livestock production also present significant threat to food security by absorbing massive amounts of land for the production of fodder or feed for often very badly treated animals, instead of food for human beings. Government subsidies that now support the expan¬sion of industrial-scale live¬stock and feed operations should be ended and the "externalities" on which animal agriculture is dependent—such as riverine and marine pollution, contamination of soil and groundwater, land degrada¬tion, and greenhouse gas emissions (GHGs)—should be paid for, in full, by the industry and/or specific facili¬ties that cause them.It will also be necessary to change consumption and production patterns that "promote waste and unnecessary consumption by a minority of humankind, while hundreds of millions still suffer hunger and deprivation." Also required will be energy systems that do not harm the environment or remove land from food production; some of these may be based successfully on local resources and technologies. Political openness, especially in policy-making, ought to be encouraged so that voices ques¬tioning intensive animal farming and promoting sustainability and equity can be heard.Although the United States cannot – and should not – be blamed for all anthropogenic climate change occurring around the world (according to the EPA, the US was responsible for 19 percent of global greenhouse gas emissions in 2008), it is necessary to acknowledge the huge influence the US has on other cultures and societies. In many countries, such as China, meat used to be a condiment or side dish. However, now the Chinese are adopting westernized, US-style (and US-size) diets. This is unsustainable. The US now has an unprecedented opportunity to facilitate a global paradigm shift from a meat-heavy industrial model of agriculture, to a more sustainable, healthier food system – through public advocacy, policy, individual action, technology, and science.					
Kevin	Matthews	The draft NCADAC report clearly recognizes the basic fact that mitigation (the net reduction of greenhouse gas emissions) and adaptation (adjusting infrastructure and systems to avoid damage from climate change) are directly connected:"This 'systems approach' tries to connect, for example, how adaptation and mitigation strategies are themselves dynamic and interrelated systems that intersect with the sectors described here, like the way adaptation plans for future coastal infrastructure are correlated to the kinds of mitigation strategies that are put into place today." - Draft NCA p105, Introduction to the SectorsHowever, the mitigation and sector-specific chapters of the draft report - where the rubber hit the road - are seriously substandard - lost inside the box of business-as-usual - compared to the excellent and more mature climate science section, Chapter 2.The President's science advisor, John Holdren, wrote in a Whitehouse blog entry on January 11, 2013 that	1. Executive Summary				This report is intended to provide a scientific foundation for decision making but is not recommending any policy outcome. The authors have chosen not to make the suggested changes in language.

		the report "does not make recommendations regarding actions that might be taken in response to climate change."Yet, given that mitigation, adaptation, and impacts are "themselves dynamic and interrelated systems," what kind of relevance can the sector analysis provide without addressing mitigation?What kind of relevance can the mitigation chapter (Chapter 27) have, relative to the needs of the nation in 2013, if it doesn't define specific strategies to meet specific scenarios? What kind of relevance can the mitigation chapter have if the concept of climate wedges, for instance (or some alternative approach) is not even discussed in the abstract?If we're in 2013, pretending to add up potential damages due to climate change as if industrial business-as-usual can actually continue indefinitely - as if, for example, a practical issue to be concerned about is a shortened Arctic oil drilling season due to melting permafrost - well, I guess we really have our work cut out.If the draft report acknowledged the technical reality that there is now in effect a fixed budget of CO2e that can be put into Earth's atmosphere - a fixed total carbon budget with a size somewhere in the range of half to one-fifth of the stated reserves of the top 100 fossil fuel companies - then perhaps with a little "systems thinking" it could determine that obstacles to oil and gas drilling that has to be stopped anyway are not in themselves a big cause of concern.For instance, when the need to reduce fossil fuel production is quantified and projected, then it becomes clear that a shortened Arctic oil drilling season due to melting permafrost is not a significant issue of concern.I grant that to say that we're actually _going_to_ leave 50%-80% of already-known reserves in the ground is probably one of those dreaded "policy issues," at times considered off-limits to the rank and file of federal science and bureaucracy.However, in 2013, to simply say that we _have_to_ leave 50%-80% of already-known reserves in the ground, in order to have a reasonable chance of stabilizing the global climate at a survivable level, is not policy. In 2013, expressly outlining functional mitigation strategies is simply science. If the U.S. "Third National Climate Assessment (NCA) Report" doesn't define what would need to be done technically, in order to meet reasonable _potential_ policy goals (as well as international agreements, etc.), then what federal project will?At the same time as the draft NCADAC report shows stunningly how bad things will get if we don't act, in its current form it seems to embody the very institutional blinders that are tending to prevent us from acting.As a prelude to acting, or even making the policy choices to act, it is reasonable for top-level decision makers to have a quantified menu of mitigation options before them.In addition, without establishing a menu of quantified mitigation options, the NCADAC internalizes the irrationality of concern over adaptations that could become moot due to mitigation tactics (as in the example of Arctic drilling concerns, noted above). Adaptive approaches will ultimately have to be prioritized according to how they synergize or conflict with effective mitigation approaches. The NCADAC must not shy from dealing substantively and quantitatively with a complete suite of mitigation approaches, which together would be sufficient _at_a_minimum_ to quantitatively meet specific, scientifically defensible, potential emissions reductions targets for 2020, 2030, 2040, and 2050.					
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		forefront of modernization and globalization. With that, the US must devote resources toward developing sustainable solutions for the US agricultural system, which will inevitably serve as a model for global food systems. According to the US Environmental Protection Agency (EPA), the agricultural sector was responsible for 7.2% of the US greenhouse gas emissions in 2011. This does not include emissions from indirect agricultural activities, such as the clearing of grasslands to create farmland or the fuel burned when transporting agricultural products. The EPA attributes almost one quarter of the agricultural sector's methane emissions to cattle production. The Food and Agriculture Organization (FAO) of the United States estimates that 18 percent of global greenhouse gas emissions can be attributed to the world's livestock sector. In the US and abroad, agriculture is a major contributor to climate change. Each year, more than sixty billion animals are raised globally for human consumption. Meat and dairy production already uses 30 percent of Earth's land surface, 70 percent of agricultural land, and accounts for eight percent of the water humans use, mostly to irrigate feed crops. The global livestock industry is, according to the FAO, "probably the largest sectoral source of water pollution," and one of the key agents of deforestation. Some estimates project that the global production of meat will double by 2050, which could mean increasing the number of animals used each year in the food industry to 120 billion. This prediction has serious implications for the continued—and escalating—impacts that industrialized animal agriculture has on the Earth. Almost all of the growth in production of livestock is occurring within the industrial system, not among small operations or local farms. This has created a notable geographic concentration of large-scale farming operations, resulting in a disconnect between the animals raised for food and the animal feed needed to support the industry. Animal feed is purchased internationally, lowest cost being the highest priority, no matter the ecological impacts. These include the clearing of land for crops and the use of fossil fuel-based and often toxic pesticides and fertilizers that pose risks to human health and wildlife populations. Increasing demand for grain and oil- and fish-meals to sustain the growing global livestock population means that more of the planet's surface will have to be converted to cropland to grow food for farmed animals, not people. Notably, these kinds of 'indirect' factors were not included in the EPA's statistics for agriculture's contribution to greenhouse gas emissions. Deforestation as a result of the growth of industrial animal agriculture is a compound problem around the world, reducing available habitat for wildlife, decreasing water quality in streams and rivers, lowering ecosystems' resilience to the effects of climate change, and threatening the livelihoods and rights of indigenous peoples and other forest-dependent communities. Globally, agriculture is estimated to be directly responsible for 80 percent of deforestation. In Latin America, the growth of large-scale cattle ranching is the primary driver of forest loss, threatening Indigenous communities, including communities living in voluntary isolation in the Amazon rainforest, the Gran Chaco, and other major forests. Over half of all life on earth is found in tropical forests, which now cover only 7 percent of the world's surface. This paints a grim picture for the future of Earth's species, both human and animal. The Global Forest Watch asserts that about one fifth of the original forest in the US has been cleared over the past two hundred years. If this trend continues, we will lose the important natural resources and ecosystem services provided by rich, diverse primary forests. Genetically-modified crops, relied upon in the industrial model of agriculture as they have large outputs and are resilient to many pests and weather conditions, pose largely unknown risks to human health. China also purchases nearly 50 percent of the world's soybeans sold in global markets for use as domestic animal feed. This includes large quantities from the U.S., Brazil, and other countries in Latin America. Intensification of animal agriculture means that "the livestock sector enters into more and direct competition for scarce land, water, and other natural resources," according to the FAO. This, of course, has a significant impact on the prospects for ensuring equity and sustainability globally, along with broad-based prosperity for the world's people. "You could even feed 8 billion [people], maybe you could feed 9 billion," UN Population Fund advisor Michael Herrmann says of the current global food system, but adds that "a large share of the food we produce does not actually end				indigenous peoples, etc. are not within the scope of this chapter.

up as food on our plates;" instead it's used as animal feed. Globally, about 98 percent of soy meal (which is created by crushing soy beans) is used as feed for farmed animals. High meat consumption also puts human health at risk, contributing to rising rates of diabetes, heart disease, and increasing occurrence of some cancers. According to the American Diabetes Association, almost 26 million Americans (more than 8 percent of the population) have diabetes, and almost 80 million have pre-diabetes. Meat production itself is a major driver of animal cruelty around the globe, threatening both animal welfare and public health. Meat chickens have been bred to grow so quickly that their bodies cannot support their own weight, and many of them spend their lives in chronic pain, unable to walk or move around. Many also regularly receive antibiotics and hormones to promote rapid growth, contributing to antibiotic resistance, which is an increasing concern of global health professionals. Industrial agriculture is having devastating impacts on the lives, health, lands, territories and ecosystems of peasants, Indigenous Peoples, and other food producers and consumers all over the world, as well as on the lives and habitats of other species. Intensive livestock farming and other forms of large-scale livestock production also present significant threat to food security by absorbing massive amounts of land for the production of fodder or feed for often very badly treated animals, instead of food for human beings. Government subsidies that now support the expan¬sion of industrial-scale live¬stock and feed operations should be ended and the "externalities" on which animal agriculture is dependent—such as riverine and marine pollution, contamination of soil and groundwater, land degrada¬tion, and greenhouse gas emissions (GHGs)—should be paid for, in full, by the industry and/or specific facili¬ties that cause them.It will also be necessary to change consumption and production patterns that "promote waste and unnecessary consumption by a minority of humankind, while hundreds of millions still suffer hunger and deprivation." Also required will be energy systems that do not harm the environment or remove land from food production; some of these may be based successfully on local resources and technologies. Political openness, especially in policy-making, ought to be encouraged so that voices ques¬tioning intensive animal farming and promoting sustainability and equity can be heard.Although the United States cannot – and should not – be blamed for all anthropogenic climate change occurring around the world (according to the EPA, the US was responsible for 19 percent of global greenhouse gas emissions in 2008), it is necessary to acknowledge the huge influence the US has on other cultures and societies. In many countries, such as China, meat used to be a condiment or side dish. However, now the Chinese are adopting westernized, US-style (and US-size) diets. This is unsustainable. The US now has an unprecedented opportunity to facilitate a global paradigm shift from a meat-heavy industrial model of agriculture, to a more sustainable, healthier food system – through public advocacy, policy, individual action, technology, and science.
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Mia	MacDonald	Comments prepared by Brighter Green (www.brightergreen.org), April 2013 On the United States National Climate Assessment The importance of adapting the US agricultural system to cope with the changing climate should not be understated, but it is also crucial to identify and analyze this system's contributions to the escalation of global climate change. The US agricultural system has considerable global impacts (on climate, environment, human health, equity, and more) that must be understood in order for US policy makers, corporations, food producers, and citizens to begin making changes that will reduce US greenhouse gas emissions and overall energy consumption. When food prices rose during the major drought impacting farmers across the US in the summer of 2012, they didn't just rise in the United States; the price increase was felt around the world, intensifying issues of food security and hunger, especially in developing countries, those that are already most vulnerable to the impacts of climate change. This is just one example of the US food system's impact on other parts of the world. As a leading innovator of technology, the US is at the forefront of modernization and globalization. With that, the US must devote resources toward developing sustainable solutions for the US agricultural system, which will inevitably serve as a model for global food systems. According to the US Environmental Protection Agency (EPA), the agricultural sector was responsible for 7.2% of the US greenhouse gas emissions in 2011. This does not include emissions from indirect agricultural activities, such as the clearing of grasslands to create farmland or the fuel burned when transporting agricultural products. The EPA attributes almost one quarter of the agricultural sector's methane emissions to cattle production. The Food and Agriculture Organization (FAO) of the United States estimates that 18 percent of global greenhouse gas emissions can be attributed to the world's livestock sector. In the US and abroad, agriculture is a major contributor to climate change. Each year, more than sixty billion animals are raised globally for human consumption. Meat and dairy production already uses 30 percent of Earth's land surface, 70 percent of agricultural land, and accounts for eight percent of the water humans use, mostly to irrigate feed crops. The global livestock industry is, according to the FAO, "probably the largest sectoral source of water pollution," and one of the key agents of deforestation. Some estimates project that the global production of meat will double by 2050, which could mean increasing the number of animals used each year in the food					Thank you for your comments. However, policy issues are beyond the defined scope of the National Climate Assessment, a scientific document that provides the basis for decision making, but does not address policy. The points you make are addressed in chapters throughout the report.

industry to 120 billion. This prediction has serious implications for the continued—and escalating—impacts that industrialized animal agriculture has on the Earth. Almost all of the growth in production of livestock is occurring within the industrial system, not among small operations or local farms. This has created a notable geographic concentration of large-scale farming operations, resulting in a disconnect between the animals raised for food and the animal feed needed to support the industry. Animal feed is purchased internationally, lowest cost being the highest priority, no matter the ecological impacts. These include the clearing of land for crops and the use of fossil fuel-based and often toxic pesticides and fertilizers that pose risks to human health and wildlife populations. Increasing demand for grain and oil- and fish-meals to sustain the growing global livestock population means that more of the planet's surface will have to be converted to cropland to grow food for farmed animals, not people. Notably, these kinds of 'indirect' factors were not included in the EPA's statistics for agriculture's contribution to greenhouse gas emissions. Deforestation as a result of the growth of industrial animal agriculture is a compound problem around the world, reducing available habitat for wildlife, decreasing water quality in streams and rivers, lowering ecosystems' resilience to the effects of climate change, and threatening the livelihoods and rights of indigenous peoples and other forest-dependent communities. Globally, agriculture is estimated to be directly responsible for 80 percent of deforestation. In Latin America, the growth of large-scale cattle ranching is the primary driver of forest loss, threatening Indigenous communities, including communities living in voluntary isolation in the Amazon rainforest, the Gran Chaco, and other major forests. Over half of all life on earth is found in tropical forests, which now cover only 7 percent of the world's surface. This paints a grim picture for the future of Earth's species, both human and animal. The Global Forest Watch asserts that about one fifth of the original forest in the US has been cleared over the past two hundred years. If this trend continues, we will lose the important natural resources and ecosystem services provided by rich, diverse primary forests. Genetically-modified crops, relied upon in the industrial model of agriculture as they have large outputs and are resilient to many pests and weather conditions, pose largely unknown risks to human health. China also purchases nearly 50 percent of the world's soybeans sold in global markets for use as domestic animal feed. This includes large quantities from the U.S., Brazil, and other countries in Latin America. Intensification of animal agriculture means that "the livestock sector enters into more and direct competition for scarce land, water, and other natural resources," according to the FAO. This, of course, has a significant impact on the prospects for ensuring equity and sustainability globally, along with broad-based prosperity for the world's people. "You could even feed 8 billion [people], maybe you could feed 9 billion," UN Population Fund advisor Michael Herrmann says of the current global food system, but adds that "a large share of the food we produce does not actually end up as food on our plates;" instead it's used as animal feed. Globally, about 98 percent of soy meal (which is created by crushing soy beans) is used as feed for farmed animals. High meat consumption also puts human health at risk, contributing to rising rates of diabetes, heart disease, and increasing occurrence of some cancers. According to the American Diabetes Association, almost 26 million Americans (more than 8 percent of the population) have diabetes, and almost 80 million have pre-diabetes. Meat production itself is a major driver of animal cruelty around the globe, threatening both animal welfare and public health. Meat chickens have been bred to grow so quickly that their bodies cannot support their own weight, and many of them spend their lives in chronic pain, unable to walk or move around. Many also regularly receive antibiotics and hormones to promote rapid growth, contributing to antibiotic resistance, which is an increasing concern of global health professionals. Industrial agriculture is having devastating impacts on the lives, health, lands, territories and ecosystems of peasants, Indigenous Peoples, and other food producers and consumers all over the world, as well as on the lives and habitats of other species. Intensive livestock farming and other forms of large-scale livestock production also present significant threat to food security by absorbing massive amounts of land for the production of fodder or feed for often very badly treated animals, instead of

food for human beings. Government subsidies that now support the expan¬sion of industrial-scale live¬stock and feed operations should be ended and the “externalities” on which animal agriculture is dependent—such as riverine and marine pollution, contamination of soil and groundwater, land degrada¬tion, and greenhouse gas emissions (GHGs)—should be paid for, in full, by the industry and/or specific facili¬ties that cause them.It will also be necessary to change consumption and production patterns that “promote waste and unnecessary consumption by a minority of humankind, while hundreds of millions still suffer hunger and deprivation.” Also required will be energy systems that do not harm the environment or remove land from food production; some of these may be based successfully on local resources and technologies. Political openness, especially in policy-making, ought to be encouraged so that voices ques¬tioning intensive animal farming and promoting sustainability and equity can be heard.Although the United States cannot – and should not – be blamed for all anthropogenic climate change occurring around the world (according to the EPA, the US was responsible for 19 percent of global greenhouse gas emissions in 2008), it is necessary to acknowledge the huge influence the US has on other cultures and societies. In many countries, such as China, meat used to be a condiment or side dish. However, now the Chinese are adopting westernized, US-style (and US-size) diets. This is unsustainable. The US now has an unprecedented opportunity to facilitate a global paradigm shift from a meat-heavy industrial model of agriculture, to a more sustainable, healthier food system – through public advocacy, policy, individual action, technology, and science.
Notes:United Nations Food and Agriculture Organization (FAO), Livestock Impacts on the Environment, Spotlight, 2006. http://www.fao.org/ag/magazine/0612sp1.htm.

United Nations Food and Agriculture Organization (FAO), Livestock’s Long Shadow: Environmen¬tal Issues and Options, 2006.

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http://www.ciwf.org.uk/includes/documents/cm_docs/2010/b/beyond_factory_farming_report_2009_exec_main_final.pdf.

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An HSUS Report: The Welfare of Animals in the Meat, Egg, and Dairy Industries, Humane Society of the U.S., n.d. http://www.humanesociety.org/assets/pdfs/farm/welfare_overview.pdf

		Zhu, Yong-Guan, “Diverse and abundant antibiotic resistance genes in Chinese swine farms,” Proceedings of the National Academy of Sciences (PNAS) of the United States of America, February 2013. http://www.pnas.org/content/early/2013/02/05/1222743110 La Via Campesina, Small Scale Farmers Are Cooling Down the Earth, 2009.					
Kevin	Matthews	The draft NCADAC report clearly recognizes the basic fact that mitigation (the net reduction of greenhouse gas emissions) and adaptation (adjusting infrastructure and systems to avoid damage from climate change) are directly connected:"This 'systems approach' tries to connect, for example, how adaptation and mitigation strategies are themselves dynamic and interrelated systems that intersect with the sectors described here, like the way adaptation plans for future coastal infrastructure are correlated to the kinds of mitigation strategies that are put into place today." - Draft NCA p105, Introduction to the SectorsHowever, the mitigation and sector-specific chapters of the draft report - where the rubber hit the road - are seriously substandard - lost inside the box of business-as-usual - compared to the excellent and more mature climate science section, Chapter 2.The President's science advisor, John Holdren, wrote in a Whitehouse blog entry on January 11, 2013 that the report "does not make recommendations regarding actions that might be taken in response to climate change."Yet, given that mitigation, adaptation, and impacts are "themselves dynamic and interrelated systems," what kind of relevance can the sector analysis provide without addressing mitigation?What kind of relevance can the mitigation chapter (Chapter 27) have, relative to the needs of the nation in 2013, if it doesn't define specific strategies to meet specific scenarios? What kind of relevance can the mitigation chapter have if the concept of climate wedges, for instance (or some alternative approach) is not even discussed in the abstract?If we're in 2013, pretending to add up potential damages due to climate change as if industrial business-as-usual can actually continue indefinitely - as if, for example, a practical issue to be concerned about is a shortened Arctic oil drilling season due to melting permafrost - well, I guess we really have our work cut out.If the draft report acknowledged the technical reality that there is now in effect a fixed budget of CO2e that can be put into Earth's atmosphere - a fixed total carbon budget with a size somewhere in the range of half to one-fifth of the stated reserves of the top 100 fossil fuel companies - then perhaps with a little "systems thinking" it could determine that obstacles to oil and gas drilling that has to be stopped anyway are not in themselves a big cause of concern.For instance, when the need to reduce fossil fuel production is quantified and projected, then it becomes clear that a shortened Arctic oil drilling season due to melting permafrost is not a significant issue of concern.I grant that to say that we're actually _going_to_ leave 50%-80% of already-known reserves in the ground is probably one of those dreaded "policy issues," at times considered off-limits to the rank and file of federal science and bureaucracy.However, in 2013, to simply say that we _have_to_ leave 50%-80% of already-known reserves in the ground, in order to have a reasonable chance of stabilizing the global climate at a survivable level, is not policy. In 2013, expressly outlining functional mitigation strategies is simply science. If the U.S. "Third National Climate Assessment (NCA) Report" doesn't define what would need to be done technically, in order to meet reasonable _potential_ policy goals (as well as international agreements, etc.), then what federal project will?At the same time as the draft NCADAC report shows stunningly how bad things will get if we don't act, in its current form it seems to embody the very institutional blinders that are tending to prevent us from acting.As a prelude to acting, or even making the policy choices to act, it is reasonable for top-level decision makers to have a quantified menu of mitigation options before them.In addition, without establishing a menu of quantified mitigation options, the NCADAC internalizes the irrationality of concern over adaptations that could become moot due to mitigation tactics (as in the example of Arctic drilling concerns, noted above). Adaptive approaches will ultimately have to be prioritized according to how they synergize or conflict with	4. Energy Supply and Use				Thank you for your comment, which seems to refer to the report as a whole. Policy issues are beyond the defined scope of the National Climate Assessment, a scientific document that provides the basis for decision making, but does not address policy. In recognition of the importance of addressing response strategies, this report explicitly assesses adaptation, mitigation and decision support responses, in addition to identifying research needs associated with these topics, in Chapters 26-29. Many other chapters include assessment of adaptation responses.

		effective mitigation approaches. The NCADAC must not shy from dealing substantively and quantitatively with a complete suite of mitigation approaches, which together would be sufficient _at_a_minimum_ to quantitatively meet specific, scientifically defensible, potential emissions reductions targets for 2020, 2030, 2040, and 2050.					
John	Nielsen-Gammon	To the extent that the 'trends' statement might be based on Kunkel et al. 2012b, the following statement in Kunkel et al. is incorrect: "From a paleoclimatic perspective using tree rings as a proxy for drought, the 2011 drought in Texas is approximately equal in intensity to the worst droughts of the past 429 years. Also based on the tree ring evidence, the drought of the 1950s is not exceeded in length in the last 429 years. This confirms the unusual nature of both the 1950s and 2011 events." The paleoclimate proxies are for June PDSI. The June PDSI in 2011 was far from historically extreme. Likewise, the same tree ring study (Cleaveland et al. 2011) show longer droughts than the drought of the 1950s.	19. Great Plains		657	39	The text has been revised to incorporate this suggestion. The authors agree that there is no clear historical trend; however, PDSI comparisons of tree ring data to NCDC climate division PDSI datasets show the magnitude of the 2011 drought was comparable to historical events, although the duration of the current event is yet to be determined in comparison to the length of previous events.
Gary	Graham	Please accept these comments from Western Resource Advocates (WRA) on various chapters of the Federal Advisory Committee Climate Assessment Report (Report). Western Resource Advocates (WRA) is a non-profit environmental law and policy organization based in Boulder, Colorado. With offices and initiatives in seven states (Colorado, Utah, Arizona, Nevada, New Mexico, Wyoming and Idaho), we have developed strategic programs focusing on Water, Energy, Lands, and the climate crisis.WRA is very pleased with the quality of this report and anticipate that it will be widely used by many stakeholders addressing the challenges, impacts and vulnerabilities posed by this climate crisis. We hope that the high quality of the science and finding propel federal and state elected officials to more effectively provide solutions to the climate crisis and in doing so provide the leadership expected of us by the rest of the world. We provide the bulk of our comments for Chapters 10 (Energy-Water-Land) and 13 (Land) but some of those comments could also be included in the separate resource, adaptation, or mitigation chapters. The reason we include them here is that as stated numerous times in the Report the climate issues are cross-cutting and multisectorial. Numerous other WRA staff contributed to our comments but of special note is the discussion in Chapter 10 by Stacy Tellinghuisen.Mitigation Chapter. Additional national policies are needed to reduce the amount of carbon being released into the atmosphere in the US by both the transportation and electricity sectors of our economy. With natural gas potentially occupying a greater role in both of these sectors as we transition to a clean energy future, a greater discussion of natural gas issues within the Report seem essential. According to the recent Western Grid 2050 (1) report, to achieve long-term greenhouse gas reduction goals, a sizable portion of the electricity demand over the next 40 years will need to be met by natural gas generation. If used appropriately, natural gas can play an important role filling that gap in the transition to a clean energy future, particularly in the West. If, however, it is not produced responsibly, natural gas extraction will have severe adverse impacts on the West's land, air, water, communities and climate. Fugitive methane emissions, a significant contributor to the climate crisis, is barely mentioned in the Report. Additionally, undue reliance on natural gas, i.e., simply replacing coal with natural gas generation, will reverse advances made toward renewable energy integration into western electricity portfolios. Importantly, if community impacts and public health concerns are not properly addressed,	27. Mitigation				The discussion of various measures for emissions mitigation has been strengthened, and the important role being played by natural gas has been noted. Discussion of the many suggested details is beyond the scope of the Mitigation chapter given space limitations.

		municipalities and other local governments and the public will continue to oppose natural gas--even as a transition fuel. Many industries want a national policy to provide more certainty for their investments in renewable energy, energy efficiency, and demand side management. WRA has developed the cornerstones of such a policy with the Clean Energy Standard (CES)(2). As developed, the CES would require each utility in a state to systematically reduce the carbon footprint of its generation each year (e.g. 3% per year) from a baseline (e.g. 2010 emissions). Clean energy is measured by how much less CO2 a generator emits than a coal plant producing an equivalent amount of energy. Components of this WRA design, particularly the credit mechanism, were used in the development of former Senator Bingaman's 2012 clean energy standard bill. Because the CES requires absolute reductions, and because credits represent metric tons of CO2 reduction, the program would link easily with other, and future, CO2 regulatory regimes. Finally, our initial analysis shows that the costs of the program would be very manageable – typically raising electric rates less than 1% per year.(1)The report Western Grid 2050: Contrasting Futures, Contrasting Fortunes is available at: http://www.cleanenergyvision.org/wp-content/uploads/2011/08/WG2050_final_rev082211.pdf(2) Michel, S. (2011), A Model Clean Energy Standard. The Electricity Journal. Vol. 24, Issue 3, pp. 45-51, (http://EconPapers.repec.org/RePEc:eee:jelect:v:24:y:2011:i:3:p:45-51).					
Lauren	Baum	The NCA should take note of Swiss Re's latest sigma study reveals that natural catastrophes and man-made disasters in 2012 caused economic losses of USD 186 billion with approximately 14 000 lives lost.LINK: http://media.swissre.com/documents/sigma2_2013_en.pdf	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				This reference has not been included in this report and seems more suited to one of the chapters assessing impacts and adaptation needs.
Albert	Johnson	This comment deals with the intended audience for the report. If the report is intended for the scientific community and no one else, then no change is needed. However if the report is intended to influence opinion and to help change minds of those who do not believe that climate change is human induced then the following changes are recommended for without these changes you will not even capture the attention of those would doubt climate change. Approximately 30% of the American public does not believe that global warming is caused by human activity. A policy brief by Duke University Nicholas Institute (NI-PB 13-01, Feb 2013) reported that 29% of the US population believes that climate change is due to natural causes. However, in the same report just over half of the population (54%) believes it is due to human activity. That leaves 46% that do not agree. In the September 2012 report of the Six America series (Leiserowitz, A., Maibach, E., Roser-Renouf, C., Feinberg, G. & Howe, P. (2013)) published jointly by Yale University and George Mason University, the authors state that the percent of those that do not express concern or belief for climate change (Doubtful (13%), Disengaged (9%), and Dismissive (8%)) comprise 30% 0f the population. The Executive Summary needs to reflect an understanding that there is a significant percent of the American public that is doubtful of human caused climate change. If the Executive Summary and later sections the report are left as written, the reaction of those who do not believe in human induced climate change or are not concerned with it,	1. Executive Summary				This report is intended to provide a scientific foundation for decision making but is not recommending any policy outcome. The authors have chosen not to make the suggested changes in language.

		and whom the report should try to influence, may be to throw the report in the trash saying, "It's obvious that these people don't know what they are talking about." The following changes are recommended. The closing sentence of the opening paragraph states emphatically that global climate change is "primarily driven by human activity." Again assuming that the intent of the report is to support changes to either mitigate climate change or to support adaptive behavior by the American people it is not a good idea to evoke a negative emotional response in 30% to 50% of the intended audience right at the start. Remove the last sentence (lines 5 and 6) of the first paragraph of the Executive Summary and replace with the following; "These changes are part of the pattern of global climate change. Although the 40% to 50% of the American public does not agree that climate change is human induced. This report is intended to show verifiable evidence that human activity is the most significant factor in climate change and when coupled with the well understood natural cause to global warming and sea level rise in coastal areas."A similar change is also necessary for the term "human-induced" as used throughout the Executive Summary. This term is used an adjective to describe the type of global warming or climate change. It will get the response stated above, and the report will lose a significant portion of its intended audience. In this vein the Finding 1 (page 8, lines 1 through 8) should be replaced with the following: "The climate change of the past 50 years is due primarily to human activities being superimposed on natural factors U.S. average temperature has increased by about 1.5°F since 1895, with more than 80% of 5 this increase occurring since 1980. The most recent decade was the nation's warmest on record. Because human-induced warming, predominantly the burning of fossil fuels, is superimposed on a naturally varying climate, rising temperatures do not match the expected climate trends and are not evenly distributed across the country or over time (Ch. 2).By reference Chapter 2 (page 8, line 8) will need to be reviewed and modified. My concern is that the report as written will not reach those who do not believe, but only those who already do. I do not deny that this is a dilemma, but hopefully one that the authors can rectify while keeping the scientific findings of the report strong.					
Albert	Johnson	The concept of storm surge is well understood by the American public, at least the portion that lives on the eastern seaboard. They understand that it is not caused by global warming. In most instances this Executive Summary implies through the use of the use of the term that storm surge is not the result of winds and reduced pressure at center of a cyclonic storm as defined by NOAA. On the NOAA website storm surge is described as the result of water being pushed toward the shore by the force of the winds moving cyclonically around the storm. The impact on surge of the low pressure associated with intense storms is minimal in comparison to the water being forced toward the shore by the wind. (http://www.nhc.noaa.gov/surge/) This report should stick to the understanding of storm surge provided by NOAA and which the people in coastal regions understand. This will keep the message simple and at the same time help ensure the credibility of the report and how well it is accepted by the American people – at least those on the coast. Storm surge is initially discussed in the Executive Summary on page 4, beginning at line 23. In this paragraph it is mentioned twice, correctly. It is first mentioned (page 4, line 23) as having been / and will be in the future increased by "sea level rise". In the second mention storm surge is said to be (page 4, line 27) "exacerbated by rising sea levels". This is the manner in which storm surge should be discussed. Yes, storm surge will be exacerbated by the rising sea levels due to global warming, but it is not correct to imply that storm surge is a direct result of global warming. To do so reduces the credibility of the report. This caution is relevant not just to the Executive Summary but to the rest of the report as well. The following changes are recommended: a. Page 7, line 3: remove "storm surge" from the title line of Finding 6.	1. Executive Summary				Thank you for these comments. The reference to storm surge has been removed from the beginning of the Report Finding on infrastructure. The Report Finding has further been revised to focus on the combination of factors, including climate change, that damage infrastructure. The regional table has been replaced with a regional infographic. We have amended the section on sea level rise scenarios in response to the comment.

		b. Page 7, line 5: change to read “Sea level rise and associated potential increase in storm surge”. c. Page 11, Table 1.1, “Northeast”: change to read “Sea level rise and associated potential increase in storm surge”. d. Page 11, Table 1.1, “Coast”: change to read “… higher sea levels and associated potential increase in storm surge”. e. Page 20, line 21: change to read “… sea level rise and associated potential increase in storm surge”.					
Paul	Torcellini	Increased temperature not only increases the electrical use, but also the water use as most larger buildings use cooling towers. Water use is also increased at the power plant with the increased electrical use from the buildings.	10. Water, Energy, and Land use		389		We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include.
John	Nielsen-Gammon	A search of Kunkel et al. 2012b turned up no mention of projections of more droughts, so I cannot tell what this projection is based on nor whether it takes into account recent studies showing that PDSI is an inappropriate measure of climate change's impact on drought.	19. Great Plains		663	18	We have added additional appropriate references.
Christy	Foran	This is a great effort and provides a wonderful overview of the practices associated with planning and management under uncertain conditions. Generally, climate change presents a planning dilemma not only because of the complexity of the topic and the uncertainty associated with forecasting, but also because of the diversity of stakeholders, organizations, processes and histories which must act in concert to develop effective courses of action. Our comments center around ways in which the “activation energy” of getting people to work together to enhance climate preparedness might be lowered. More specific comments: Using a Decision Framework: A figure is needed here to develop the point to which you have been building. We suggest something like the following: [FIGURE]. The discussion of adaptive management seems incomplete, or at least tangential, without addressing the problems associated with adaptive management. The National Academies published a good criticism of applied adaptive management associated with the Everglades that is worth summarizing here. It is also worth describing that those features that complicate adaptive management are exemplified in the problem of planning for a changing climate. Specifically, difficulties often center around coping with uncertainty, coordinating a diverse group of stakeholders and agencies with disparate priorities and interests, and developing a monitoring strategy that best informs future decisions (or informs them at all). Under those circumstances, we have argued that adaptive management needs to be based on a formal decision model that can incorporate uncertainty and a range of values, as well as be utilized to determine the material value of monitoring information (“Enhanced Adaptive Management”; Convertino et al., submitted; Keisler et al. 2013). A structured approach also allows future decisions to be proposed without recreation of the entire decision process Ð something which may be critical in this context. The adaptive management structure as diagramed below uses stakeholders to develop a integrative decision model that suggests a course of action as well as the data needed to reduce uncertainty in future analyses. [FIGURE] Problem Framing and Establishing Decision Criteria: This section needs to more explicitly address the role of social, political and historical interest in development of a course of action. For example, despite climate projections and overwhelming costs, we as a society are unlikely to abandon Manhattan or New Orleans. We need to not just “acknowledge” but assimilate “controversy” in decision criteria. Multi_criteria decision analysis is one way to do this (Linkov and Moberg, 2012), requiring inclusion of the values and priorities of multiple agencies and stakeholders. In the absence of this process, any decisions that do arise from these	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				We have included additional text and a graphic that introduces the chapter content. We have revised the text on iterative adaptive risk management and decision criteria to more clearly describe the process. Research priority added to support knowledge sharing of decision support activities to allow for a large-scale assessment and access to such case studies and tools by the public.

		processes will be irrelevant. Note that “scenario analysis” means different things to different groups, reviewed by Tourki, Keisler and Linkov (2013). Assessing, Perceiving and Managing Risk: A distinction should be made here about risk and resilience. Colloquially, risk is cost associated with failure of something whereas resilience is a measure of how quickly it can recover its function. However, much has been written about this distinction (Park et al., 2013). While resilience is somewhat incorporated in the concepts of sensitivity and adaptive capacity, this is an important clarification. Communities may find in the planning process that they are unable (especially in the short term) to adapt to changing climate. Under those limitations, they may decide to invest in preparedness in way that enhances resilience. This distinction and its implications for planning are worth describing in some detail. Improving Decision Processes: Recommendations include both support for the USGCRP to develop decision support tools and an assessment of decision support resources. A fusion of the two goals seems to be more appropriate. Climate change is being assessed by communities across the country in different ways and to different degrees of effectiveness. Several case studies, described in detail and generalized for utilization by other decision makers, would be useful. In this way, the effective utilization of decision tools can be tied to the specific needs of communities and the utility of data gathering (climate projection, infrastructure evaluation) can be demonstrated. Utilizing lessons learned from these studies, roadmaps for planning for a changing climate can be developed for different classes of organizations or different levels of government. REFERENCES Convertino, M., Foran, C.M., Keisler, J.M., Scarlett, L., LoSchiavo, A., Kiker, G.A.,Linkov, I. (2013, submitted). Enhanced Adaptive Management for Everglades in Response to Climate Change. Scientific Reports Karvetski, C.W., James H. Lambert, J.H., Keisler, J.M., Sexauer, B., and Linkov, I. (2011). Climate Change Scenarios: Risk and Impact Analysis for Alaska Coastal Infrastructure. International Journal of Risk Assessment and Management. 15:258_274 Keisler, J., Collier, Z., Chu, E., Sintra, N., Linkov, I (2013, published on_line). Value of information analysis: the state of application. Environment, Systems, and Decisions, 33 Linkov, I., Moberg, E. (2012). Multi_Criteria Decision Analysis: Environmental Applications and Case Studies. CRC Press. Park, J., Seager, TP, Rao, PCS, Convertino, M., Linkov, I. (2013). Contrasting risk and resilience approaches to catastrophe management in engineering systems. Risk Analysis 33: 356Ð367. Tourki, Y., Keisler, J., Linkov, I. (2013) Scenario analysis: a review of methods and applications for engineering and environmental systems. Environment, Systems, and Decisions, 33: 3_20.					
Beth	Brumbaugh	The wording of the sentence in these lines is confusing, and it implies that geographic/seasonal distribution of insect populations is affected by access to health care. I would suggest rewording the sentence or removing the comma after "insect populations" so that the way the sentence reads implies that the factors listed could influence the geographical/seasonal distribution of the diseases carried by insect vectors.	9. Human Health		343	31	The text has been revised to incorporate this suggestion, deleting the comma after "populations."
Lauren	Baum	The NCA should take note of a recent report on trans arctic navigability: Abstract: Recent historic observed lows in Arctic sea ice extent, together with climate model projections of additional ice reductions in the future, have fueled speculations of potential new trans-Arctic shipping routes linking the Atlantic and Pacific Oceans. However, numerical studies of how projected geophysical changes in sea ice will realistically impact ship navigation are lacking. To address this deficiency, we analyze seven climate model projections of sea ice properties, assuming two different climate change scenarios [representative concentration pathways (RCPs) 4.5 and 8.5] and two vessel classes, to assess future changes in peak season (September) Arctic shipping potential. By midcentury, changing sea ice conditions enable expanded September navigability for common open-water ships crossing the Arctic along the Northern Sea Route over the Russian Federation, robust new routes for moderately ice-strengthened (Polar Class 6) ships over the North Pole, and new routes through the Northwest Passage for both vessel classes. Although numerous other	22. Alaska and the Arctic				We have added the suggested citations in our chapter assessment.

		nonclimatic factors also limit Arctic shipping potential, these findings have important economic, strategic, environmental, and governance implications for the region.CITATION: Smith, L.C. and Stephenson, S.R. (2013). New Trans-Arctic shipping routes naviagable by bid century. PNAS. Link: http://www.pnas.org/content/early/2013/02/27/1214212110.full.pdf					
Aditi	Mishra	As far making a link between climate change and energy infrastructure goes, this chapter does a very good job of detailing how climate change consequences, such as rising sea levels and more frequent extreme weather, will affect energy infrastructure, and subsequently the changing patterns of energy use.From a climate science perspective, there are some very important links made between energy infrastructure vulnerability and seasonal variability in both climate and water availability. Mentioning risks associated with water availability issues was by and far one of the strongest aspects of this chapter — papers related to energy often fail to recognize water as an important component of all energy supply, not just hydropower. Another very strong aspect of this chapter was Table 4.2, which focused on adaptation strategies. The Table mentioned ways in which both governments and private sector companies could adapt energy infrastructure to meet climate change in a very easy-to-read and clear way.However, there were some aspects of energy supply and use that I would have wanted the chapter to cover. There was very little mention of the national grid and how to adapt the grid not only to increased peak loads but also to changing sources of energy. The paper also mentioned at certain places that investment in clean tech would have to be made, but not how much and by whom. How big of a role should the government play in encouraging alternative energy innovation? Why are failed investments like those made by the government in Solyndra being chastised so much, when it's natural for most start-ups to fail? There was also a lack of financial statistics throughout the paper — especially the costs of damages that could be incurred by extreme weather, the financial challenges of adaptation and how companies should present the "no-regrets" scenarios in their projected budget reports, etc. Perhaps mentioning the difference between expense of damage incurred both with and without adaptation could help portray that adaptation is potentially cheaper in the long run. There was also very little discussion of political "hot topics" like clean coal, hydraulic fracturing, sequestration and nuclear power.The chapter could have done a better job with backing claims with financials and evidence of change, the graphs could be less complex, time-frames of when action needs to be taken and how long we have left before energy infrastructure is most at risk could be discussed, and some links could be made with the regional chapters at the end of the report (northwest, south, etc) to show the main problems each region should focus on and adapt to. But overall, the chapter was cogent, connected well with other chapters, and was thorough in its consideration of adaptation strategies.	4. Energy Supply and Use				Thank you for the accolade. Also, please see the chapter on Water, Energy, and Land (Chapter 10). The authors agree that the impacts related to changing sources of energy are important, and addressed these issues in Key Message #5, which identifies the many uncertainties affecting the evolution of the energy systems in the future and the possible ways that such could be impacted by changing climate conditions. The page limitations in the National Climate Assessment prevented a detailed treatment of all issues, including some of the ones mentioned in this thoughtful comment.
Cynthia	Finley	In this table, the Clean Air Act Prevention of Significant Deterioration (PSD) and Title V permitting programs are listed as federal regulations that "target ways to reduce future climate change by decreasing greenhouse gas emissions emitted by human activities." However, the Title V and PSD permitting programs are not effective in reducing greenhouse gas emissions from wastewater utilities. Wastewater utilities are performing a necessary and vital function to protect human health and the environment. The processes generating carbon dioxide in a wastewater treatment facility are the same as those that occur in nature, except that in a wastewater treatment facility they occur in an environment optimized for waste destruction. Regulating these carbon-neutral emissions that would occur naturally anyway creates unnecessary costs and burdens for wastewater utilities, diverting resources that the utility could use on other issues. The processes used to treat wastewater at utilities also generate biogas and biosolids which, when combusted, are among the most carbon-neutral fuels available. While greenhouse gas emissions from these biogenic sources are currently deferred from the Title V and PSD permitting programs, if EPA does not permanently exempt combustion of biogas and biosolids from these regulations, the costs for utilities may be too high to use these environmentally friendly, renewable energy sources.	27. Mitigation	27.2	969		We're not making judgments about the total effectiveness of the Federal programs, simply noting that they have some effect in reducing GHG emissions.

Shaye	Wolf	(1) The Assessment underestimates the level of future sea level rise. The body of scientific studies supports sea level rise greater than that 1 to 4 foot range reported in the Assessment, and this should be corrected. Studies that have improved upon the 2007 IPCC estimates have found that a mean global sea-level rise of at least one to two meters is highly likely by 2100, as follows: 0.5 to 1.4 m (Rahmstorf 2007), 0.75 m to 1.90 m (Vermeer and Rahmstorf 2009), 0.8 m to 2.0 m (Pfeffer et al. 2008), 0.8 m to 1.3 m (Grinsted et al. 2010), and 0.6 m to 1.6 m (Jevrejeva et al. 2010). In its 2012 sea-level rise assessment, the National Research Council reviewed these studies and estimated likely global sea-level rise at 8 to 23 cm by 2030, 18 to 48 cm by 2050, and 50 to 140 cm by 2100 (NRC 2012). The 50 to 140 cm range by 2100 from the NRC (20112) equates to 1.6 to 4.6 feet. Moreover, studies that have reconstructed sea-level rise based on the geological record, including oxygen isotope and coral records, have found that larger rates of 2.4 to 4 m per century are possible (Milne et al. 2009). (2) The Assessment should emphasize that the amount of future sea level rise is highly dependent on our mitigation efforts: there will be less sea level rise with lower emissions pathways. For example, according to Vermeer and Rahmstorf (2009), the lowest emissions scenario considered, B1, (which leads to 550 ppm CO2 in 2100) leads to an average SLR of 1.04 meters (81 -131 cm) above 1990 levels in 2100. The highest scenario considered, A1FI, which we have largely tracked, (which leads in 970 ppm CO2 in 2100) would lead to an average SLR of 1.43 meters (113-179 cm) above 1990 levels in 2100. On a lower emissions pathway, such as one that achieves 350 ppm CO2 or lower, most of these sea level rise impacts would be avoided (Hansen et al. 2008), as long as the irreversible melting of the Greenland ice sheet was not triggered. (3) The Assessment should discuss the risk of triggering the irreversible melting of the Greenland ice sheet and the effect this will have on sea level rise. For example, Robinson et al. (2012) found that a 0.8 to 3.2°C temperature rise above pre-industrial has the potential to trigger irreversible melting of the Greenland ice sheet, which would result in an eventual seven meters of sea level rise that would inundate small island nations and heavily populated coastal areas. Therefore, we are already in the range of warming for triggering this melt.(4) The Assessment should discuss that future sea level rise will continue to increase after 2100 and it should present estimates of that sea level rise, since it is quite substantial. Grinsted, A., J. C. Moore, and S. Jevrejeva. 2010. Reconstructing sea level from paleo and projected temperatures 200 to 2100 AD. Climate Dynamics 34:461-472. Hansen, J., M. Sato, P. Kharecha, D. Beerling, R. Berner, V. Masson-Delmotte, M. Pagani, M. Raymo, D. L. Royer, and J. C. Zachos. 2008. Target Atmospheric CO2: Where Should Humanity Aim? The Open Atmospheric Science Journal 2:217–231. Jevrejeva, S., J. C. Moore, and A. Grinsted. 2010. How will sea level respond to changes in natural and anthropogenic forcing by 2100. Geophysical Research Letters 37:L07703, doi:10.1029/2010GL042947. Milne, G. A., W. R. Gehrels, C. W. Hughes, and M. E. Tamisiea. 2009. Identifying the causes of sea-level change. Nature Geoscience 2:471-478. NRC. 2012. Sea-Level Rise for the Coasts of California , Oregon , and Washington : Past , Present , and Future, National Research Council of the National Academies. Pfeffer, W. T., J. T. Harper, and S. O'Neel. 2008. Kinematic constraints on glacier contributions to 21st-century sea-level rise. Science 321:1340-1343.	1. Executive Summary		20	16	The Climate Science chapter authors carefully considered all of the existing literature prior to coming to their conclusions on this topic. For more information please refer to Chapter 2 and associated appendices. This chapter merely summarizes the highlights from other chapters.

		Rahmstorf, S. 2007. A semi-empirical approach to projecting future sea-level rise. Science 315:368-370. Robinson, A., R. Calov, and A. Ganopolski. 2012. Multistability and critical thresholds of the Greenland ice sheet. Nature Climate Change 2:429-432. Nature Publishing Group. doi: 10.1038/nclimate1449. Vermeer, M., and S. Rahmstorf. 2009. Global sea level linked to global temperature. Proceedings of the National Academy of Sciences of the United States of America 106:21527-21532.					
Christopher	Lindsay	Specify "the adoption of more efficient plumbing codes" as an effective demand side management issue. This is an important strategy for policymakers to consider as they look at non-structural approaches.	3. Water Resources		129	23	The text has been revised to incorporate this suggestion.
Lauren	Baum	The NCA should take note of a recent study that finds that women pregnant during heat waves face a higher risk of giving birth to babies with a rare defect causing blindness. CITATION: Zutphen, A.R. et al. (2012). A population-based Case-control study of extreme summer temperature and birth defects. Environmental health perspectives. Link: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3491926/	9. Human Health				Thank you for your suggestion, there have been numerous studies identifying particular high-risk groups and health outcomes of exposure to extreme weather events including heat. Space limitations preclude our ability to address all of these findings.
Hunter	Cutting	The report should note the findings from this study:Petoukhov, V., Rahmstorf, S., Petri, S., Schellnhuber, H. J. (2013): Quasi-resonant amplification of planetary waves and recent Northern Hemisphere weather extremes. Proceedings of the National Academy of Sciences (Early Edition) [doi:10.1073/pnas.1222000110]The world has suffered from severe regional weather extremes in recent years, such as the heat wave in the United States in 2011 or the one in Russia 2010 coinciding with the unprecedented Pakistan flood. Behind these devastating individual events there is a common physical cause, propose scientists of the Potsdam Institute for Climate Impact Research (PIK). The study suggests that man-made climate change repeatedly disturbs the patterns of atmospheric flow around the globe's Northern hemisphere through a subtle resonance mechanism. Weather extremes provoked by trapping of giant waves in the atmosphereMeridional windfield over four different timespans.“An important part of the global air motion in the mid-latitudes of the Earth normally takes the form of waves wandering around the planet, oscillating between the tropical and the Arctic regions. So when they swing up, these waves suck warm air from the tropics to Europe, Russia, or the US, and when they swing down, they do the same thing with cold air from the Arctic,” explains lead author Vladimir Petoukhov.“What we found is that during several recent extreme weather events these planetary waves almost freeze in their tracks for weeks. So instead of bringing in cool air after having brought warm air in before, the heat just stays. In fact, we observe a strong amplification of the usually weak, slowly moving component of these waves,” says Petoukhov. Time is critical here: two or three days of 30 degrees Celsius are no problem, but twenty or more days lead to extreme heat stress. Since many ecosystems and cities are not adapted to this, prolonged hot periods can result in a high death toll, forest fires, and dramatic harvest losses.Anomalous surface temperatures are disturbing the air flowsClimate change caused by greenhouse-gas emissions from fossil-fuel burning does not mean uniform global warming – in the Arctic, the relative increase of temperatures, amplified by the loss of snow and ice, is higher than on average. This in turn reduces the temperature difference between the Arctic and, for example, Europe, yet temperature differences are a main driver of air flow. Additionally, continents generally warm and cool more readily than the oceans. “These two factors are crucial for the mechanism we detected,” says Petoukhov. “They result in an unnatural pattern of the mid-latitude air flow, so that for extended periods the slow synoptic					Thank you for the comments. While the details of this work are beyond the scope of the NCA, you will find improved discussion of these topics in the Climate Science chapter and the appendices.

		waves get trapped."The authors of the study developed equations that describe the wave motions in the extra-tropical atmosphere and show under what conditions those waves can grind to a halt and get amplified. They tested their assumptions using standard daily weather data from the US National Centers for Environmental Prediction (NCEP). During recent periods in which several major weather extremes occurred, the trapping and strong amplification of particular waves – like "wave seven" (which has seven troughs and crests spanning the globe) – was indeed observed. The data show an increase in the occurrence of these specific atmospheric patterns, which is statistically significant at the 90 percent confidence level.The probability of extremes increases – but other factors come in as well"Our dynamical analysis helps to explain the increasing number of novel weather extremes. It complements previous research that already linked such phenomena to climate change, but did not yet identify a mechanism behind it," says Hans Joachim Schellnhuber, director of PIK and co-author of the study. "This is quite a breakthrough, even though things are not at all simple – the suggested physical process increases the probability of weather extremes, but additional factors certainly play a role as well, including natural variability." Also, the 32-year period studied in the project provides a good indication of the mechanism involved, yet is too short for definite conclusions.Nevertheless, the study significantly advances the understanding of the relation between weather extremes and man-made climate change. Scientists were surprised by how far outside past experience some of the recent extremes have been. The new data show that the emergence of extraordinary weather is not just a linear response to the mean warming trend, and the proposed mechanism could explain that.Article: Petoukhov, V., Rahmstorf, S., Petri, S., Schellnhuber, H. J. (2013): Quasi-resonant amplification of planetary waves and recent Northern Hemisphere weather extremes. Proceedings of the National Academy of Sciences (Early Edition) [doi:10.1073/pnas.1222000110]					
John	Nielsen-Gammon	The figure and caption emphasize the general principle that wet get wetter and dry get drier. But Scheff and Frierson (GRL, 2012) found with CMIP5 that the general principle was that the poles get wetter and the subtropical dry regions expand poleward, with little change in the dryness within the already dry regions overall.	2. Our Changing Climate	2.5	34		The figure title has been revised to incorporate this suggestion. The "wet get wetter, dry get drier" statement is only a general statement with many differences in the details.While we agree the high latitudes get wetter, the subtropics most certainly get drier in the CMIP5 model projections used in the figure.
Rhonda	Hunter	In reviewing this chapter, from my professional background in 25 years of state work as an environmental education manager and public involvement coordinator, I find a big piece missing. Please add components that engage the PUBLIC, not just scientists and decision-makers. We need public support to push changes in climate policy and action and too many people are still not informed or engaged in this democracy. Certainly more are experiencing climate disruption in extreme weather, droughts, fires and more which affect U.S. people of all political persuasions, creeds and races so they are becoming more willing to engage. Climate change is a huge threat and we urgently need to increase our speed to deal with slowing it down, as you know. Thank you for your clear draft and compelling explanations, which I hope are not politically watered down or diluted! But what is missing is the means to garner PUBLIC support for policy actions to show climate change. Washington State has an excellent example to follow in the Dept. of Ecology report Preparing for a Changing Climate, Ch. 12. Although this is focused on adaptation & preparation, it also references mitigation to slow climate change and earlier work in public engagement done in that arena. It was created by 8 state agencies, Univ. of Washington & NWF, plus numerous advisory groups. Although this is a state document, it could be applied to the federal efforts on a broader scale. Many of the 13 federal agencies on this advisory committee have departments and resources to conduct and collaborate on this kind of	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				We have made discussion of the role of the public and stakeholders more explicit in the chapter.

		communication and outreach to the public. And nationally there are others who work with you also. You can find the report at http://www.ecy.wa.gov/climatechange/ipa_responsestrategy.htm and the Ch 12 section at https://fortress.wa.gov/ecy/publications/publications/1201004o.pdf . If your system will allow, I have cut & pasted excerpts below: Without an informed public conversation, the adaptation strategies and actions will lack the support they need for effective implementation. Building support to reduce climate risks is proving to be difficult as policymakers, local communities, and the public are currently challenged with urgent issues such as the economy and jobs. The risks that climate change will result in more frequent and severe floods, wildfires, droughts, and other extreme events make it necessary for policymakers and scientists to step up efforts to increase public awareness and build grassroots action.Climate change is creating a new and dynamic decision environment. Citizens, governments, and businesses need an accurate understanding of the problem and its causes, the likelihood and severity of the impacts, how the risks may affect them personally and collectively, and the costs and benefits of taking action. Communication, education, and outreach are powerful tools that government agencies, private organizations, and nonprofits can use to dispel misconceptions and to bring climate impacts and hazards to the attention of the public.Strategy I-1. Create coordinated and cohesive communication messages and tools on climate change impacts and adaptation, and ensure they are effectively distributed to a wide variety of people and professionals across all levels of government and the public.Actions: 1. Continue to leverage partnerships between state agencies and research organizations to develop clear and consistent messaging on climate change impacts and adaptation. The messages must connect to other priority issues and resonate with people's core values, such as health, safety, and the economy. 2. Develop targeted climate change risk communication training for use communication staff within by state agencies and other entities. 3. Conduct targeted outreach to state and local elected officials, leaders, and staff to share information and outreach materials, improve the understanding of risks, and inform decision-making. 4. Develop communication materials focused on vulnerable communities that are at high risk and have a low capacity to respond, paying particular attention to low-income and underserved populations. 5. Develop risk maps and decision-support tools to identify climate change risks for specific geographic areas throughout the state. 6. Support additional research to identify how people perceive climate risks, what messages resonate with people, and how people learn and respond to information about climate change.Strategy I-2. Leverage existing education and outreach networks and integrate communication about climate change.Actions: 1. Build on existing networks and integrate climate change into current state agency education and outreach efforts related to public health, land use, ecosystems, water resources, coastal management, agriculture, forests, and infrastructure. 2. Use a variety of channels to communicate about climate change, such as: ▪▪ Web sites, agency listservs, newsletters, and news releases.					

		▪▪ Social media, including Facebook, Twitter, and video clips. ▪▪ Meetings of climate educators and climate communicators group. ▪▪ Presentations at public events. ▪▪ Publications including Frequently Asked Questions (FAQs). 3. Promote effective integration of climate change education into K-12 educational programs and school curricula. 4. Bolster the network for climate educators, such as hosting peer-to-peer networking events and summits to share and exchange information, experiences, and best practices. 5. Encourage universities and community colleges to integrate climate considerations into vocational and educational training programs. For example, provide training for engineering students to incorporate more frequent and severe weather, flooding, sea level rise, or other climate impacts into design. 6. Build on the existing climate education website hosted by state agencies to provide information on existing tools, materials, and best practices in teaching and learning about climate change. 7. Partner with extension programs to incorporate climate information into community outreach efforts and programs. Build on successful models such as the Washington State University Extension's Carbon Masters program, the Master Gardeners program, and others.168 8. Provide peer-to-peer professional training opportunities and encourage sharing of information among levels of government, nongovernmental organizations, and professional associations.Strategy I-3. Engage the public in climate change conversations and solutions for addressing impacts.Actions: 1. Develop a framework for citizen engagement and action, modeled after the framework developed in 2007 as part of the Governor's climate change challenge.169 2. Develop compelling, visual stories and social media to connect climate change impacts to concerns people already have, convey the benefits of addressing climate change, and demonstrate how actions currently underway can address impacts of climate change. 3. Partner with scientists, community leaders, and organizations credible to target audiences and those affected directly by the impacts of climate change when delivering messages on climate change to citizens. 4. Engage the news media and provide information to help citizens make informed choices. 5. Develop "citizen science" initiatives that engage the public in making observations and collecting and recording data on climate change and its effects on communities and the environment. Build on successful initiatives, such as the Washington King Tides Photo Initiative,170 Washington Sea Grant citizen science initiatives,171 National Phenology Network, and Audubon's Christmas Bird Count.					

		6. Improve Ecology's climate change clearinghouse to make the information more accessible and easier to understand. Build off successful models in other states, such as the Cal-Adapt website 172 and link to existing tools, case studies, projects, and portals, such as the Climate Adaptation Knowledge Exchange (CAKE) and the Georgetown Climate Center's Adaptation Clearinghouse.173Please feel free to contact me if you have questions or if I can provide more information or access to other professionals who might help. Rhonda Hunter					
Lauren	Baum	The NCA should take note of a federal report released by the U.S. Dep't of Agriculture that finds that wildfires in the U.S. will be at least twice as destructive by 2050, burning around 20 million acres nationwide each year.LINK: http://www.usda.gov/oce/climate_change/effects_2012/FS_Climate1114%20opt.pdf	7. Forestry				That report is summarized in Vose et al 2012, which we do reference.
Shaye	Wolf	(1) The Assessment should put more emphasis on the point that Arctic sea ice is melting much faster than even the newer climate models predict, and should re-iterate this point in the caption of Figure 2.29. (2) The studies cited by the Assessment (Stroeve et al. 2012, Wang and Overland 2009) along with Lindsay et al. (2009) and Zhang (2010) project that Arctic summer sea ice will likely disappear in the 2030s, and the Assessment should clarify this point instead of using the longer and more vague time horizon "before mid-century." In the Ocean and Marine Resources section on page 836, the text states: "Models that best match historical trends 38 project seasonally ice-free northern waters by the 2030s (Stroeve et al. 2007; Stroeve et al. 2012; 39 Wang and Overland 2012)"—which as discussed above, is consistent with the scientific literature.Lindsay, R. W., L. J. Zhang, A. Schweiger, M. Steele, and H. Stern. 2009. Arctic sea ice retreat in 2007 follows thinning trend. Journal of Climate 22:165-176. Zhang, X. D., and J. E. Walsh. 2006. Toward a seasonally ice-covered Arctic Ocean: Scenarios from the IPCC AR4 model simulations. Journal of Climate 19:1730-1747.(3) The Assessment should discuss the rapid decrease in sea ice thickness which makes it less stable and more vulnerable to further melting (Giles et al. 2008, Kwok et al. 2009, Kwok and Rothrock 2009, Maslanik et al. 2011). For example, Kwok and Rothrock (2009) found that the average Arctic-wide ice thickness at the end of the melt season declined by more than half (53%) between 1958-1976 and 2003-2007. Giles, K. A., S. W. Laxon, and A. L. Ridout. 2008. Circumpolar thinning of Arctic sea ice following the 2007 record ice extent minimum. Geophysical Research Letters 35, L22502, doi:10.1029/2008GL035710. Kwok, R., G. F. Cunningham, M. Wensnahan, I. Rigor, H. J. Zwally, and D. Yi. 2009. Thinning and volume loss of the Arctic sea ice cover: 2003-2008. Journal of Geophysical Research 114, C07005, doi:10.1029/2009JC005312. Kwok, R., and D. A. Rothrock. 2009. Decline in Arctic sea ice thickness from submarine and ICESat records: 1958-2008. Geophysical Research Letters 36:L15501, doi:15510.11029/12009GL039035. Maslanik, J., J. Strove, C. Fowler, and W. Emery. 2011. Distribution and trends in Arctic sea ice age through spring 2011. Geophysical Research Letters 38, L13502, doi:10.1029/2011GL047735.(4) Sea ice loss linked to destabilization in jet stream The Assessment should include new research indicating that Arctic warming and the loss of sea ice are linked to the increased frequency of extreme weather events, including droughts, floods, heat waves, and cold spells, in the United States and other mid-latitude regions of the Northern Hemisphere due to disruption of the jet stream (Francis and Vavrus 2012).Francis, J.A. and S.J. Vavrus. 2012. Evidence linking Arctic amplification to extreme weather in mid-latitudes. Geophysical Research Letters 39:	2. Our Changing Climate		66	14	The first three numbered comments have been incorporated into the revised text on p. 67-68. Figure 2.29's caption has been modified as suggested. The projections of summer ice loss by the 2030s have been noted (with references to Wang and Overland (2012) and Stroeve et al. (2012); we also now note that extrapolation of the observed rate of ice loss gives an even earlier ice-free Arctic. The loss of ice thickness and volume is now stated, with references to Kwok and Rothrock (2009) and Maskanik et al. (2011). Regarding comment (4), we already cite the Francis and Vavris' (2012) proposed linkage between sea ice and extreme weather, but that study has been called into question by a recently published paper (Screen and Simmonds, 2013), as noted by the following review comment -- who urges equal time for the counterpoint to Francis and Vavrus.

		L06801.					
Christopher	Lindsay	Add the "International Association of Plumbing and Mechanical Officials" to the list of example organizations providing policy, legal and institutional support. It is important for policymakers to keep in mind that effective adaptive strategy includes the adoption of more efficient codes and standards. Quite often, this is the area where conservation research findings become codified and implemented.	28. Adaptation	28.4	994		The list provided is not meant to be comprehensive, meaning that not all organizations could be included. A thorough screening process was conducted to select the examples currently in the text. As such, no change was made.
Justin	Augustine	The Forestry section discusses the potential for increased fire. It important to keep in mind as well the extreme fire deficit in many regions of the West (see, e.g., Stephens et al. 2007, Miller et al 2012, Williams and Baker 2012), and that increased fire is critical in such areas in order to provide habitat for wildlife that relies on post-fire habitat, especially habitat created by stand-replacing fire (see, e.g., Hutto 1995, Hanson and North 2008, Hutto 2008, Bond et al. 2009, Malison and Baxter 2010, Swanson et al. 2010, Bond et al. 2012, Buchalski et al. 2013). This chapter, in order to be balanced, should acknowledge and explain the importance of stand-replacing fire and should note the fire deficit that exists.Literature Cited Bond, M. L., D. E. Lee, R. B. Siegel, & J. P. Ward, Jr. 2009. Habitat use and selection by California Spotted Owls in a postfire landscape. Journal of Wildlife Management 73: 1116-1124.Bond, M.L., R.B. Siegel, and D.L. Craig. 2012. A conservation strategy for the Blackbacked Woodpecker (Picoides arcticus) in California—Version 1.0. U.S. Forest Service, Pacific Southwest Region, Vallejo, CA.Buchalski, M.R., J.B. Fontaine, P.A. Heady III, J.P. Hayes, and W.F. Frick. 2013. Bat response to differing fire severity in mixed-conifer forest, California, USA. PLOS ONE 8: e57884.Hanson, C. T. and M. P. North. 2008. Postfire woodpecker foraging in salvage-logged and unlogged forests of the Sierra Nevada. Condor 110: 777–782.Hutto, R. L. 1995. Composition of bird communities following stand-replacement fires in Northern Rocky Mountain (U.S.A.) conifer forests. Conservation Biology 9:1041–1058.Hutto, R. L. 2008. The ecological importance of severe wildfires: Some like it hot. Ecological Applications 18:1827–1834.Malison, R.L., and C.V. Baxter. 2010. The fire pulse: wildfire stimulates flux of aquatic prey to terrestrial habitats driving increases in riparian consumers. Canadian Journal of Fisheries and Aquatic Sciences 67: 570-579. Miller, J.D., B.M. Collins, J.A. Lutz, S.L. Stephens, J.W. van Wagtendonk, and D.A. Yasuda. 2012. Differences in wildfires among ecoregions and land management agencies in the Sierra Nevada region, California, USA. Ecosphere 3: Article 80.Stephens, S.L., R.E. Martin, and N.E. Clinton. 2007. Prehistoric fire area and emissions from California's forests, woodlands, shrublands, and grasslands. Forest Ecology and Management 251:205–216.Swanson, M.E., J.F. Franklin, R.L. Beschta, C.M. Crisafulli, D.A. DellaSala, R.L. Hutto, D. Lindenmayer, and F.J. Swanson. 2010. The forgotten stage of forest succession: early-successional ecosystems on forest sites. Frontiers Ecology & Environment; doi:10.1890/090157.Williams, M.A., W.L. Baker. 2012. Spatially extensive reconstructions show variable-severity fire and heterogeneous structure in historical western United States dry forests. Global Ecology and Biogeography. DOI: 10.1111/j.1466-8238.2011.00750.	7. Forestry				We have modified the text to mention that these impacts are compounded by a legacy of fire suppression, in that many U.S. forests have become increasingly dense due to past efforts to suppress fire (Covington et al. 1997, Swetnam and Baisan 2003, Rhodes et al. 2008, Swanson et al. 2010). We have added one of the references, but space limitations preclude adding them all.
Marilyn	McNabb	The Mitigation Section is an important addition and I believe brings the National Climate Assessment closer to its legislative mandate. In the future, perhaps this section could address the effects and efficacy of various strategies to reduce greenhouse gas pollution to levels necessary to stabilize climate. Of course, there would be large uncertainties, starting with the question of the point of instability, but if we are to make progress, we need goals, at both the local and national level.For example, our publicly-owned electric company in Lincoln, Nebraska relies on coal as the fuel for 80% of our generation. How quickly should be we moving to other fuels and investment in energy efficiency in order to protect climate stability? Privately-owned electric utilities and their regulatory bodies could also benefit from this information, even if the bands of uncertainty are very large.Another example is at the national level: a remedy of "fee and dividend" has been proposed by the Citizens Climate Lobby	27. Mitigation				Discussion of mitigation measures, including fee and dividend, has been strengthed in the chapter. However, discussion of the U.S. role in an international climate regime with a particular atmospheric or temperature target is beyond the scope of the chapter given space constraints.

		(specifics available at citizensclimatelobby.org). It would tax green house gas emissions and distribute the funds through the Internal Revenue System to adult U.S. citizens in equal amounts. It would also put in place a set of border adjustments so that incoming products or fuels would be taxed at the same levels as U.S. enterprises, and U.S. exports would be refunded their carbon payments. There needs to be assessment of the costs of different levels of a carbon tax on Americans' electric rates, gas station expenses, etc. Also to be examined would be the question of whether distribution of the funds collected would adequately compensate people for the higher prices that would result when such a tax is passed on to consumers. In addition, the broader effects such a fee and dividend system might have on the economy might be examined. The costs of administration should be assessed. While these and related questions about international trade etc. may be difficult to quantify and call on the dismal science of economics rather than the disciplines engaged in this work so far, it seems to me it would be a great service to the country, in line with the original national assessment mandate, to undertake this analysis. We need to know what kinds of mitigation--local and national, limited and broad--are likely to be effective in stabilizing climate. Marilyn McNabb					
Aditi	Mishra	This Table does a great job overall of proposing adaptation strategies for the various threats to energy infrastructure mentioned in the chapter. It's easy to follow and understand. The fact that all threats are included on the same table is good because organizations can see whether they want to focus an adaptation strategy on one threat of many simultaneously.Some things that could have made the Table more thorough would be information about estimated cost of each strategy, and how effective each strategy would be with respect to a certain infrastructure threat. There have to be certain strategies mentioned in the Table that are more effective than others, but this can't be seen with the current format of the table. There's also no evaluation of the lifetime of each strategy and how long it would take before it would have to be replaced, renewed or maintained. Also, what would be some of the ways in which these adaptation efforts could be incentivized? How do we get businesses and government to adopt them? Should the government regulate them, or should we wait for the market to naturally adopt them, even if that takes a longer time? With respect to "no regrets" strategies, why haven't they been adopted already of they have short-term paybacks? Some accompanying discussion about whether the effort has to be undertaken on the governmental or private level would be nice.	4. Energy Supply and Use	4.2	178		Thank you for the accolade. As discussed throughout this chapter, energy supply and use decisions are primarily made on a local basis based on numerous factors. It is not possible to estimate the value of or provide implementation information on the range of adaptation actions in this chapter due to page length constraints.
Jeff	Weitz	To: National Climate Assessment Editors and Writers From: Jeff Weitz, Science Teacher, Horace Mann School, 231 West 246th Street, Bronx, NY 10471I am very grateful for your work. My Selected Topics in Physics Class has been discussing Energy and Climate, and your document has provided an excellent finale for our discussions. The class has been greatly reduced in size by a senior project option, and so I have but seven student reviews to offer for your consideration.My students bring varying writing ability to this task, and I haven't edited their papers. You are hearing them in their own voices. I can tell you that they have in common great energy and passion for living, and concern for the world they will inherit. My students are very sensitive to media and communications, and they know how they would like to be reached. Several of the students have made suggestions about social media. They all have agreed in discussion that they would like to see more graphics in the document, and one student urges that you include video clips, a suggestion that brought nods all around. I can attest to the power of video in communicating with teenagers.I did emphasize that a climate assessment would not include much in the way of mitigation and adaptation policy, but many of my students made suggestions in these areas anyway. I see this as the impatience of youth. They see a problem and they want it fixed. My students don't have much patience for political niceties.It may be that when you set up outreach using social networking, as you said you would at the AAAS convention, that you incorporate a section in which students can recommend and discuss mitigation and adaptation approaches. I believe teens would appreciate this opportunity and I can say	1. Executive Summary				Thank you very much for the comments from your class. It is inspiring to hear such thoughtful suggestions. It is the intent of the NCA authors and the government agencies to make this report available in more accessible ways through social media and searchable web-based formats.

		as a teacher that I would encourage my students next year to participate.Again, thank you so much for your efforts. Please do not underestimate the value of your work to high school teachers looking for responsibile discussions of climate.jwDana Bolster (dana_bolster@horacemann.org) has reviewed chapter six. She suggests: Include information about farming techniques to mitigate and adapt to climate change. Say more about food access in an era of climate change. Nicholas Burko (nicholas_burko@horacemann.org) has reviewed chapter ten. He suggests: Emphasize the interdependence of air, water and land resources. Portray the potential of wind turbines and solar collectors in a more positive light. Use social media extensively to build awareness of the NCA among teens.Cynthia Irobunda (cynthia_irobunda@horacemann.org) has reviewed chapter eleven. She suggests: Give a few examples of elements of infrastructure affected by climate change. Specify the nature of urban vulnerability to climate change and, in particular, highlight social vulnerability. Highlight the relationship between elements of our infrastructure and the economy. Increase accessibility to young people through the use of social networking.Yuhna Lee (Yuhna_Lee@horacemann.org) is a city dweller who was initially resistant to reviewing chapter seven, on forestry. She has discovered the relevence of this study to her own life, and suggests: Emphasize early on the role of forests as a carbon sink. Suggesting approaches to balance environmental, energy and economic needs (the 3 e's). Emphasize the potential of corn ethanol. Consider the balance between regulatory approaches and individual responsibility.Diana Li (diana_li@horacemann.org) has reviewed chapter five. She suggests: Include a focus on a very long-term view and incorporate examples of how creative approaches to transportation might mitigate or adapt to climate change. More emphasis on more efficient fuel consumption and the roles of alternative fuels in the transportation sector.Alexa Meltzer (alexa_meltzer@horacemann.org) has reviewed chapter two. She suggests: Specify in chapter two at least a few examples of human activities that contribute to climate change. These changes could be further articulated later in the report. Highlight additional development in Appendix II. Although much of the information in Chapter 2 is					

		further developed in Appendix II, there is only one mention of Appendix II. Increase accessibility. Young people especially respond to multimedia presentations. Perhaps film clips could be integrated into the document.Philip Perl (Philip_Perl@horacemann.org) has reviewed chapter nine. He suggests: Include suggestions for mitigation and adaptation to climate change to protect human health. Recommend alternatives in urban settings, such as encouraging bicycle use. Recommend planting of low-pollen plants in urban areas. Emphasize the need for strategies to reduce the impact of excessive heat on urban areas, particularly on the elderly.					
Lauren	Baum	The NCA should take note of a recent study that used state-of-the-art climate models and found what the authors call "some of the clearest evidence to date of a discernible [human] influence on atmospheric temperature." Abstract: We perform a multimodel detection and attribution study with climate model simulation output and satellite-based measurements of tropospheric and stratospheric temperature change. We use simulation output from 20 climate models participating in phase 5 of the Coupled Model Intercomparison Project. This multimodel archive provides estimates of the signal pattern in response to combined anthropogenic and natural external forcing (the fingerprint) and the noise of internally generated variability. Using these estimates, we calculate signal-to-noise (S/N) ratios to quantify the strength of thefingerprint in the observations relative to fingerprint strength in natural climate noise. For changes in lower stratospheric temperature between 1979 and 2011, S/N ratios vary from 26 to 36,depending on the choice of observational dataset. In the lower troposphere, thefingerprint strength in observations is smaller, but S/N ratios are still significant at the 1% level or better, and range from three to eight. We find no evidence that these ratios are spuriously inflated by model variability errors. After removing all global mean signals, model fingerprints remain identifiable in 70% of the tests involving tropospheric temperature changes. Despite such agreement in the large-scale features of model and observed geographical patterns of atmospheric temperature change, most models do not replicate the size of the observed changes. On average, the models analyzed underestimate the observed cooling of the lower stratosphere and overestimate the warming of the troposphere. Although the precise causes of such differences are unclear, model biases in lower stratospheric temperature trends are likely to be reduced by more realistic treatment of stratospheric ozone depletion and volcanic aerosol forcing.CITATION: Santer, B. et al. (2012). Identifying human influences on atmospheric temperature. PNAS. Link: http://www.pnas.org/content/early/2012/11/28/1210514109.full.pdf+html?with-ds=yes	2. Our Changing Climate				The discussion on attribution has been expanded in the chapter, including the addition of the Santer et al. reference.
John	Nielsen-Gammon	Sheffield et al. 2012 and Hoerling et al. 2012 have convincingly demonstrated that the standard PDSI is inappropriate as a measure of future drought severity because of its parameterization of evaporation based on temperature alone. This figure is therefore incorrect and should be deleted.	2. Our Changing Climate	2.21	57		Note that this figure using PDSI has been moved the appendix and a detailed discussion of the limitations of this drought index added. The new discussion about drought in chapter 2 focuses on soil moisture projections in the western US (a similar calculation for the entire country being yet unavailable) and Consecutive Dry Days. Both of these measure suggest

							increased drought risk for much of the US. To rule out PDSI as another drought indicator is an overreaction to the Hoerling et al study.
Cynthia	Finley	This chapter should include a discussion of how federal regulations that are meant to be environmentally protective can create additional greenhouse gas emissions. Wastewater utilities experience this with Clean Water Act regulations. In some locations, strict nutrient discharge requirements must be met, but the nutrient removal technology available to utilities is energy-intensive and expensive. The net environmental benefits of these requirements should be considered, along with alternate methods for reducing nutrients in water bodies.Green infrastructure may also be an effective method for improving water quality in some locations, with the added benefits of improving greenhouse gas mitigation and community aesthetics. However, some communities have faced opposition from federal officials to reopening their consent decrees dealing with combined sewer overflows. Municipalities must have appropriate flexibility to use green infrastructure and receive appropriate credit for it in the combined sewer overflow and stormwater control programs.	27. Mitigation				Discussions of interactions with the water sector, though important, are beyond the scope of the chapter given space limitations.
Shaye	Wolf	This summary on ocean acidification is generally well-done.(1) You could provide more scientific support for the statement “Recent analyses show that large areas of the oceans along the U.S. west coast (Gruber et al. 2012), the Bering Sea, and the western Arctic Ocean (Orr et al. 2005) will become difficult for calcifying animals within the next 50 years” by citing additional sources.For the vulnerability of the Bering Sea and Arctic Ocean, the Assessment should cite Fabry et al. (2009). Seasonal aragonite undersaturation is already occurring in the Bering Sea (Fabry et al. 2009, Mathis 2011, Mathis et al. 2011 a,b) and Chukchi Sea (Bates et al. 2009). Arctic surface waters are projected to be persistently undersaturated with respect to aragonite by 2050, and most of the Arctic, including regions of the Bering and Chukchi seas, will be undersaturated with respect to calcite by 2095 (Fabry et al. 2009, Feely et al. 2009) under a higher emissions scenario. Arctic pteropod marine snails, which are important food sources for pollock, herring, and cod, are particularly vulnerable to negative impacts of ocean acidification (Comeau et al. 2009, 2010).Sources: Bates, N. R., J. T. Mathis, and L. W. Cooper. 2009. Ocean acidification and biologically induced seasonality of carbonate mineral saturation states in the western Arctic Ocean. Journal of Geophysical Research 114, C11007, doi:10.1029/2008JC004862.Comeau, S., G. Gorsky, R. Jeffree, J.-L. Teyssié, and J.-P. Gattuso. 2009. Key Arctic pelagic mollusc (Limacina helicina) threatened by ocean acidification. Biogeosciences Discuss. 6:2523-2537.Comeau, S., R. Jeffree, J.-L. Teyssie, J-P. Gattuso. 2010. Response of the Arctic pteropod Limacina helicina to projected future environmental conditions. PLoS One 5: e11362 Fabry, V.J., J.B. McClintock, J.T. Mathis, and J. M. Grebmeier. 2009. Ocean acidification at high latitudes: the bellweather. Oceanography 22:160-171Feely, R. A., S. C. Doney, and S. R. Cooley. 2009. Ocean acidification: present conditions and future changes in a high-CO2 world. Oceanography 22:36-47.Mathis, J.T. 2011: The Extent and Controls on Ocean Acidification in the Western Arctic Ocean and Adjacent Continental Shelf Seas [in Arctic Report Card 2011], http://www.arctic.noaa.gov/reportcard.Mathis, J.T., J.N. Cross, and N.R. Bates. 2011a. Coupling primary production and terrestrial runoff to ocean acidification and carbonate mineral suppression in the eastern Bering Sea. Journal of Geophysical Research. 116, C02030, doi:10.1029/2010JC006453.Mathis, J.T., J.N. Cross, and N.R. Bates. 2011b. The role of ocean acidification in systemic carbonate mineral suppression in the Bering Sea. Geophysical Research Letters 38, L19602, doi:10.1029/2011GL048884. (2) This section could also point out that ocean acidification is	2. Our Changing Climate		69	15	These are all great references but they don’t fundamentally alter the basic message. Given space limitations, we will not alter the text, but thank the reviewer. Note that the style/form of the NCA differs from a traditional scientific review where you would include as many relevant references as possible. On sound, this comment is based on a misunderstanding of a rapidly moving field. Lowering pH due to ocean acidification does indeed lead to a reduction in the in-situ absorption of low-frequency sound in seawater through changes in the acid-base chemistry of boric acid (Brewer and Hester, 2009). This led to speculations that there could be an increase in the acoustic noise environment in the ocean and negative effects on marine mammals (Brewer and Hester, 2009; Ilyina et al., 2010). In-situ sound absorption, however, is only a minor component of the loss or damping mechanisms for low-frequency acoustic signals in the ocean that are dominated by surface and bottom boundary interactions. A series of papers demonstrated that pH changes will have only minimal impact on ocean noise levels at low frequency compared to other environmental and

		increasing sound levels in the ocean. Ocean acidification exacerbates the impacts of ocean noise pollution (Brewer and Hester 2009) which is a growing concern for noise-sensitive marine life since ocean acidification will amplify disturbances from vessel traffic, oil and gas development, and other industrial activities.Brewer, P. G., and K. C. Hester. 2009. Ocean acidification and the increasing transparency of the ocean to low-frequency sound. Oceanography 22:86-93.					human factors (Joseph and Chiu, 2010; Reeder and Chiu, 2010; Udovydchenkov et al., 2010). We did not think it appropriate, therefore, to include this in the chapter given the small impact of pH on the marine acoustic environment and no studies yet showing any impacts on marine mammals.
Jeff	Weitz	This from my student, Alexa Meltzer (alexa_meltzer@horacemann.org)Suggestions for the National Climate Assessment Draft: The National Climate Assessment draft encompasses a wealth of important statistical details and information on the current status of climate change throughout the United States. However, there are certain changes that could be made in order to improve the understanding and reception of their findings. As the entire document is thousands of pages long, I will focus on one specific chapter, chapter two entitled Our Changing Climate. The three primary suggestions I would make are: more specificity regarding the types of human activities that cause climate change, integration of or specific reference to the information presented in Appendix II, and to make the assessment more technologically accessible to younger generations on whom the NCA is relying on to make many of the improvements that they promote. More Specificity to which human activity is contributing to climate change: Throughout chapter two, the NCA refers to a range of climate related problems that have been occurring for over 100 years. Among these issues are temperature increase, increase in precipitation, increase in extreme weather patterns, rise in the sea level, and the length of the frost-free season is also increasing. Throughout the chapter, there is constant reference to all these changes occurring because of human-induced activity, however, the NCA fails to make clear what these activities are and how they can be ameliorated. For example, the first key point states that much of the climate change over the past 50 years is due to human activity, however, as there is a significant range of human activity that exists, it makes it difficult to understand what this really means. Therefore, I would suggest that specific examples of the human activity that are contributing to these changes as well as what we could do to mitigate the damage done by our activities are included in this chapter. The NCA should delineate more clearly what activities are causing the problem and how we can change our behavior. By not delineating these human induced activities, people don't know what to do about this issue and therefore will become apathetic to these climate issues where as by providing people with specific steps to take, they are more likely to make these changes in their behavior, at least on a small level. By telling people what they are doing wrong and how much of an impact that behavior has on our environment, it will make them more likely to make a change. You cannot change if you don't know what you are doing wrong and what you can do to make improvements. Bringing more attention to the Appendix II: Throughout chapter two, there are a number of areas that would benefit from more detail. Though often this detail is included in Appendix II, the NCA only make one reference to the appendix in the very beginnings of the chapter and never refer to it again. This makes it hard to get additional information on a particular area of climate change. It would be more helpful if there were additional information available that the author would refer the reader directly to in a specific part of Appendix II. Additionally, the information from the appendix could be integrated into the document itself; however,	2. Our Changing Climate				We have added additional references to the Appendix throughout the chapter. The assessment will also be online with specific capabilities to go to other more detailed discussion on a given topic that may be found in an Appendix.We also added to the discussion on human related emissions in the chapter itself.

		I understand that there could also be some drawbacks to this idea as well, such as, not keeping the information streamlined and as accessible. Therefore, the best possible solution is to make direct reference to the appendix as the resource is available so that the readers could find more information more efficiently. For example, in chapter two, the authors mention how heat-trapping gases are partially responsible for global climate change. At this point in chapter two, it would be very helpful if they refer the reader to a particular page within Appendix II where the science of greenhouse gases and how it is contributing to climate change is explained. In addition, some of the images in Appendix II such as the one displaying greenhouse gases would be better suited to chapter two. Some people find that seeing an image is more effective than conveying the issue within an entire paragraph. This would also break up the long sections of text, making the document more visually appealing to readers.Accessibility: Accessibility of this document is of paramount importance in its success at making changes on a global scale. This is because people have to be aware of the situation and make changes to keep it from getting worse. Among the people it would be most important to convey the message to are the youth. In its current state, the document is not extremely accessible to younger generations. It is the youth that could make an extremely significant impact in our global climate and therefore the document should be targeted towards their attention. For example, perhaps a video clip could be integrated within the assessment such as the Tragedy of the Commons video. The attention span of younger generations is more about seeing and hearing rather than reading, so any attempt to break apart dense text and make it into pictures, video, or audio would be beneficial in getting the message across to the youth. Instead of just plainly presenting the map images, it might be more interactive to include sliders that show the extent of the climate change over a certain period of time. As you moved to slider to the right, the colors on the map would reflect higher average temperatures throughout the United States. Similar interactive displays could be done with precipitation and extreme weather. The overall accessibility of this document is extremely important in being able to make change on a more global scale.Overall, the National Climate Assessment draft encompasses a plethora of information that is needed in order to take steps to improve our environmental conditions. Three key suggestions of mine include: more specificity regarding the types of human activities that are the cause of climate change, integration of or specific reference to the information presented in Appendix II, and to make the assessment more technologically accessible to younger generations on whom you are relying on to make many of the improvements that are promoted in this draft. Incorporation of some of these suggestions would not only improve the draft from a design perspective but also improve the draft from a marketing perspective, as it would help surface the draft to viewers who might not have had the desire to read it prior to these changes.					
Peter	Saundry	I write on behalf of the National Council for Science and the Environment to provide comments on the Draft Third National Climate Assessment Report.I would like to begin by commending the NCADAC and the many authors for their work in analyzing, synthesizing and integrating a wide range of scientific studies to produce the draft report. Understanding and responding to Climate Change is of critical importance to health, safety and prosperity of the American public; as well as to health and productivity of our Nation’s ecosystems. Those who have contributed to this Assessment have served their Nation and their fellow citizens well.The report effectively surveys the cumulative and growing evidence for the many impacts that climate change is already having on the United States; impacts which will become ever more significant and mostly negative. It clearly shows that while continuing research is needed to understand and predict regional impacts (Chapter 29, Research Goal 1 and 7), there is sufficient evidence to warrant response by the citizens of the United States and their representatives. We agree that such a response requires serious attention to both mitigating the human-drivers of climate change and adapting to those impacts of climate change that are already					Thank you for your comments. Policy considerations are beyong the scope of the NCA, a scientific document with provides the basis for decision making. While the authors attempted to include economic information where possible, for this report, economic information is limited to what could be developed from case studies and reports in particular sectors and regions. The ongoing sustained assessment process developed around this Third NCA report can hopefully

		unavoidable.We are particularly pleased to see the report's focused attention on decision-support. It is critical that the scientific community be as helpful to decision-makers as possible in addressing the challenges that lie ahead. We must strive for a society where environmental decisions by everyone are based on an accurate understanding of the underlying science, and the potential consequences of their action or inaction. Our core recommendation for the final report is that it should strongly emphasize strategies that support the scientific community in providing solutions and constructive options for decisions. This is included within the draft report (Chapter 29 Research Goal 2-5 and Chapter 30, in particular). However, we wish to underscore its importance.There are three elements to this core recommendation which we would like to highlight:1. The research program must be aimed at solutions that:a. address both adaptation and mitigation;b. recognize social and economic aspects as well as physical and life sciences and engineering; and,c. empower actions at all levels of decision-making from the local to the international, public and private.2. The proposed Sustained National Climate Assessment (Chapter 30) represents an excellent vehicle to provide research-based information for use by decisionmakers across the nation, on an ongoing basis, rather than just a quadrennial report. In this regard, a Sustained National Climate Assessment should utilize networks and resources associated with organizations such as the National Council for Science and the Environment, scientific societies, and associations of decisionmakers, to both help produce its products and to link to stakeholders.3. Decision-support should include valuations (costs/benefits) of adaptation and mitigation actions versus inaction. The cost of inaction needs to be recognized in wise decision-making that benefits the America public today and in the future.Thank you for the opportunity to comment on the Assessment. We hope that the final Report will be widely read and influential, and be acted upon in a timely and significant manner.					contribute to an improved assessment of the valuation of climate impacts, mitigation, and adaptation. The Research Agenda and the rest of the chapters have attempted to address impacts and drivers at multiple levels. A more detailed report on the Sustained Assessment process has been developed by the NCADAC separately from this report.
Jeff	Weitz	This from my student Cynthia Irobunda (cynthia_irobunda@horacemann.org)Hello, I am Cynthia Irobunda. I am currently a junior in high school. Recently, my class has been discussing topics such as climate change, energy, complexity and Barry Commoner's idea of the 3 E's (energy, environment, and economy). There was news of the NCADAC creating a climate assessment draft report and we couldn't wait to read through it. I have read the NCA's draft on climate change. There was a substantial amount of information that fit perfectly with the topics we were discussing. I am going to be focusing on one of the chapters in your draft and that is chapter 11. Chapter 11, on urban systems, infrastructure and vulnerability is a very vital chapter. As stated in Chapter 11, 80% of our population lives in cities. I believe this chapter is central because a large number of our population lives in cities and depends on urban infrastructure and systems. I learned a lot from reading this chapter; however, there were some things that can make this draft more complete. There are four key messages that come out of this chapter as stated in the beginning of the Chapter. I have three key recommendations to improve this chapter. In order to get the idea of how important climate change is to everyone, it is necessary to appeal to as many people as possible. My first recommendation is that when you are stating how much of an impact climate change has on infrastructures in urban areas, it is important to give examples as a way to back it up. This will give the argument more depth. My second recommendation is that you should go more into detail about vulnerability because it a huge topic that affects urban areas deeply. This chapter did not give enough examples or vindications to what kinds of vulnerability is present in urban areas; nor did it go in depth about social vulnerability and how that plays a role in urban areas. It was not clear enough of how climate change and climate vulnerability is influenced by a city's social vulnerability. My third recommendation is that this chapter should go more into detail about the nature of how our infrastructures can disrupt our economy. There were not enough elements to that part of the chapter. My fourth recommendation is that in order for a lot of people to read and be aware or educated in this subject of climate change, it is necessary that you make this assessment clear and available to as many people as possible especially the youth.	11. Urban Systems, Infrastructure, and Vulnerability				While we concur with your suggestions, we were extremely constrained by the prescribed length of the chapter we were given and the breadth of the topic that needed to be covered. More detail and explanations would be useful, but there simply wasn't enough space to do this.

		Infrastructure is very indispensable in the way that it is something everyone uses everyday of their life. There is a strain on urban infrastructure seeing that there are about 245 million residents currently living in urban areas in the U.S. and that number is certainly growing. I believe this chapter could have used more examples such as the massive storm Hurricane Sandy that destroyed so many infrastructures in the northeast region. This much destruction disrupted states like New York and it's economy. Because of the lack of infrastructures not holding up, the amount of damage was not what was expected or predicted. This all occurred because states like New York have a lot of old infrastructure and even new infrastructure that was not built to handle storms like Hurricane Sandy which is a huge problem. This all affect New York's economy. The Wall Street Journal reports estimates from the disaster-modeling firm Eqecat Inc. of "$10 billion to $20 billion in losses insured by private companies, plus additional losses insured by the National Flood Insurance Program as well as uninsured losses." This is bringing the total estimated losses to about $30 to $50 billion. This storm isn't the only one that is racking up losses. In 2005 Hurricane Katrina did a lot of damage to New Orleans, Louisiana along with many southern states racking up about over $100 billion in total losses, according to NOAA estimates. I love the idea you presented about how social inequalities that reflect age, ethnicity, gender, income, health, and dis(ability) differences have a huge influence on climate venerability. This key message of this chapter got the shorthand of the draft. You only focused on this key message for about half a page out of the twenty-pages utilized in this chapter. It is a very big topic but there were fundamental aspects of this that were left out of this chapter. Social inequalities such as race, age, and gender play a crucial role in the economic part of urban areas. There is such as thing as environmental racism. Environmental racism is defined the geographic relationships between environmental degradation and low income or minority communities.1 According to dosomething.org people of color make up the greater part of those occupying neighborhoods located within 1.8 miles of the U.S.'s hazardous waste facilities. In addition, African Americans are 79% more likely than whites to live in neighborhoods where industrial pollution is suspected of causing great health dangers. A study by the Commission for Racial Justice that three of the five largest waste facilities dealing with hazardous materials in the Unites States are located in poor black communities.2 The same study also found that three out of every five African American and Latinos live in areas near toxic wastes as well as areas where the levels of poverty are well above the national average. Social inequalities like environmental racism, that has a lot to do with the socio-economic inequality, are good examples of how that can affect climate vulnerability. Things such as environmental racism are testimony to how urban areas are no homogenous when it comes to their social structure. The lack of a homogenous social structure causes these social inequalities to have a hug impact on a cities capacity for their residents to prepare for events. It is fair to say that because of these inequalities a mass of people who live in urban areas would not be prepared incase of an event. Climate change has been increasing over the years and with a city not able to prepare its residents for events is unacceptable. Barry Commoner stated "everything is connected to everything." It is understandable that this draft is the national climate assessment, which means it will mainly focus on the environment and energy. However, according to the laws of complexity and Barry Commoners three E's, it is otherwise. The sum really is greater than the part. You cannot strictly focus on one part of the climate change more than the other. Environmental factors do play a great part in climate change, but according to Barry Commoner, you can't have only environment alone because it affects the economy that effect energy. I believe that this chapter could have more parts that have to do with the economy.					
John	Nielsen-Gammo	Hoerling et al. 2012 showed that soil moisture projections are NOT consistent with the simpler PDSI metric, especially with regard to magnitude of changes.	2. Our Changing	2.22	58		These projections are based on the state-of-the-art VIC hydrologic model,

	n		Climate				which is unrelated to the PDSI. We believe that this model provides realistic estimates of soil moisture change for the specified climate scenarios. No change made.
Lauren	Baum	The NCA should take note a study that finds that the rate of sea-level rise of the past few decades is greater than projected by the IPCC models.Link: http://iopscience.iop.org/1748-9326/7/4/044035/article	2. Our Changing Climate				It has already been noted that climate models underpredict rates of sea level rise, however, a reference to this paper has been added.
Jeff	Weitz	This from my student Yuhna Lee (yuhna_lee@horacemann.org)Hello, my name is Yuhna Lee. I am currently a 12th grader at Horace Mann School in Riverdale, New York and am currently enrolled in class called Topics in Physics, a science elective. In our class, we have discussed many different ideas and topics over the course of the year such as complexity, thermodynamics, hurricanes, energy, the Tragedy of the Common, risks and stakes, the 3e's (energy, economy, and environment), ultimately leading to our current discussion of climate and the growing concerns of the effects of global warming on our climate. This has led our class to read chapters from the Draft of the National Climate Assessment that was recently published. I read chapter 7, forestry, in the Draft. The evidence supplied in this chapter makes it clear that global warming is causing the decline of tree health and increasing tree mortality. It also emphasizes the crucial role of trees in our environment as a carbon sink. Although chapter 7 provides a strong argument, this argument will become stronger if information on tools to fix tree mortalities, the discussion of the 3 e's in carbon uptake, the benefits corn ethanol can provide, and requirements in management choices are mentioned. The first key message, Increasing Forest Disturbances, poses the issue of tree moralities. It specifically talks about tree mortality and its relationship with insect infestations, drought, pollution, fires, and droughts. While it is clear that tree morality is a serious issue, a point made later in the section should also be mentioned earlier in the first key message. The issue of trees being a carbon sink needs to be emphasized in the beginning of the message. With increasing tree morality, our carbon sink, the trees, will disappear which will only accelerate global warming and heighten its effects on our environment. It is assumed that with the mortality of trees, trees as a carbon sink will become smaller. Therefore, less carbon dioxide will be absorbed by trees, which would ultimately result in more carbon dioxide. If this point is emphasized in the beginning, the issue of tree mortality may seem more prevalent to our current situation in the environment. Also, it is clear that humans are indirectly causing a significant amount of mortalities in trees such as pollution and the rising temperatures, which is often correlated with global warming and therefore our consumption of carbon dioxide. But, there is no mention of ways to stop tree mortality or to at least prolong a tree's life. Although we cannot control the weather, what we can do is to provide trees with fertilizers, pesticides to possibly protect trees from insect outbreaks, and other tools to prolong the tree's life. We can possibly alleviate the situation, but it is not even mentioned if using such tools will be advantageous to trees and therefore ultimately to our environment. I think this information should be included to allow people to not just know of the dire situation with tree mortality, but ways that they too can help. While posing the issue of our reducing carbon sink, tree mortality, and the ways we can counteract these events, the problem at hand may be better understood by people. The second key message, Changing Carbon Uptake, talks about the issue of our shrinking carbon sink, our forests. Knowing that 13% of all carbon dioxide emitted by fossil fuel burning in the U.S alone is a shocking statistic considering that tree mortality is only increasing as mentioned earlier in the chapter.	7. Forestry				We are impressed with the understanding and fine attention to detail demonstrated in this comment. The reviewer's comments would seem to take this chapter in an entirely different direction, however, thus no change was made.

		The point is made clear that our trees must be taken care of and this information is briefly mentioned later in the message. But, towards the middle of the message economic factors are mentioned in one sentence. This should be emphasized while many may think that we can just stop killing our trees and use fertilizers to take care of them; the solution is not as easy as it seems. The link between the 3e's (economy, environment, and energy) is complicated especially in this situation. Because while one solution may benefit the environment, it may not benefit the economy or energy use. The solution seems simple: do not cut down trees. But, if we simply do not cut trees, many businesses may fail. In addition, the construction of buildings, roads will all halt also causing the loss of jobs, which in our current economy is not a friendly option. The complicated relationship between environment, energy, and the economy needs to be emphasized as there will probably have to compromise in the near future in order to better our environment. In the third key message, Bioenergy Potential, discusses bioenergy as a new market for wood. Here the economy is mentioned. According to the NCA, the economic effects of bioenergy depend on regional context and circumstances. However, according to the U.S department of energy, corn ethanol, a form of bioenergy, is better than fossil fuels and results in lower greenhouse gases. Also, because corn can be grown domestically, there would be no need to import corn. Therefore, using corn ethanol would be cheaper than consuming fossil fuels. The usage of specifically corn ethanol I believe would validate the point in the potential of bioenergy. Just from not importing fossil fuels, corn ethanol would make the cost of energy cheaper. This is an aspect that affects a huge majority of our nation. People may be more proactive in advocating for bioenergy if they knew that corn ethanol would be cheaper and cleaner. In addition, fossil fuels are limited and we will eventually run out of fossil fuels to burn. But, since corn is grown, we can always have a reliable source of energy. The issue regarding not having fossil fuels is a heated topic as we are not entirely certain how long we will be able to be dependent on fossil fuels. Because the consumption of fossil fuel is related to rising temperatures, this aspect should be included in the National Climate Assessment. Corn ethanol also releases less carbon dioxide than fossil fuels, which clearly makes it a more appealing source of energy. What also should be mentioned is the construction of bio fineries. Because bioenergy is a new, emerging market, it will support economic growth and provide jobs. But, although its intention is to help the environment and the economy, the construction and management of these bio fineries may do the opposite of its intention and harm the environment. However, this would be a risk that our nation needs to consider when increasing the consumption of corn ethanol. By mentioning the benefits of corn ethanol and the economic benefits as a nation, the potential for bioenergy as a reliable, stable energy source will be validated. The last key message of this chapter discusses the influences on management choices. Private owners own 56% of U.S forestlands. Corporate owners (18%) may not have forest management as a primary objective. Here regulatory requirements are mentioned, but what's important to include is what those regulatory requirements may be and to what extent they would affect how private owners can manage their land. Because the land is private, the owners do have a right to do what they want with their land. It is obvious that with regulates requirements; some private owners will be against new regulations. There is also the possibility that owners may be able to get around the requirement and will not be penalized. The message should talk in more detail about what management choices may and may not be affected by private owners. Private owners do own the majority of the land in the U.S; therefore, what they do with their land can greatly affect the environment. Chapter 7 in the Draft of the National Climate Assessment provides statements discussing forestry and the climate. The discussion of tree mortality, carbon uptake, bioenergy, and influences on management					

		choices provide a strong argument in raising awareness in our trees. As global warming only heightens our current situation in the environment, it is imperative that we as a nation to make a change quickly. Because global warming pertains to countries all over the world, the U.S must work with other countries to save our planet. However, this draft, the media, and other tools may help influence everyday people in this world to make a change.					
Lauren	Baum	The NCA should take note of a recent report published by MunichRe that examined natural disaster losses between 1980 and 2011, finding that weather-related loss events in North America "nearly quintupled" during the period, compared to just an increase factor of two in Europe, for example.Link: http://www.munichre.com/en/media_relations/press_releases/2012/2012_10_17_press_release.aspx	2. Our Changing Climate				The author team has seen the suggested report, deliberated, and decided not to include the citation. Separating out the societal factors from climate factors in loss data is quite challenging and an area of continuing research. A recent paper in BAMS (Kunkel et al. 2013) addresses many of the data challenges identifying changes in extreme storms. We have added some text to Key message #8 to bring up the increase in losses but also identify the above issues in attributing increased losses to climate.
Jeff	Weitz	This from my student Dana Bolster (dana_bolster@horacemann.org)Chapter 6 of the NCA Climate Change Draft Report, Agriculture, is very in-depth about the effect of climate change on crops, livestock, soil, water, insects and weeds. However, it lacks information on farming methods that are being used to combat and adapt to climate change, as well as information on food access in coming years. SUGGESTION The chapter, specifically the "Rate of Adaptation" sub-head, lacks concrete examples of viable options to combat and adapt to the effects of climate change on farming and livestock. Mentioned in passing are "changes in crop rotations, planting times, genetic selection, water management, and shifts in areas of crop production."1 However, no further detail is given about any of these, despite their having been used successfully. Because this report will be influencing legislation, this chapter would benefit from a more intense look into what methods have and haven't worked. There are many changes happening in American agriculture. Some are more widespread and warrant mention and research because they are so common. Others are more experimental and need mention because of their potential for either good or bad. A 2010 report published by the U.S. National Research Council, provides several examples and case studies of the positive effects of biodiversity, water management, and soil management, among other things. For example, it outlines the shift in American agriculture toward a "no-till" or "conservation till." A study cited, carried out by the Kellogg Biological Station, says, "No-till … had negative CO2 release (-110 g/m2 per year of CO2 equivalent)."2 Specific information, like this, about agricultural methods used to address climate change is important to include and more meaningful than a passing mention of, for example, "changes in crop rotation." SUGGESTION	6. Agriculture				This comment overlooks reference made to adaptation strategies. Please see, for example, the section in this chapter on an adaptation plan in California's Central Valley consisting of integrated changes in crop mix, irrigation methods, fertilization practices, tillage practices, and land management. These practices are available to all agricultural regions of the U.S. as potential adaptation strategies. The comment ends with a call for research on alternative methods, which is mentioned in the chapter. Numerous comments in this entry touch on advocating policy, which is beyond the scope of the report. Examples include: food access, food healthfulness (e.g., food choices by the public).

		The chapter needs to discuss the effects climate change could have on food access. The availability and healthfulness of food around the United States, and around the world, is a key issue. Access to healthy food is vitally important to America, especially when more than one third (35.7%) of American adults are obese.3 America's two major agricultural crops, and most important sources of agricultural revenue, are corn (84 million acres; $63.9 billion in cash receipts from sales) and soybeans (73.8 million acres; $37.6 billion in cash receipts from sales).4 The nutrient value of both of these is low and the monocropping that is required to produce them in such large quantities is destructive to soil and biodiversity. The report should include more research about the effects of climate change on the farming of high nutrient and bio-diverse plants, as these are likely the future of agriculture.Many farming methods widely used today, such as monocropping, are destructive to the nation's farmland and contribute to global climate change. Further research about alternative farming methods could keep America's farmlands safe and productive, and help keep healthy food accessible.					
Aditi	Mishra	Overall, this figure is good because it shows the drastic difference between a higher emissions scenario (A2) and a lower emissions scenario (B1), and these differences in future temperatures are very drastic and easily visible.However, the graph doesn't contrast change in number of cooling days with number of heating days. The number of heating days would be higher with B1 emissions because the average temperature rise would be lower and therefore the yearly averages temperatures for that scenario would be lower than with A2. This would call for more heating days than A2. So could the fact that A2 has more cooling days but B1 has more heating days make a difference? Does energy required for a higher number of cooling days still overtake energy required for more heating days?	4. Energy Supply and Use	4.3	171		It is not possible to evaluate multiple emission scenarios in this chapter due to page length limitations. Chapter 2 - Our Changing Climate provides a more detailed discussion of both emissions scenarios.
Lauren	Baum	The NCA should take note of a recent study that implies that the seas could rise dramatically higher over the next few centuries than scientists previously thought — somewhere between 18-to-29 feet above current levels, rather than the 13-to-20 feet they were talking about just a few years ago.Link: http://www.sciencemag.org/content/337/6091/216.full	2. Our Changing Climate				Some discussion has been added regarding sea level rise beyond 2100. However, a discussion of the last interglacial as an analog for modern sea level rise and warming rates is beyond the scope of the rather short section on sea level rise. For this reason, additional discussion of the paper suggested here has not been included.
Justin	Augustine	It is unclear what the intent is of the Figure entitled, "Effectiveness of Fuel Treatments." If the intent is to address the issue of defending people and structures from wildfire (i.e., what is sometimes referred to as the "defense zone"), then fuel treatments can indeed be effective. However, outside of defense zones, fuel treatments can be ineffective or unnecessary for several reasons: 1) the treated area may not actually burn (or at least not burn during the time the treatment would be meaningful) (see, e.g., Rhodes and Baker 2008), 2) mechanical treatments can be detrimental to wildlife (e.g., spotted owls, fishers, squirrels, woodpeckers [see, e.g., Hutto 1995, Robertson and Hutto 2007, Manning et al. 2012]) while providing little or no ecological benefit; therefore, when treatments do occur, they should rely upon prescribed fire (put simply, there is a deficit of fire in the West, not a deficit of mechanical treatments), 3) there is a deficit of moderate/high-severity fire in many areas and, therefore, reducing its occurrence on the landscape will not be ecologically appropriate and will instead harm species that rely on habitat created by moderate/high-severity fire (see, e.g., Hutto 1995, Hanson and North 2008, Hutto 2008, Swanson et al. 2010, Bond et al. 2012, Buchalski et al. 2013). Moreover, in a recent study in Sierra Nevada mixed-conifer forests, the highest total aboveground carbon storage was found to	7. Forestry	7.2	268		We have added the following sentence in the text: "These impacts are compounded by a fire deficit, in that many US forests have become increasingly dense due to past efforts to suppress fire (Rhodes et al. 2008, Swanson et al. 2010)." We have modified the caption to Fig. 7.2 to state the following: "Forest management that selectively removes trees to reduce fire risk, among other objectives (a practice referred to as "fuel treatments" maintain uneven-aged forest structure and create small

		occur in mature/old forest that experienced 100% tree mortality from wildland fire (and was not salvage logged or artificially replanted) relative to lightly burned old forest and salvage logged areas (Powers et al. 2013 [Fig. 1b]).Literature Cited Bond, M.L., R.B. Siegel, and D.L. Craig. 2012. A conservation strategy for the Blackbacked Woodpecker (Picoides arcticus) in California—Version 1.0. U.S. Forest Service, Pacific Southwest Region, Vallejo, CA.Buchalski, M.R., J.B. Fontaine, P.A. Heady III, J.P. Hayes, and W.F. Frick. 2013. Bat response to differing fire severity in mixed-conifer forest, California, USA. PLOS ONE 8: e57884.Hanson, C. T. and M. P. North. 2008. Postfire woodpecker foraging in salvage-logged and unlogged forests of the Sierra Nevada. Condor 110: 777–782.Hutto, R. L. 1995. Composition of bird communities following stand-replacement fires in Northern Rocky Mountain (U.S.A.) conifer forests. Conservation Biology 9:1041–1058.Hutto, R. L. 2008. The ecological importance of severe wildfires: Some like it hot. Ecological Applications 18:1827–1834.Klenner, W., R. Walton, A. Arsenault, L. Kremsater. 2008. Dry forests in the Southern Interior of British Columbia: Historical disturbances and implications for restoration and management. Forest Ecology and Management 256: 1711-1722.Manning, T., J.C. Hagar, and B.C. McComb. 2012. Thinning of young Douglas-fir forests decreases density of northern flying squirrels in the Oregon Cascades. Forest Ecology and Management 264: 115-124.Powers, E.M., J.D. Marshall, J. Zhang, and L. Wei. 2013. Post-fire management regimes affect carbon sequestration and storage in a Sierra Nevada mixed conifer forest. Forest Ecology and Management 291: 268-277. Rhodes, Jonathan J. and William L. Baker. 2008. Fire Probability, Fuel Treatment Effectiveness and Ecological Tradeoffs in Western U.S. Public Forests. The Open Forest Science Journal,1: 1-7.Swanson, M.E., J.F. Franklin, R.L. Beschta, C.M. Crisafulli, D.A. DellaSala, R.L. Hutto, D. Lindenmayer, and F.J. Swanson. 2010. The forgotten stage of forest succession: early-successional ecosystems on forest sites. Frontiers Ecology & Environment; doi:10.1890/090157.					openings in the forest; this in turn can under some conditions help prevent large wildfires from spreading." We have added one of the references, but space limitations preclude adding them all.
Elizabeth	Perera	On behalf of the Sierra Club, the oldest and largest grassroots environmental organization, and our 2.1 million members and supporters we appreciate the opportunity to provide comments on the Draft National Climate Assessment (NCA). We live in a world where climate disruption is no longer a dire prediction; it is our new reality. Communities across the country are seeing the effects of climate change on their local environment and lives, through climate-related disasters—storms, floods, heat waves and wildfires—that threaten and have harmed public health and safety. The National Climate Assessment stated purpose is “linking science and decision making” through surveying, integrating, and synthesizing science. On the Assessment’s website it states that the Assessment is to be “used by U.S. citizens, communities, and businesses as they create more sustainable and environmentally sound plans for the nation’s future.” While this draft assessment has synthesized the science extremely well, the severity of the impacts and the urgency for mitigation are understated. Furthermore, there are areas where the assessment inadequately links these findings to useful decision making information for the general public. Severity of Impacts Many Americans rank economic worries as more important than climate change because they perceive these issues as directly affecting their families and communities. Logically, they prioritize what they perceive as the most pressing concerns. Yet climate disruption has the potential to devastate our economy, health, and well-being. Recent climate disasters provide ample case studies for making the connection between global climate and local safety and prosperity. However, these examples and case studies do not have a place in the national climate assessment. We recommend adding a section where case studies of real climate disasters and impacts can be featured in order to illustrate the magnitude and severity of impacts and help decision makers prepare. The report also seems to talk about potential benefits from climate change but then does not describe the magnitude of benefits versus costs adequately. For example in the Executive Summary Page 1: “While some changes will bring potential benefits, such as longer growing seasons, many will be disruptive to society because our institutions and infrastructure have been designed for the relatively stable climate of the past, not the	1. Executive Summary				Thank you for these comments. The authors have worked hard to ensure that the findings of this report and the underlying documentation will be accessible to support decision making. The authors agree there is a need for stronger economic evidence associated with impacts of climate change and have added a section on the need for this in future assessments (see the Context and Background section). It is also important to present a balanced view of the scientific conclusions and avoid policy prescriptive language.

		changing one of the present and future..” Mitigation Urgency We urgently need to act if there is any hope in avoiding the worst impacts of climate change and we must make our communities more resilient to the impacts of the climate change we cannot avoid. The mitigation chapter talks about long lag times between actions taken to reduce carbon dioxide emissions and reductions in its atmospheric concentration. Furthermore it goes on to recognize that mitigation efforts that only stabilize global emissions will therefore not reduce atmospheric concentrations of carbon dioxide, but will only limit their rate of increase. However, Children born today are going to be living in a much different world than we live in and many of these children are expected to live into the 22nd century. This urgency needs to be conveyed in these reports for both policy-makers and the public.Usefulness for US Citizens and Decision-makers The current draft needs to be strengthened to better address the most important information needs of stakeholders, and consider the decisions stakeholders are facing. While the “Key Messages” are very helpful they need to be more straightforward and simple so that an average US citizens, community leader or businessperson can understand how they may want to adjust their decision-making in light of the major climate disruption we face. Furthermore, there are no specific examples about public health preparedness such as work the CDC is doing and the immense co-benefits possible (for example the EPA/CDC Guide to Extreme Heat and Preparedness). If this is to truly be a "sustained assessment process" then the entire draft needs to be on the web with live links which are sharable via all social media applications. Finally, we would suggest that authors be able to add additional recent journal articles when processing comments.					
Appendix A of NRC Review		As noted above, the figures need to be integrated better with the text. Also, the captions tend to be long. Perhaps these figures could be presented in boxes, in which case the long discussion in what is now called the caption could simply be discussion in the box. This would set it aside from the other discussion in the text. In several places, there is information or discussion in the caption that goes beyond what is illustrated in the figure. This seems quite awkward.	6. Agriculture	6.4	232		We have added a figure number in the text.
Appendix A of NRC Review		Here is an example of where the report does provide some sense of the magnitude (economic significance) of impacts. This is very useful.	6. Agriculture		238	1	Thanks for the comment.
Appendix A of NRC Review		Is the message here that innovative conservation methods can (fully) offset degradation of soil and water assets? That is what this seems to say.	6. Agriculture		238	37	Thank you for your comment. After consideration of this point, we have decided to keep the text as is. This section integrates both the potential management aspects along with soil erosion.
Appendix A of NRC Review		scenes similar to what??	6. Agriculture		240	4	We have added the figure number to the text to clarify the meaning of "scenes" in the sentence.
Appendix A of NRC Review		Can some indication of the cost of installing subsurface drainage be included here? That would help with providing some idea of the economic magnitude of the impact.	6. Agriculture		240	9	We added the current cost for ISU extension in 2012.
Appendi		The headings here ("Extreme Precipitation" and "Heat and Drought") seem odd, given the text that	6.		238		Thank you for your comment. We have

x A of NRC Review		follows. The discussion in the section titled "Extreme Precipitation" is primarily about soil erosion and, to a lesser extent, about the impact of extremely HIGH precipitation (downpours) on soil erosion. It says nothing about extremely LOW precipitation. In contrast, the section on "Heat and Drought" also talks about extreme climate events, but in this case it seems to be focused on the impact of LOW precipitation (among other things) and heat stress.	Agricultu re				modified the subheading for Key Message 3, but still feel that the subheading for Key Message 4 is closely in line with the topics covered in the section.
Appendi x A of NRC Review		It seems too strong to say that climate change presents unprecedented challenges TO THE SUSTAINABILITY of U.S. agriculture. It certainly presents new challenges, but not necessarily to the sector's sustainability. And this is certainly not the message in other parts of the chapter, which suggest that innovation and adaptation can offset many of the impacts in this sector.	6. Agricultu re		243	5	Thanks for the comment. After consideration of this point, we have decided to leave the text as is. The statement reflects the supporting literature that suggests that in the longer term, adaptation will be more difficult and costly because the physiological limits of plant and animal species will be exceeded more frequently, and the productivity of crop and livestock systems will become more variable.
Appendi x A of NRC Review		Is not clear what it means to say productivity becomes "less reliable." Is that supposed to be a statement about increased variability of yields?	6. Agricultu re		243	11	We reworded "less reliable" for clarification.
Appendi x A of NRC Review		How is climate change supposed to affect food processing, retailing, and the ability to purchase food? Some examples to illustrate these effects are needed.	6. Agricultu re		243	30	Climate change and changes in extreme events affect food processing, storage, transportation, and retailing, through the disruption of transportation as well as the ability of consumers to purchase food. We have modified the text to provide this detail.
Appendi x A of NRC Review		This figure seems to be randomly placed here. It does not relate to the discussion in this section.	6. Agricultu re	6.1	244		The figure, "Herbicide Loses Effectiveness at Higher CO2" is no longer in the chapter.
Appendi x A of NRC Review		One of the references in the evidence base is Malcolm et al 2012, but there is not a complete citation for this reference.	6. Agricultu re		252		We added a complete citation.
Appendi x A of NRC Review		The confidence for this message is rated as high and very high. However, it is not at all clear what the impacts on food processing and retailing will be and they receive only one line of text (without explicit reference) in the main body of the chapter. Thus, it seems odd that they are noted here in the discussion of confidence. Also, in the description of evidence base, if one tried to link to ERS 2012, which is provided as a key part of the evidence base, and could not find the page. Furthermore, the NRC report (2007) listed here is a report of a Workshop. In order to have high or very high confidence in this key message, it seems that more substantial documentation should be cited.	6. Agricultu re		254		We added more detail in the text that addresses this comment.
Appendi x A of		There is an apparent difference between the findings of this chapter and NCA-1's agriculture chapter on the impacts/benefits of changes in climate on agriculture. Careful comparison of each of the	6. Agricultu				This comment does not appear be for this chapter. We have checked for

NRC Review		assessment's finding would be helpful.	re				consistency of this chapter with the rest of the report.
Appendix A of NRC Review		Why is changing the crop type (species) not mentioned here as an adaptation? (is in main text)	6. Agriculture		228	12	We have added crop species to the sentence.
Appendix A of NRC Review		Section on 'weeds, diseases & pests' is heavy on disease and weak on pests. Suggest at least adding that much of increased pest damage will be from (1) new pests moving in (southern pests moving north) and (2) increased generation time that allows more rapid and higher buildup of population numbers during growing season and (3) warmer winters lowering winter mortality, that also allows bigger buildup of numbers.	6. Agriculture		238	10	These are generally accepted statements; however, the information to support this inclusion in the report is not generally available.
Appendix A of NRC Review		Does this figure display dollar value, land allocation, or calories produced?	6. Agriculture	6.1	229		The caption has been modified to clearly indicate this is monetary value.
Appendix A of NRC Review		The claim that reduction in solar radiation may affect crop growth is doubtful at best. The respose of canopy photosynthesis to sunlight is nonlinear, with small increases in photosynthesis occuring near full sunlight and much larger increases occurring under shaded conditions. Consequently, small changes in light neear full sunlight associated with variation in solar output will have a negligible affect on crop growth.	6. Agriculture		235	13	Thank you for your comment. Small effects when cumulative over a season will have an impact. For this reason, we have decided to keep this statement as is.
Appendix A of NRC Review		Though less certain than temperature and CO2, it would be worth discussing ozone impacts.	6. Agriculture				Already, studies indicate that current ambient ozone levels are suppressing yields of crops such as alfalfa, bean, clover, cotton, peanut, potato, rice, soybean, sugar cane, and wheat in many regions of the United States and worldwide (Booker et al. 2009; Grantz and Vu 2009). We have added text to the chapter to address these findings.
Appendix A of NRC Review		It should be noted here, that theory suggests that the temperature optimum is dependent on [CO2].	6. Agriculture		231	13	It is unclear from the comment what the theory is. Without a reference for this statement it is impossible to validate.

Appendix A of NRC Review		caption: Given that DAYCENT was used here, these effects on yield must be entirely due to decreasing grain-fill period (or growing season length). Without accounting for effects on water stress or physiology and surface energy balance, it is hard to see how you can conclude much here.	6. Agriculture	6.4	232		The point of this illustration is to maintain the water levels as adequate to examine the effect of temperature. The assumption that this effect is entirely concentrated in the grain-filling period is not supported in the current literature (Hatfield et al., 2011)
Appendix A of NRC Review		Really? Citing a personal communication with yourself ??	6. Agriculture		233	8	We removed the personal communication.
Appendix A of NRC Review		This could probably be rephrased in a clearer manner.	6. Agriculture		235	9	We have reworded the text in question as suggested by another comment (Comment ID #9076).
Appendix A of NRC Review		Seems important to include the impact of rising CO2 on water use here.	6. Agriculture		241	14	We have modified the text to include impact of rising CO2.
Appendix A of NRC Review		In addition to regulating C exchange with the atmosphere, forests strongly affect biophysical factors (e.g. albedo and latent heat flux) regulating local climate. Particularly in boreal regions, the relative effect of biophysical factors and contribute more strongly to climate than changes in biogeochemistry. Why, then, are biophysical factors not more thoroughly discussed in this chapter and elsewhere?	7. Forestry				We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include.
Appendix A of NRC Review		"...of forests to ecosystem change..." should read "...forest ecosystems to change..."	7. Forestry		263	14	The text has been revised to incroporate this suggestion.
Appendix A of NRC Review		The authors are editorializing in this paragraph; expressing opinion that may or may not prove to be valid. Recommend striking.	7. Forestry		277	1	The text has been revised to incorporate this suggestion. The text has been revised to observe that legally binding requirements may constraint adaptive management where plants, species, ecosystems, and people are adapting to climate change.
Appendix A of NRC Review		When looking at impacts on the forestry sector, there are two key pieces of the picture: (1) the biophysical relationships that govern how forest ecosystems respond to climate change, and (2) the economic influences and the behavioral responses (e.g., land use and management changes) that are induced. It would help in understanding this chapter if the importance of these two was explicitly stated at the very beginning. As written, the chapter jumps back and forth between these without making a clear distinction between them and the related evidence regarding them.	7. Forestry				We tried in our rewrite to make these logical distinctions.
Appendix A of NRC		This statement about how information can improve decisions is a general statement that could apply to any sector, not just the forestry sector. It seems odd to include it here and not elsewhere (e.g., in the chapter on agriculture). Maybe this should be a cross-cutting theme, highlighted in the executive	7. Forestry		263	30	We appreciate this suggestion. No changes have been made to this chapter.

Review		summary along with the other cross-cutting themes.					
Appendix A of NRC Review		The opening sentence here should refer more broadly to the ecosystem services provided by forest ecosystems, which include but are not limited to wood products, recreational opportunities, and amenities. This paragraph seems to undersell the importance of forests, especially their ecological value.	7. Forestry		263	34	The text has been revised to incorporate this suggestion. We have extensively revised this introductory text to identify the diversity of forests and what they provide society.
Appendix A of NRC Review		The reference to the bioenergy potential of forests should, if possible, be linked to its implications for climate change. In other words, state why this is relevant to this report.	7. Forestry		264	9	The text has been revised to incorporate this suggestion. This sentence was moved to the bioenergy section where the relevance is further explained.
Appendix A of NRC Review		It would help the reader to have an example or illustration of why the challenges and opportunities differ across public vs. private land.	7. Forestry		264	18	The text has been revised to incorporate this suggestion. A contrast between public forestlands and private forestlands was added.
Appendix A of NRC Review		What is the MODIS Global Disturbance Index?	7. Forestry	7.1	265		The text has been revised to incorporate this suggestion. The text has been revised to add information on the nature of the disturbance index, the technical term removed, and the dates over which the disturbance index was estimated.
Appendix A of NRC Review		The phrase "normal yet rare at large scales" is confusing. Does this mean they are frequent at small scales but infrequent at large scales?	7. Forestry		266	25	The text has been revised to incorporate this suggestion.
Appendix A of NRC Review		The text refers to a "growing body of research" but provides no reference(s). Need some documentation here.	7. Forestry		266	26	The text has been revised to incorporate this suggestion. We added references and a modifying statement that the literature generally emphasizes western forests but also relevant for eastern forests.
Appendix A of NRC Review		The term "mesic" is not likely to be familiar to a lay audience.	7. Forestry		267	16	We removed the term "mesic" and restated the point.
Appendix A of NRC Review		It would help to have an example of the "major challenges to forest management" .	7. Forestry		267	18	This text has been revised in response to this comment and others; management challenges are discussed in a later section and not here, given the page limit of the chapter.
Appendix A of NRC Review		In general, the wording in this paragraph is awkward and unclear.	7. Forestry		267	20	The text has been revised to incorporate this suggestion.

Appendix A of NRC Review		This figure is not referenced in the text anywhere, and it is unclear how it relates to the text. Also, the term "fuel treatments" is not likely to be familiar to a lay audience.	7. Forestry	7.2	268		We added a citation to the figure in the text in the sentence that begins "Given strong relationships between climate and fire, even when modified by land use and Management (Figure 7.2),". We have clarified the caption as follows: Figure 7.2: Effectiveness of Forest Management that Selectively Removes Trees Fuel Treatments. Caption: Forest management that selectively removes trees to reduce fire risk, among other objectives (a practice referred to as “fuel treatments” maintain uneven-aged forest structure and create small openings in the forest; this in turn can under some conditions help prevent large wildfires from spreading.
Appendix A of NRC Review		It is unclear how the last sentence in this paragraph relates to carbon uptake.	7. Forestry		269	16	The text has been revised to incorporate this suggestion. The sentence was deleted and the reference to the Ecosystems chapter for species shifts and climate change was added above.
Appendix A of NRC Review		This is an important recognition of the role of economic factors and other factors. This should be explicitly acknowledged right at the beginning of the chapter.	7. Forestry		271	7	After consideration, we still feel that the text is clear and accurate. The introductory text includes a sentence that acknowledges the influences that economic factors have had and will continue to have on forests. And as this text deals explicitly with carbon, the details seem most appropriate here.
Appendix A of NRC Review		The figure legend is labeled "Forest Production (T/ha/yr)" while the caption says that the figure shows "carbon uptake rates". This is confusing.	7. Forestry	7.4	271		We have clarified this caption.
Appendix A of NRC Review		Again, "fuel treatments" is not likely to be a familiar term for lay audiences.	7. Forestry		272	25	This text has been revised to incorporate this suggestion. Fuel treatments has been replaced with forest management.
Appendix A of NRC Review		In general, this discussion of bioenergy potential needs to be linked more clearly to climate change, i.e., what are the implications/conclusions of this discussion for climate change impacts?	7. Forestry		272		After consideration, we still feel that the text is clear and accurate. The bioenergy section encompasses this material.
Appendi		The reference here is to the "environmental" consequences of bioenergy production. Presumably this	7.		272	5	The term 'environmental' is not used

x A of NRC Review		is intended to be a broad statement, but in its breadth, it is also vague. A more specific statement about CO2 consequences would be helpful	Forestry				on this page.
Appendix A of NRC Review		This paragraph should be highlighted (and expanded) more, since it is really the key part of the discussion here. The idea in this paragraph should be included as part of the main message highlighted at the top of the page.	7. Forestry		272	23	After consideration of this point, we still feel that the existing text is clear and accurate. Due to the size of the sector, we focused on broad trends rather than delving too deeply or providing such a level of specificity.
Appendix A of NRC Review		What are the IMPLICATIONS of this figure for climate change?	7. Forestry	7.6	275		The text explains the role of bioenergy in the management of forests, under climate change. This figure provides the location of potential forestry biomass resources for bioenergy.
Appendix A of NRC Review		The fact that U.S. climate change policies affect management choices is a general statement that could apply to all sectors, in the same way that the statement about the value of having better information applies much more generally than just in the forestry sector. As suggested above, these common themes should perhaps be highlighted much early, for example, in the section on cross-cutting themes.	7. Forestry		276	3	We appreciate this suggestion.
Appendix A of NRC Review		The reference on line 3 is to the effect of climate change policy, while the reference on lines 7-8 is on policies related to forest land, on forest management decisions. These are two different sets of policies, although the language here seems to treat them as synonymous.	7. Forestry		276	3	After consideration of this point, we still feel the existing text is clear and accurate. The key finding identifies the role that climate change policy will have on forest management responses to climate change. The introductory text starts with a discussion on what currently influences private and public land management and then moves to the broader policy on climate change.
Appendix A of NRC Review		It is unclear what is meant by this sentence. Does "development" here simply mean "expansion"?	7. Forestry		276	19	The text has been revised to incorporate this suggestion. Development here meant expansion or contraction of the international firms. The term 'lack of development' was deleted.
Appendix A of NRC Review		Was there an explicit statement like this about the profitability of bioenergy in the previous section on bioenergy potential? The statement here is much more explicit than the statement on p. 274, lines 18-22. These two sections should be consistent in their message about the economics of bioenergy.	7. Forestry		276	21	The text has been revised to incorporate this suggestion. Text was deleted here to keep the bioenergy discussion focused in the bioenergy section of the chapter.
Appendix A of NRC Review		The statements here about the importance of other economic factors is a key point that should be made earlier. It affects the previous issues (e.g., carbon management, p. 270) as well. Likewise, the statement about the impact and importance of societal values (lines 30-31) should be highlighted earlier.	7. Forestry		276	22	The text has been revised to incorporate this suggestion. Economic factors are introduced in the first paragraph and the second paragraph has been extensively revised to emphasize the economic and social influences on forestland.

Appendix A of NRC Review		It is good that landowners "may be" able to capitalize on existing mangement options, but will they have an INCENTIVE to do so??	7. Forestry		276	36	The text has been revised to provide more detail on the economic challenges facing private landowners, in particular the land conversion decision.
Appendix A of NRC Review		An example of regulatory requirements might penalize innovative management would help in understanding this point.	7. Forestry		277	2	The paragraph associated with this text has been revised and after consideration of this point, we still feel that the text is clear and accurate. Given the page limit on the chapter, we focused on broad trends, rather than delving too deeply or providing such a level of specificity.
Appendix A of NRC Review		It is not only the ecosystems that are responding; people are responding as well. And regulations need to embody these responses as well.	7. Forestry		277	5	The text has been revised to incorporate this suggestion.
Appendix A of NRC Review		The knowledge gap will impede effective management not only in the forestry sector, but in all other sectors as well.	7. Forestry		277	10	We agree. No change to the text.
Appendix A of NRC Review		It is surprising that the confidence for this message is only "medium." There is no question about whether this message is "true" or not. While the magnitudes of the impacts might be uncertain, the message does not include a statement about magnitudes.	7. Forestry		282		The science is simply not as definitive as the other Key messages.
Appendix A of NRC Review		A major omission in this introduction is the low visibility of ecosystem condition to those who depend upon benefits from an ecosystem. E.g., the loss of coastal wetlands from development and anthropogenic nutrient inputs lowers the ability to buffer storm surges. But this is a surprise to adjacent residents and decision makers at all levels--despite warnings and appraisals from the scientific community. Such "known unknown" surprises have been repeated so often that they are surely important aspects of ecosystems to the NCA. Furthermore, bringing out these issues at the top-line also serves to highlight the "unknown unknown" issues in ecosystem responses to changing climates. (See also comment on infrastructure as a metaphor in Exec Sum.)	8. Ecosystems, Biodiversity, and Ecosystem Services		291	2	We have added text to the first paragraph of the Introduction; "Changes in many services are often not obvious to those that depend on them."
Appendix A of NRC Review		The concluding sentence is correct but weak. Consider instead: "Advances in estimating ecosystem services, ecological modeling, and methods coupling human dimensions to ecological response are providing important, increasingly actionable insights into ways to manage human systems so as to build ecological resilience for human benefit. The gathering of data through monitoring and remote sensing needed to support these analyses remains incomplete and in need of clearer prioritization, however."	8. Ecosystems, Biodiversity, and Ecosystem Services		292	11	No change. The authors, and especially the NCA staff have worked hard to make the language accessible to the largest possible group of readers.
Appendix A of NRC Review		Where is this figure referred to in the text? This appears to be a problem with all the figures and the boxes in this chapter.	8. Ecosystems, Biodiversity, and	41487	295		We appreciate the comment. The authors determined where to add in-text references to figures.

			Ecosystem Services				
Appendix A of NRC Review		A property loss of $1.9 million looks low; is it billion?	8. Ecosystems, Biodiversity, and Ecosystem Services		296	16	Edited as suggested.
Appendix A of NRC Review		"Almost unrecognizable" seems imprecise given the following text. Some of the discussion talks about shifts in vegetation regime (e.g., conifer to broadleaf forest) and implies that the vegetation regime would be accompanied by its current ecological companions. The ecosystems observed in a particular place would be historically unfamiliar in that case, but not unrecognizable. Elsewhere, however, the text implies that what will transform is the ecological community in a structural sense, forming assemblages previously unknown. That could well be unrecognizable even to trained observers (though the concept of conserving a stage, referenced via Anderson & Ferree 2010, suggests that unrecognizability may not be a dispositive criterion for concern). A comment clarifying which if these is meant, and the limitations in our ability to project either within the time spans of the assessment, would be helpful.	8. Ecosystems, Biodiversity, and Ecosystem Services		296	23	No change. The authors and, especially, the NCA staff have worked hard to make the language accessible to the largest possible group of readers.
Appendix A of NRC Review		Needs a citation for adaptive management such as the U.S. Department of Interior's Adaptive Management Technical Guide, http://www.doi.gov/initiatives/AdaptiveManagement/TechGuide.pdf.	8. Ecosystems, Biodiversity, and Ecosystem Services		299	12	Citation added.
Appendix A of NRC Review		This link between these observations and a changing climate is obscure.	8. Ecosystems, Biodiversity, and Ecosystem Services		303	23	Text in both examples has been revised to be more clear.
Appendix A of NRC Review		Box 2 provides a catalog of observed changes that are correlated with changing climate, and intersperses the list with projections of future change. The projections would be expected to be qualitatively more severe than the observed changes, since the projected shifts in temperature, recurrence of severe disturbances, and sea level rise are all substantially larger than what has been observed over the past century. This is not apparent, however, in a quick scan of the italicized projections, as compared to the plain text observations. This way of presenting observations and projections should be discussed in a caption.	8. Ecosystems, Biodiversity, and Ecosystem Services		302	5	Map of selected observed and projected biological responses to climate change across the United States. Case studies listed below correspond to observed responses (black icons on map) and projected responses (white icons on map, italicized statements). In general, because future climatic changes are

							projected to exceed those experienced in the recent past, projected biological impacts tend to be of greater magnitude than recent observed changes. Because the observations and projections presented here are not paired (i.e., they are not for the same species or systems), that general difference is not illustrated.
Appendix A of NRC Review		This sentence while true seems to imply that we need to understand everything there is to know about ecosystems and climate before taking positive steps to reduce damage from climate change.	8. Ecosystems, Biodiversity, and Ecosystem Services		292	11	Changed to "responses ranging from altered . . "
Appendix A of NRC Review		Confusing. Is greater water yield from the Mississippi basin a function of climate change or from land use change. This should be clarified. If it's the latter, we shouldn't attribute the dead zone in the Gulf indirectly to climate change. Also see line 36.	8. Ecosystems, Biodiversity, and Ecosystem Services		293	1	The text has been revised to clarify that both climate and land use change contribute to the increase in water yield from the Mississippi.
Appendix A of NRC Review		Invoking mismatches between microbial communities and soil nutrient mineralization seems like a reach that on the surface is not supported by the references provide. ...an interesting hypothesis, though.	8. Ecosystems, Biodiversity, and Ecosystem Services		298	27	No change. The Muller and Bormann (1976) reference, directly addresses this mismatch.
Appendix A of NRC Review		Key messages and intro: The intro of the chapter could note existing threats to ecosystems -- development, urbanization, expansion of food and energy production. All of these stresses are currently doing more damage than climate change and are also undermining the adaptability of ecosystems to climate change.	8. Ecosystems, Biodiversity, and Ecosystem Services		291		No change. The text already states that "Although ecosystems and ecosystem services are what we interact with every day, their linkage to climate change can be elusive because they are influenced by so many additional entangled factors."
Appendix A of NRC Review		Adaptation section. Regarding ecosystem-based management approaches, can the report say anything about how effective these approaches have been? are there some examples of successes that could be pointed out?	8. Ecosystems, Biodiversity, and		299		No change. Detailed examples are provided by the citations. We do not have space to elaborate on them here.

			Ecosystem Services				
Appendix A of NRC Review		Several topics in this chapter have relevance to health that is not mentioned. For instance, each of the key messages have a health dimension:	8. Ecosystems, Biodiversity, and Ecosystem Services				No change. Health impacts are covered in another chapter.
Appendix A of NRC Review		Key Message 1. [Water quality and flow influence risk for enteric diseases as well as the distribution and abundance of mosquitoes and other vectors of human disease.]	8. Ecosystems, Biodiversity, and Ecosystem Services				No change. Health impacts are covered in another chapter.
Appendix A of NRC Review		Key Message 2. [Fires, floods and storms have a direct influence upon human health as well as indirect influence by affecting vector populations.	8. Ecosystems, Biodiversity, and Ecosystem Services				No change. Health impacts are covered in another chapter.
Appendix A of NRC Review		Key Message 3. [Changes in the geographic distribution of plants and animals will directly influence the distribution and abundance of disease vectors (ticks, mosquitoes, fleas, etc.) and reservoir hosts of zoonotic diseases thus changing the distribution of disease risk to humans.]	8. Ecosystems, Biodiversity, and Ecosystem Services				No change. Health impacts are covered in another chapter.
Appendix A of NRC Review		Key Message 4. [Insect vectors also have phenologies that can increase risk of human disease by increasing the transmission season for vector-borne pathogens. Avian migration can influence the seasonality and geography of bird-borne zoonotic pathogens such as West Nile virus and Eastern equine encephalitis.]	8. Ecosystems, Biodiversity, and Ecosystem Services				No change. Health impacts are covered in another chapter.
Appendix A of NRC		Key Message 5. [Management decisions should consider potential impacts upon vector-borne and zoonotic diseases which could result from activities such as wetlands restoration and species relocations or reintroductions. The discussion on increased vulnerability of invasive species should be	8. Ecosystems,				No change. Health impacts are covered in another chapter.

Review		extended to exotic pathogens of humans as well as wildlife.]	Biodiversity, and Ecosystem Services				
Appendix A of NRC Review		Tone of "key messages" is unscientific in places, and may turn off the reader. Suggest the following changes: pt3 "... changes in some regions will be great enough that novel communities of plants and animals will emerge."	8. Ecosystems, Biodiversity, and Ecosystem Services		291	13	No change. The authors and, especially, the NCA staff have worked hard to make the language accessible to the largest possible group of readers.
Appendix A of NRC Review		pt4 - correction "Timing of ... HAS SHIFTED, leading to ....."	8. Ecosystems, Biodiversity, and Ecosystem Services		291	22	Changed as suggested.
Appendix A of NRC Review		pt5: This needs to be placed in lay language - the reader should not have to read the main text to understand the key points. The average person equates "ecosystem" with all wildlife, nature, etc. Suggest rephrasing to make distinctions clear here and throughout. For same reason, suggest replacing 'biodiversity' with 'wild species'. Also, find another term for "ecosystem based management approaches" - the public will not likely understand what that means. Possibly "holistic mangement approaches"? "Management approaches that view whole systems rather than each species separately"? "Systems-based management"?	8. Ecosystems, Biodiversity, and Ecosystem Services		291	25	No change. The authors, and especially the NCA staff have worked hard to make the language accessible to the largest possible group of readers.
Appendix A of NRC Review		Need better phrasing than "distorted rhythms of nature" - sounds like a meditation ad. Again, need more scientific phrasing.	8. Ecosystems, Biodiversity, and Ecosystem Services		292	4	No change. The authors, and especially the NCA staff have worked hard to make the language accessible to the largest possible group of readers.
Appendix A of NRC Review		This section is poorly written. Need to clarify that higher N & P ultimately come from human activities - not heavier precip. Need to clarify that is an interaction of human-driven fertilization and increased transport of these pollutants.	8. Ecosystems, Biodiversity, and Ecosystem Services		292	34	Changed as suggested.
Appendi		Again - Gulf Coast dead zone was there long before climate change - need to clarify this and then	8.		293	4	No change. We do not have space to

x A of NRC Review		discuss how CC has & will affect already-existing dead zones.	Ecosystems, Biodiversity, and Ecosystem Services				go into details about the formation of dead zones. It is clear that these are driven by nutrient inputs and these go up with discharge.
Appendix A of NRC Review		This is first mention that N&P come from fertilizing farms (& add high intensity feedlots, and automobile exhaust) - this needs to be moved to beginning of discussion of impacts of increased floods/discharge.	8. Ecosystems, Biodiversity, and Ecosystem Services		293	41	This is now mentioned in the third paragraph of this section, in response to comment #42481.
Appendix A of NRC Review		Again, less evocative and more scientific wording is appropriate. Simply say something like "existing plants and animals may disappear from some regions, and be replaced by novel communities"	8. Ecosystems, Biodiversity, and Ecosystem Services		296	21	No change. The authors, and especially the NCA staff have worked hard to make the language accessible to the largest possible group of readers.
Appendix A of NRC Review		Phrasing needs to be more careful as to causation. Increased fires in SW desert is also due to invasive grasses that burn taking over areas that used to be cactus dominated (non-burn systems).	8. Ecosystems, Biodiversity, and Ecosystem Services		296	33	The text has been edited to indicate that expansion of exotic annual grasses plays a role in the increase in fire in southwestern deserts.
Appendix A of NRC Review		Most of the studies used in Chen et al (2011) are from the UK - 16 UK out of 22 total studies - with 69% of species from UK+Finland. Add some refs that are more geographically diverse to support such a broad statement - e.g. Root et al 2003, Parmesan & Yohe 2003, Parmesan 2006, Rosenzweig et al 2008.	8. Ecosystems, Biodiversity, and Ecosystem Services		296	39	No change. We were directed to focus more on new (post 2009) literature.
Appendix A of NRC Review		Changes are not just predicted, they've already occurred. Change wording to "...HAVE SHIFTED ..."	8. Ecosystems, Biodiversity, and Ecosystem		298	4	Changed to "are shifting."

			Services				
Appendix A of NRC Review		Two more very good reviews of conservation strategies for climate change are: (1) Mawdsley et al (2009). A Review of Climate-Change Adaptation Strategies for Wildlife Management and Biodiversity Conservation. Conservation Biology, 23(5), 1080-1089. and (2) Pettorelli, N. (2012). Climate change as a main driver of ecological research. J. Applied Ecology, 49, 542Ð545.	8. Ecosystems, Biodiversity, and Ecosystem Services		300	7	No change. While the comment suggests good specific examples, the authors feel the existing examples are appropriate.
Appendix A of NRC Review		Very nice figure (8.4)	8. Ecosystems, Biodiversity, and Ecosystem Services	8.4	302		Thanks for the nice comment!
Appendix A of NRC Review		Few ecosystems in the U.S. are managed purely for the benefit of biodiversity. The discussion of planning makes no mention of the need to engage not just scientist and managers but also the public (those interested or affected by a decision). Yet linking scientific analysis to public deliberation is at the heart of adaptive risk management and has been repeatedly recommended by the NRC and the literature. This approach is crucial because very difficult value choices will have to be made as climate change alters ecosystems, drives local extinctions, and even shifts the landscape in many parts of the U.S. highly valued by the public, but with different segments of the public having very different views about the best course of action. Without up -front linking of the scientific analysis to public deliberation, trust could be shattered making effective management almost impossible.	8. Ecosystems, Biodiversity, and Ecosystem Services				No change. We feel that public engagement is central to, and facilitated by, the ecosystem services approach as defined in the beginning of the chapter.
Appendix A of NRC Review		The idea behind Figure 8.4 is great (while the map is a bit clunky). It would be nice to see this approach used in the rest of the report.	8. Ecosystems, Biodiversity, and Ecosystem Services	8.4	302		Thanks for the nice comment!
Appendix A of NRC Review		Section on health is limited to direct effects of diseases and health conditions within the domain of environmental health (heat stroke, respiratory disease, allergies, etc) and does not mention health threats caused by infectious agents which in some instances may pose more serious threats to human health in the U.S. (pandemic influenza, SARS, dengue fever, West Nile virus, etc.). This chapter overemphasizes the direct impact of climate and weather on health conditions traditionally considered to be within the discipline of environmental health (heat stress, respiratory ailments, allergies) and only superficially covers infectious diseases which are traditionally excluded from the discipline of environmental health. Much more research on climate change impact has been done within the discipline of environmental health because climate change issues fit well within the mission of this discipline. The effects tend to be direct and are therefore predictable. Accurate assessments can be made on current impacts and therefore projections into the future can easily be made. In contrast, infectious diseases have received relatively little attention in relation to climate change and the	9. Human Health				We appreciate this suggestion, but space is limited. The author team deliberated and agreed that a balance had to be stuck, given the considerable constraints on text that we could commit to a fuller discussion of climate change and its interactions with a range of infectious diseases. The context of the chapter and Report largely focus on US-based research and effects. Authors have tried to address and concisely review current

		impacts are less direct requiring a more in-depth understanding of the processes involved. Without a basic understanding of how climate and weather influence infections in humans, projections into the future and adaptation planning cannot be made. The reasons for the imbalance between environmental health and infectious diseases are understandable and not unexpected. Nonetheless, infectious diseases do pose real and serious threats to public health and should be considered more fully in a discussion of climate change and health. This constitutes a major gap in our knowledge that should be recognized and addressed prominently in this report.					sources on vector-borne infectious illnesses. We include West Nile virus and dengue fever, which appear in the Reference list; we are adding a new reference on the increase in dengue fever hospitalizations in the US in recent years, 2000-2007 (Streit et al. 2011); and text mentions dengue fever and Lyme disease in the section, 'Large-Scale Environmental Change Favors Disease Emergence.' If there is a bias in the US-based research that does not more fully address SARS, pandemic influenza, meningitis, etc. and the links to climate factors, authors are limited in their ability to expand the discussion, given space constraints.
Appendix A of NRC Review		The Traceability section on infectious diseases (limited to insect and rodent-borne diseases) is not well documented and many of the references actually contradict the statements attributed. This has been a contentious topic suffering from a lack of objective studies that can be referenced. Nonetheless, admission that knowledge is weak and uncertain is preferable to citing contradictory or ambiguous references. The assessment should truthfully reflect what has been published rather than conveying a misleading level of confidence. Some example REFS: *Rogers DJ, Randolph SE. 2006. Climate change and vector-borne diseases. In: Hay SI, Graham A, Rogers DJ, editors. Advances in Parasitology, Vol 62: Global Mapping of Infectious Diseases: Methods, Examples and Emerging Applications. San Diego: Elsevier Academic Press Inc; p. 345-81. *Gage, KL, Burkot, TR, Eisen, RJ, et al. 2008. Climate change and Vectorborne disease. American Journal of Preventive Medicine. 35:436-450. *Lafferty, KD. 2009. The ecology of climate change and infectious diseases. Ecology, 90:888-900. *Mills, JN.; Gage, KL.; Khan, AS, 2010. Potential influence of climate change on Vector-Borne and Zoonotic Diseases: A review and proposed research plan. Environmental Health Perspectives, 118:1507-1514.	9. Human Health				Thank you for highlighting the uncertainty surrounding climate change and infectious disease transmission - I believe the cited literature is important as it conveys differing perspectives on the intersection of the two areas of research. To quote Lafferty (2009) - "With a firmer ecological understanding of how infectious organisms may respond to climate change, we will be better able to deal with those cases where diseases will increase or expand".
Appendix A of NRC Review		Key drivers should include changes in growing season and changes in the spatial distribution of rainfall and droughts that influence the distribution and abundance of disease vectors and reservoir hosts of zoonotic diseases.	9. Human Health		334	10	We changed the text to mention increasingly frequent extreme precipitation and changes in precipitation patterns that lead to drought and ecosystem changes.
Appendix A of NRC Review		National, rather than global deaths should be included for wildfire effects. Other figures and health statistics should be checked for consistency of geographic base and reflect national data.	9. Human Health		340	10	We updated the text to reflect the addition of available U.S. data on wildfire-related mortality, but no similar statistics on national wildfire smoke-related mortality and morbidity are yet available.
Appendix A of NRC Review		Diseases directly transmitted by humans, such as influenza and meningitis have geographic differences in seasonality and fungal diseases such as coccidioidomycosis are dependent upon rainfall. Climate change can have impact upon directly transmitted disease as well as those that are vector-borne or zoonotic.	9. Human Health		343	29	The comment is absolutely correct; however, we are focused on North America for the NCA. The IPCC Africa chapter contains a segment on climate

							and meningitis in the Sahel of Africa. As far as influenza is concerned, there are new data on weather and climate links, but we are constrained by space in this section .
Appendix A of NRC Review		The list of nationally reportable vector-borne and zoonotic diseases is much more extensive. The geographic distribution of nearly all, if not all of these diseases is dependent upon local climatic conditions and landscape features, and the intensity of transmission is commonly influenced by weather. While other factors mentioned (immunity, socioeconomic, etc.) can influence disease incidence, the fundamental ecology of the pathogen is highly dependent upon environmental factors that will be affected by climate change. Although because there have been so very few studies on the impact of climate change on infectious diseases to cite specific examples, dependence upon climate is well established in the literature for many of these diseases.	9. Human Health		343	39	This is indeed true, but one cannot discount the importance of the other factors noted in the section. For example, if infrastructure is well-developed, there may be limited vector-human contact which could result in lack of transmission of disease. All of the other factors stated influence the transmission dynamics of disease; weather and climate are factors, but not the sole factors.
Appendix A of NRC Review		The figure caption does not cite the correct reference for the maps displayed. The correct reference is Brownstein et al. 2005 EcoHealth 2:38-46.	9. Human Health		345	8	We have changed the reference for this figure. We are using maps of changes in tick habitat adapted from the maps found in Brownstein, John S., Theodore R. Holford, and Durland Fish, 2005: Effect of Climate Change on Lyme Disease Risk in North America. EcoHealth, vol 2, p. 38-46. DOI 10.1007/s10393-004-0139-x.
Appendix A of NRC Review		Chikungunya is not a fatal disease. Population devastation is an exaggeration of the effects of this disease. Debilitated would be a more appropriate term that reflects morbidity rather than mortality	9. Human Health		353	21	We thank the reviewer for the helpful suggestion, however the text in question is no longer in the chapter.
Appendix A of NRC Review		The Key Message on' Diseases from Insects and Rodents' cites the following references: Lafferty 2009; McGregor 2011; Tabachnick 2010, Epstein 2010; Reiter 2008; Rosenthal 2009; Russell 2009. But if one actually looks at these references, you find that they convey a far more equivocal, cautious message about our state of understanding than the NCA Key Message does.	9. Human Health		357		Authors had to strike a balance given the considerable constraints on text that we could commit to a fuller discussion of climate change and its interactions with a range of infectious diseases. After consideration of this suggestion, we still feel the existing text describes some of the broad topic areas explored in these references. While the state of understanding on climate change's effects on complex disease transmission dynamics continue to be an area of active study and research, confidence is high that climate change has contributed to the expanded range of certain disease vectors that include Ixodesticks, U.S. vectors for Lyme disease.

Appendix A of NRC Review		The caption highlights one tradeoff between the high levels of withdrawal (once-through) versus consumption (with cooling ponds/towers). It completely misses the crucial differences between these technologies with respect to the thermal pollution of rivers and threats to aquatic life. Furthermore, there is no discussion of the electrical production efficiency/losses associated with these alternatives.	10. Water, Energy, and Land use	10.4	398		Additional explanation was added to the caption.
Appendix A of NRC Review		This statement: "A typical horizontal well for shale gas production requires from 2.5 to 5 million gallons of water, frequently from streams, reservoirs, or groundwater (DOE 2009a), but also from private water, municipal and re-used produced water" is sloppy on two scores: (i) what does this volume represent? Construction phase, operations? Daily, weekly, annual, lifetime use? and (ii) it presents what seems to be a large number, but this has absolutely no bearing on anything unless placed into some comparative context. For example, the range given would represent the equivalent of the approximate water use by a small city of 25,000-50,000 for a day, or daily consumption by one or two combined cycle natural gas cooling towers (500MW), or 10-15 minutes of operation of a 500MW once-through nuclear power plant.	10. Water, Energy, and Land use		399	39	The section on natural gas was revised to include more information on the amounts of water used in hydraulic fracturing.
Appendix A of NRC Review		Some explicit mention should be made of the politics/litigation/citizen concerns regarding fracking (e.g. the situation in NYS vs Pennsylvania), irrespective of the political constraints of motivation associated with carbon mitigation. A good place to mention this would be in the last paragraph on p.400 or the first paragraph on p.401.	10. Water, Energy, and Land use		399		We appreciate the suggestion, but space is limited. The author team has deliberated and chosen the most important topics to include. The discussion of specific policy choices in Pennsylvania and New York is beyond the scope of this report. The authors have revised the text to provide additional information about societal concerns about hydraulic fracturing.
Appendix A of NRC Review		First paragraph under Solar Power Generation. "Efficient solar power requires long days with few clouds. Such conditions are prominent across the Southwest U.S., and, with few exceptions, current and pending utility-scale solar facilities are located in the Southwest where sparsely populated land is available. Climate change, however, is projected to affect surface and groundwater supplies within this already arid region (see Ch. 20: 11 Southwest)." Figure 10.4 indicates a generally extremely low water requirement for solar power systems, except for wet-cooled CSP, and then only in terms of its consumption relative to other power production technologies. "Another technology for utility-scale electricity generation Ð concentrating solar systems, requires up to 15 acres per MW and wet cooling consumes 1,040 gallons of water per MWh." The remainder of this section indicates there will be limits to such systems as described for SEGs. And, for photovoltaics which require less water, there are land and protected species issues (as the text indicates). But one misses the overall assessment of the value of solar technologies for truly reducing the nation's carbon emissions. Ending the paragraph with "Thus plant designs will have to carefully balance cost, operating issues, and water availability." is not a very strong or compelling statement.	10. Water, Energy, and Land use		401		The solar power discussion has been revised greatly and addresses this perspective.
Appendix A of NRC Review		on Biofuels: While there is some discussion of tradeoffs with respect to land and water, there is no discussion on the tradeoffs associated with biofuels on: impacts on soil carbon and long-term fertility; the net return on energy investment of biofuels; impact of N2O emission side effects that at least partially negate the CO2 "credit".	10. Water, Energy, and Land use		403		The biofuels section has been revised to provide additional information on environmental and social aspects.
Appendix A of NRC		Need to mention explicitly that this potential pollution from nutrients comes from the industrial fertilizers necessary to grow these crops.	10. Water, Energy,		404	10	The text has been clarified.

Review			and Land use				
Appendix A of NRC Review		The first and second sentences in the paragraph seem at odds: "Carbon capture and storage (CCS) technologies have the potential to reduce emissions from coal- and natural gas-fired plants by 90%, allowing continued use of fossil fuel in a carbon-constrained future. In addition, capturing and storing carbon dioxide emissions from the combustion of biofuels represents one of very few potential options for reducing atmospheric CO2 (IPCC 2005)." First off, 90% under what conditions and with what loss of efficiency or $$ costs? Next, the second sentence has the seemingly contradictory / oxymoronic notion of "capturing and storing from combustion of biofuels", as combustion releases CO2. And right after the 1st sentence on CCS, the phrase in the 2nd sentence about biofuels as ("one of very few potential options for reducing atmospheric CO2") makes little sense. Also, this section was presumably about geologic carbon capture, with biofuels discussed earlier; but the very next sentence will completely throw a non-technical reader: "Carbon from the atmosphere accumulates in growing plants that are used to produce a biofuel. When the biofuel is combusted, the CO2 is captured and stored, constituting a net removal of CO2 from the atmosphere for as long as storage continues and the standing stock of plants is sustained." Although an informed reader understands the closed looped concept that the authors are trying to describe, the wording (actually the word ordering) is tortuous and will completely confuse the less initiated reader. The phrase "When the biofuel is combusted, the CO2 is captured and stored," initiates this trainwreck. If the chapter is trying to discuss biofuels per se, this should have all been discussed under the preceding section. Very awkward and confusing.	10. Water, Energy, and Land use		404	39	The technology section (KM2) has been significantly revised to improve balance across discuss of technology types.
Appendix A of NRC Review		section on CCS: No mention at all of the geologic issues associated with such technology; nor the stability of CO2-enriched, injected groundwater; nor assessment of whether or not there are enough suitable sites across the U.S. to make any meaningful contribution to the CO2 mitigation aim.	10. Water, Energy, and Land use		404		We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information to include. CCS is a very complex topic, and the author team has attempted to provide a clear and useful overview of the topic. The CCS discussion has been revised to add information on environmental impacts and containment. The Mitigation chapter discusses mitigation aims and context. Added a note on additional issues to consider.
Appendix A of NRC Review		Section on Challenges to Reducing Vulnerabilities: The use of the Columbia Basin is instructive, but the text dives into what is essentially a "Spotlight" on this particular basin. It needs a little more text to stage the multi-dimensional issue. Figure 10.7 offers little but some nice colors. A more instructive graphic might be a visual depicting the various interconnections between climate-induced changes and response planning that are discussed in the text, maybe a well-crafted box and arrow diagram could achieve this.	10. Water, Energy, and Land use		405		The supporting text for Key Message 3 has been revised to incorporate this suggestion. Text has been added on reducing vulnerabilities.
Appendix A of NRC Review		This chapter is clearly written from an energy perspective. An unkind but perhaps accurate comment may be that the chapter should be retitled "Where are we going to get the Water and Land we need to Produce Energy?". For instance, see Key Message 2, which is all about the resources necessary to meet energy needs	10. Water, Energy, and Land use				The text has been amended to better describe the energy-water-land nexus and the author team's choice of an energy focus.
Appendix A of		Does not show interactions between water energy and land. The effects of energy and land are indicated for water in that the quantities used for energy (thermo-electric) and agriculture are shown.	10. Water,	10.3	393		Additional explanation was added to the caption and text.

NRC Review		But, the energy and land data are not related the other spheres.	Energy, and Land use				
Appendix A of NRC Review		Does present interesting data on the water required for a variety of energy sources. What would be interesting is a joint presentation of the amount of resource embedded in the other. For example, what is the embedded energy and land in different water uses, etc. What is the embedded energy and water in agriculture? For example, nitrogen fertilizers are necessary to maintain our productivity and they are produced by the Harber-Bosch process, which is very energy-intensive. It would be interesting if a diagram was created which illustrated the major interactions and interchanges between water, energy, and land use. This would be a contribution to allow for the joint impacts of climate change to be identified.	10. Water, Energy, and Land use	10.4	398		A conceptual figure was added to the chapter that helps to illustrate these connections.
Appendix A of NRC Review		The discussion supporting the third key message is not very compelling. It illustrates the interactions but provides no indication of how joint consideration of water, energy, and land use can lead to better outcomes. A discussion of what the improved outcomes might be is needed to support this key message.	10. Water, Energy, and Land use				The section has been revised to delineate the challenge more clearly.
Appendix A of NRC Review		Overall: structure of chapter does not address water, energy, land, AND CLIMATE in upfront materials. Suggest restructure to describe the inteactions of ELW either separately or specifically include the CLIMATE interactions within or in a 2nd section.	10. Water, Energy, and Land use				The text has been revised to incorporate this perspective. The introduction has been restructured and discussion added on energy, water, and land interactions, and on climate impacts.
Appendix A of NRC Review		The chapter could use a good conceptual figure..	10. Water, Energy, and Land use				A conceptual figure illustrating these interactions will be added in the final version.
Appendix A of NRC Review		Some refs to consider: ¥ Dšll, P., Hoffmann-Dobrev, H., Portmann, F.T., Siebert, S., Eicker, A., Rodell, M., Strassberg, G., Scanlon, B. (2012): Impact of water withdrawals from groundwater and surface water on continental water storage variations. J. Geodyn. 59-60, 143. ¥ Morgan Bazilian, et al.;Considering the energy, water and food nexus: Towards an integrated modelling approachEnergy Policy, Volume 39, Issue 12, Dec 2011, P 7896-7906 ¥ Shah T. (2007): Groundwater, a global assessment of scale and significance, in: Molden (ed) Comprehensive Assessment of Water Management in Agriculture, Earthscan, Colombo, International Water Management Institute. ¥ Gerten D., Heinke H., Hoff H., Biemans H., Fader M., Waha K. (2011): Global water availability and requirements for future food production, Journal of Hydrometeorology, doi: 10.1175/2011JHM1328.1 ¥ McCornick P.G., Awulachew S.B. and Abebe M. (2008): Water-food-energy-environment synergies and tradeoffs: major issues and case studies. Water Policy, 10: 23-36 ¥ Shahbaz Khan, Munir A. Hanjra; Footprints of water and energy inputs in food production Ð Global perspectives, Food Policy 34(2), 2009, pp 130-140. ¥ A.K. Plappally, J.H. Lienhard V; Energy requirements for water production, treatment, end use, reclamation, and disposal;Renewable and Sustainable Energy Reviews, Vol.16, Issue 7, September 2012, P.4818-48 ¥ World Energy Council; Water for Energy; 2010.	10. Water, Energy, and Land use				We appreciate the suggestion, but feel the current references are appropriate and adequate given the chapter's space limitations.
Appendix A of NRC Review		Include natural gas, nuclear.	10. Water, Energy, and Land		387	24	The text has been amended to include a wider range of energy projects.

			use				
Appendix A of NRC Review		"Energy mix" should include not just renewables.	10. Water, Energy, and Land use		388	15	The text has been edited to include non-electric energy and broader set of electric generation options.
Appendix A of NRC Review		Possible to add more examples? Refs?	10. Water, Energy, and Land use		389	15	We agree that this is an important point, and have added addition explanation of the social and resource management implications to the text.
Appendix A of NRC Review		Why not also show power demand or some other indicator to illustrate the interactions?	10. Water, Energy, and Land use	10.2	391		We appreciate the suggestion, but space is limited. The author team has deliberated and agreed on the most important information/illustrations to include. The text was clarified to explain the interactions.
Appendix A of NRC Review		Section on "Options for Reducing Emissions". It is unclear that the mitigation technology descriptions belong here or in the Mitigation chapter. Or is this section trying to address "E-L-W-C interactions and implications for mitigation"?	10. Water, Energy, and Land use		397	3	The text was revised to clarify that this section focuses on energy-water-land interactions as these relate to mitigation and adaptation.
Appendix A of NRC Review		Similarly, the section on "Challenges to Reducing Vulnerabilities" vs the adaptation chapter or be refocused on E-L-W-C interactions and implications. Again, this needs a powerful conceptual figure and is too dependent on singular case examples.	10. Water, Energy, and Land use				A conceptual figure illustrating these interactions will be added in the final version.
Appendix A of NRC Review		This is a well written chapter which also covers the essential issues and messages in a clear and succinct fashion.	11. Urban Systems, Infrastructure, and Vulnerability				Thank you for the accolade.
Appendix A of NRC Review		This chapter is unbalanced in its singular focus on adaptation and vulnerability and none on mitigation. It lacks quantitative assessments of how much U.S. urban areas contribute to emissions and why it's important to focus on cities in the context of climate change. The chapter is too descriptive with many examples from hurricanes and little offered in terms of how places have overcome obstacles or robust strategies to mitigate or adapt to climate change. The implicit message in the chapter is that adapting to climate change will be like responding to a hurricane. There needs to be a wider discussion of the range of climate change impacts on cities beyond storm surges and sea level rise and at least some discussion of what cities can do to reduce emissions. Cities are engines of economic activity in the country, but there is no discussion of how climate change will impact urban economies. Are there some cities that will be more vulnerable than others? The chapter is silent on this. Are there some adaptation strategies that are more appropriate for large cities? Coastal cities? Old cities? Similarly, are there	11. Urban Systems, Infrastructure, and Vulnerability				Climate change mitigation was not part of the charge to the chapter authoring team. Also, space limitations prevented detailed regional or city analyses. We refer you the regional chapters of this report.

		mitigation strategies that are more suited for NYC than Knoxville, or regional variations? The chapter could be greatly improved if there were more geographically-specific details about what communities can do. There are a lot of geographically-specific examples (mainly on Katrina and NYC), but little in terms of lessons learned or synthesis of different strategies.					
Appendix A of NRC Review		Section on Urbanization and Infrastructure: This section could expand its definition (currently missing) of infrastructure. This section currently only addresses water, energy, and transport.	11. Urban Systems, Infrastructure, and Vulnerability		420	8	Thank you for your suggestion. Based on your comment, edits have been made.
Appendix A of NRC Review		Section on Essential Services: This focuses too much on describing their interconnections rather than what can be done. Also, most of this section is comprised of examples. It would be more useful to know how communities can respond or prepare, rather than providing so many examples.	11. Urban Systems, Infrastructure, and Vulnerability		422	1	The examples are meant to illustrate the interdependencies. The comment about what communities should do is prescriptive and not within the scope of this scientific assessment.
Appendix A of NRC Review		Section on Social Vulnerability: Like the earlier sections, too focused on example of Katrina, and not enough about what can be done.	11. Urban Systems, Infrastructure, and Vulnerability		425	10	What can be done is prescriptive and beyond our scope. We disagree with the reviewer that there is too much focus on Hurricane Katrina as the Chicago heat wave example was also included for balance.
Appendix A of NRC Review		Section on Trends in Early Adaptation: Most of the country is not like NYC. It would be more useful to a larger community if there were examples from smaller communities. How about including examples from places like Chattanooga or Denver?	11. Urban Systems, Infrastructure, and Vulnerability		426	1	It is our perspective that the experiences of NYC are transferable to other urban settings. Given space constraints we were not able to include other case examples.
Appendix A of NRC Review		Key Message 4: How can cities overcome "barriers to implementing and incorporating wider governmental, general public, and private efforts"?	11. Urban Systems, Infrastructure, and Vulnerability		426	2	Elements of response to this issue were already present in the text; introduced text to highlight conditions for enhancing adaptation policy success
Appendix A of		Why cities are early responders (causality) is not established in the literature. Restate to be more factual (e.g., many cities have developed climate action plans).	11. Urban		428	33	Thank you for your suggestion. Based on your comment, edits have been

NRC Review			Systems, Infrastructure, and Vulnerability				made in several locations to more fully define the issues.
Appendix A of NRC Review		This sentence structure suggests that climate adaptation plans cause the expansion of urban landscape.	11. Urban Systems, Infrastructure, and Vulnerability		429	39	Comment does not appear to point to correct section of text.
Appendix A of NRC Review		The chapter argues that tribal areas are poor and disadvantaged, have inferior infrastructure, and are highly dependent on natural resources, all of which will increase their vulnerability to climate change. While argument makes sense based on the general findings of the vulnerability literature, the empirical evidence on climate change impacts and vulnerabilities of tribal populations is quite thin for all areas covered in the chapter other than the Arctic. The chapter should emphasize the need for more research on impacts, vulnerability and adaptation of tribal areas and populations.	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources				The text has been revised to incorporate this suggestion. We have added a number of new references and more specific information.
Appendix A of NRC Review		In the section on traditional knowledge, the connections between climate change and traditional knowledge need to be untangled. Traditional knowledge clearly has a vital role to play in understanding climate change impacts and promoting adaptation. Climate change may also contribute to loss of traditional knowledge if the impacts are so severe as to disrupt communities. However, the loss of traditional knowledge is not (yet) primarily being driven by climate change. This loss has more to do with broader societal forces - development, globalization, assimilation, changes in lifestyle preference among young people, and so forth. The role of these other factors should be acknowledged and the causality(ies) between climate change and loss of traditional knowledge should be clearly laid out.	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources				To address the need to clarify the role of TEK in climate change, we added the following statement and citation: "Traditional knowledge can play a role in understanding the impacts of climate change and inform potential strategies for adaptation (Lynn et al. 2013). " In regards to the potential loss of TEK, the authors feel this is addressed by the statement on pg. 445 line 27 - 30: "However, there are elements of traditional knowledge that are identified as being increasingly vulnerable with changing climatic conditions (Voggesser et al, 2013). These elements include language, culture and cultural identities, ceremonies, sense of place, all our relations (human and non-human), and traditional ways of life. (Basso,

							1996)"
Appendix A of NRC Review		In the section on Water Quality and Quantity, might water infrastructure shortcomings also exacerbate vulnerability to climate change and limit adaptation options?	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources				The text in Key Message #2 has been revised to incorporate this suggestion.
Appendix A of NRC Review		Is the map displaying percent Native American of each county's population? How were the map categories selected (8 and above, 3.0 to 7.9, 1.5 to 2.9)? These seem like relatively low percentages; the map makes it appear as if N.A. populations dominate these areas.	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources		442	12	The text in the caption has been revised to incorporate this suggestion. The major aspects captured by the graphic are: (1) not all indigenous people reside on reservation lands; (2) reservation-based tribes are responsible for vast land distribution where climate impacts are occurring; and (3) tribal cultural resources, for which tribes have responsibility for beyond the reservation boundaries, are at risk of climate change impacts.
Appendix A of NRC Review		The literature used to demonstrate poor socioeconomic conditions and vulnerability is all grey literature. It would be useful to include evidence from peer-reviewed literature on socio-economic conditions in tribal areas.	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources		443	8	The text has been revised to incorporate this suggestion. We have added a number of new, peer-reviewed scientific references and more specific information.
Appendix A of NRC Review		The caption mentions "mitigate and adapt" to climate change, but all of the projects seem to be associated with mitigation.	12. Impacts of Climate Change on Tribal, Indigeno	12.2	443		We deleted the words “and adapt to” to more accurately capture the graphic.

			us, and Native Lands and Resources				
Appendix A of NRC Review		What percent of Alaska's land base is this (44 million acres)?	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources		444	4	The text has been revised to incorporate this suggestion. We have added the phrase: "about 42% of Alaska's land base."
Appendix A of NRC Review		Why is there a reference to a non-U.S. location here? The text should specify that this is non-U.S. and should explain its relevance.	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources		453	25	The text has been revised to incorporate this suggestion. The example of Tuvalu has been replaced by U.S. Island Territories.
Appendix A of NRC Review		The chapter is clearly and well-written and particularly strong in the focus of impacts and potential threats to indigenous communities. The discussion of indigenous knowledge was particularly interesting, especially the idea that climate change may pose challenges to the application of this knowledge. Similarly to the rural communities chapter, there is relatively little focus on adaptive capacity building. This could also have brought a different and welcome dimension to the discussion.	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources				We greatly appreciate your positive comment. We also appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include. We have added a number of new, peer-reviewed scientific citations, which we refer you to that include discussions on adaptive capacity building.
Appendix A of		There is a third reason. The benefits of altering land use include many effects that are not captured by the landowner or even the community to which the land parcel belongs. As a result, many changes that	13. Land Use and		472	17	Good suggestion; edits have been made.

NRC Review		might be effective (at least over the long term) do not make sense until there is a change in the institutional arrangements to handle these commons issues. (Cf. 478/15-479/2, where there is an acknowledgment that climate is likely to have a minor impact on choices made, even though these choices will affect the resilience of communities. This is a commons effect.) The authors surely know this perfectly well, so the question is why this reason is left out.	Land Cover Change				
Appendix A of NRC Review		The time period for estimating cumulative land cover changes seems to be relevant because it is similar to the time scales mandated in the Global Change Research Act. This might be pointed out.	13. Land Use and Land Cover Change		473	14	We were unable to find wording in the Global Change Research Act related to time scales of past assessments. The only specific mention of time scales was for projections (25-100 years).
Appendix A of NRC Review		The projections reported here will seem mysterious to nonspecialist readers. Are these estimates based on economic models that drive land use changes? If so, what has been their ability to backcast? Is the rapid growth of the Sunbelt over the past two generations likely to be a model for other regions (or itself) in the next half century? Fig. 13.2 suggests that the proportions of land use will change slowly for the next 4 decades.	13. Land Use and Land Cover Change		476		Thank you for your suggestion; text has been modified.
Appendix A of NRC Review		"Low density housing" here is what is called suburban and exurban development earlier, and it would be useful to connect back to that terminology in discussing the wildland-urban interface.	13. Land Use and Land Cover Change		479	5	Good suggestion. Text has been modified.
Appendix A of NRC Review		The chapter starts off with the message that individual land use decisions of people, government, organizations can have effects on climate change impacts and reduce effects on the climate. But then the remainder of the chapter largely describes land use and land use change patterns in the U.S. and the impacts of climate on these patterns, with little discussion of land management strategies that can be undertaken to mitigate or adapt to climate change. There are some examples of land decisions (e.g., p. 478), but no prioritization of what land decisions are likely to have the biggest impact. What's the message for land managers at local, regional, or national scales? It would be useful to have a clearer message about how best to mitigate climate change through land use practices, or the land uses and land covers that will be most threatened by climate change.	13. Land Use and Land Cover Change				We are reporting on the available science, which at this point does not support prioritization. Of course, what is most important will vary among regions and depending on the decisions faced by any given decision maker. The space available in the chapter doesn't permit, of course, addressing all contingencies. We have, however, added references to the Adaptation, Decision Support, and Mitigation chapters.
Appendix A of NRC Review		Some assessment of these land use plans would be useful.	13. Land Use and Land Cover Change		481		We appreciate this suggestion, but space is limited. Moreover, these plans are very new and, to our knowledge, have not been formally assessed.
Appendix A of NRC Review		Urban land use patterns, especially the link between land use and transportation are key determinants of urban emissions. This issue is also not covered in Chapter 11. See the works of Robert Cervero, Kevin Krizek, and Brian Stone.	13. Land Use and Land Cover Change		483		We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include.
Appendix A of NRC Review		Why are the trends virtually constant for the 2010-2050 period? It's hard to believe that this will be the case, especially with current trends of baby boomers and <30 preferring to move back to cities.	13. Land Use and Land Cover	13.2	477		Yes, it is surprising. The story is embedded in the ways the projections were made, which we have summarized. Basically, when we use

			Change				reasonable assumptions of population and economic growth, benchmarked to Census population numbers and correlated with observed patterns of land use and land cover, the expected changes are relatively minor. The models make no assumptions about climate impacts on disturbance regions, changes in agricultural policy, or changing market conditions for such things as forest products, all of which could have big impacts, but which we cannot say anything about either way.
Appendix A of NRC Review		General comments: While this chapter provides important data on land cover and land cover change for the U.S, it for the most part very general and with support from anecdotes. Most of the chapter side steps specific predictions and in many places the coupling between LUC and climate is not well developed.	13. Land Use and Land Cover Change				We feel that the approach we have taken makes use of the best available science, which to our mind is not well developed enough to provide more than case study examples of specific processes. We have added more specific quantitative information to the projections section, which we hope answers this comment to some degree.
Appendix A of NRC Review		The difference between net and gross LUC and how they were calculated was not clear .	13. Land Use and Land Cover Change	13.2	475		The text has been revised.
Appendix A of NRC Review		It's really hard to see LUC as the percentage changes are so small. Is there a way to redraw that makes the changes more obvious?	13. Land Use and Land Cover Change	13.2	477		Y-axis range will be modified.
Appendix A of NRC Review		This is an example of highly anecdotal information that it is difficult to generalize.	13. Land Use and Land Cover Change		479	1	Because we are basing our chapter on the best available science, and the of adaptation is based largely on case studies, we are unable to summarize the science in a way that would be more generalizable.
Appendix A of NRC Review		The chapter presents a clear and well-researched profile of current economic, social, demographic, and environmental conditions in the rural United States. The chapter does a nice job of covering the major dimensions of climate change impacts, vulnerabilities and adaptation in rural areas.	14. Rural Communities				Thank you for the accolade.
Appendix A of NRC		One weakness of the chapter is that it says very little about the implications of mitigation policies and projects for rural communities. For example, mitigation policies that affect coal production could have a substantial economic impact on many rural communities, as could policies to promote production of	14. Rural Communities				We appreciate the comment, and have revised the text to reflect that mitigation policies and projects will

Review		non-fossil fuel energy such as wind.					have serious implications for rural communities.
Appendix A of NRC Review		While many of the general factors that are thought to increase vulnerability of a community to climate hazards such as an aging population, high poverty rates, and lack of mental health care are present in rural areas, most of the evidence presented in the chapter is indirect. For example, regarding mental health, the discussion on p. 504 notes a) the lack of access to mental health providers in rural areas and b) the (non-rural) evidence that climate change can harm mental health, but provides little direct evidence that climate change will affect mental health in rural areas. The chapter should acknowledge that there is a lack of systematic research on rural vulnerability and point out that there is a need for additional empirical research in this area. (The chapter calls for additional work on both impacts and adaptation. A similar call for work on vulnerability (and mitigation) could also be included.)	14. Rural Communities				Thank you for your comment. We have revised the text to mention the need for additional research on rural vulnerability. For readers interested in more in-depth discussions on climate change related impacts to mental health and mitigation, we have added in-text citations to the Human Health and Mitigation chapters.
Appendix A of NRC Review		This comment applies to both the rural and urban chapters: Where do suburban and especially ex-urban areas fit into either the rural or urban chapters? Most U.S. residents live in suburban and ex-urban areas that are neither urban nor rural. Ex-urban areas are characterized as "metro" but many of them share more qualities with rural areas than cities, including actively functioning resource-based economies, particularly tourism and agriculture. Suburban areas are more like cities in terms of their landscape and infrastructure, but, institutionally, they may have very limited capacity for adaptation planning. A suburban municipality within a large metro area can have upwards of 100,000 residents, but it will not have the institutional capacity for dealing with climate change (e.g., planning office, emergency management office) that a much smaller city would have in another part of the country.	14. Rural Communities				Thank you for your comment. The Land Use and Land Cover Change Chapter added a discussion of land categories to mention the significant variety across urban/suburban/exurban/rural settings and conditions, and variety in types of expected impacts. We have added an in-text citation to this chapter. The Urban Systems, Infrastructure, and Vulnerability Chapter broadly addresses metropolitan areas. We recognize there may be differences in impacts and vulnerabilities in these different areas, however, there has been little research done on this topic. We suggest this as an area for further research that should be included in future assessments.
Appendix A of NRC Review		Are there any changes since 2000 based on the 2010 census data? The map should perhaps label the white counties as metro. Many of the very large counties in western states that are classified as metro are quite 'rural' in character. This is true in the East as well. Neither Massachusetts nor New Jersey have any rural counties yet both have substantial areas that would be considered rural based on presence of resource- or agricultural-base economic activity.	14. Rural Communities	14.1	496		Thank you for your comment. We added a USDA Economic Research Service map based on Census 2010 data. The map shows nonmetropolitan counties as defined by the Economic Research Service, which considers open countryside, rural towns (places with fewer than 2,500 people), and urban areas with populations ranging from 2,500 to 49,999 (Source: http://www.ers.usda.gov/topics/rural-economy-population/rural-classifications.aspx). Figure 14.2 shows economic dependence by region.
Appendix A of		What does economic dependence entail? Does this mean that the identified sector accounts for the largest share of employment in the county?	14. Rural Commun	14.2	496		Yes. Economic dependence means that the identified sector accounts for the

NRC Review			ities				largest share of earnings and employment in the county. The U.S. Department of Agriculture, Economic Research Service has six classifications of counties by measures of earnings and employment: 1=farm-dependent; 2=Mining-dependent ;3=Manufacturing-dependent 4=Federal/State Government-dependent; 5=Services-dependent; 6=Nonspecialized. We have added a definition in the caption.
Appendix A of NRC Review		Does this assessment of agricultural resiliency match the assessment in the agricultural chapter?	14. Rural Communities		497	9	We appreciate your comment. The assessment in this chapter of the resilience of U.S. agricultural systems in the short term is consistent with Chapter 6: Agriculture. We added additional text to the chapter to more clearly mention that, in the long term, agricultural systems in some areas may need to undergo more transformative changes to keep pace with future climate change, in line with Key Message 5 in the Agriculture Chapter. We have also added in-text citations to the Agriculture Chapter.
Appendix A of NRC Review		What about the expected need for use of more herbicides and pesticides to maintain agricultural productivity (see p. 242, line 9 in the agricultural chapter)? This would add to local pollution exposure in rural communities, particularly for farm workers. REF: Wolfe, et al, 2011: "Agriculture" in (Rosenzweig, et al, eds.) Responding to Climate Change in New York State: The ClimAID Integrated Assessment for Effective Climate Change Adaptation in New York State. Annals of the New York Academy of Sciences, 1244, 2-649.	14. Rural Communities		499	24	The text was modified to address additional use of herbicides and pesticides.
Appendix A of NRC Review		The direction of causality is confusing. Might reword to say that climate change will also contribute to increased demand for water for both energy and agriculture, which will then exacerbate water scarcity.	14. Rural Communities		500	5	Increased water paucity as a result of climate change is expected to increase competition for water between the energy and agricultural sectors. We have reworded the sentence to convey this clarification.
Appendix A of NRC Review		Might also note that power and communication outages as the result of extreme events in rural areas often take longer to repair, which contributes to the isolation and vulnerability of elderly residents who may not have cell phones. Lack of cellular coverage in rural areas is still an issue in some places and can create problems for emergency response during power failures. [REF: Jacob, K., et al, 2011: "Telecommunications" in (Rosenzweig, C., et al , eds.) Responding to Climate Change in New York State: The ClimAID Integrated Assessment for Effective Climate Change Adaptation in New York State. Annals of the New York Academy of Sciences, 1244, 2-649.	14. Rural Communities		504	14	We thank the reviewer for the helpful suggestion and reference, and have amended the chapter.
Appendi		This paints a gloomy view of the potential impacts of green energy development in rural communities.	14. Rural		506	20	Text has been revised to indicate that

x A of NRC Review		Might land-based energy production like wind-power or solar potentially benefit local land owners and local communities? The idea that green energy production can be both sustainable and equitable is being discussed in the scientific and policy literature and should not be simply dismissed as something that is not likely to benefit rural communities. A separate table with the projections by region might be more useful (to which this table could refer)	Communities				the impact of mitigation activities -- switch to RE, for example -- can have both positive and negative effects.
Jeff		This from my student, Diana Li (diana_li@horacemann.org)As Chapter 5 tells us, the US economy depends on the personal and freight mobility provided by the country's transportation system. As of recent, a series of extreme weather conditions threaten our ports, airports, railroads, subways, bridges and canals. The chapter, however, fails to take innovation into consideration. Right now, roads are geared towards fuel guzzling vehicles that account for 65% of the 27% of US greenhouse gas emissions. Growing up in a world as industrial as ours, we've become familiar with expansive highways and dirty subway trains. Along highways, there are gas stations for vehicles to fill up at. However, only considering these factors stifle innovation. Limiting our view to what we have stifles creativity and does not show us what we are missing out on. Looking ahead, there will be drastically new and radically efficient means of transportation such as high speed rail, magnetic levitation or, as some radicals would push for, teleportation. As your reports mention, Vermont, Tennessee, Iowa and Missouri have been victims of severe precipitation and flooding. In the past three years, these states have seen dramatic altercations to their roads, bridges and railroads. Given the increasing likelihood of extreme weather events and increased precipitation, there will be further damages. It is necessary to take a long term view where we take into account the fact that better technology will emerge. Chapter five lacks the urge to look forward into not what we have but what we could have. Car manufactures have set the bar for themselves so that soon, they will all have to be able to run 50 miles per gallon. We need to take into consideration future advances in technology. We will not go far without a long term view. I'm not talking about a view that looks 10 years or 100 years ahead but a view that will look thousands of years ahead. In addition, one of the largest issues that we face today is our floundering economy. Transportation infrastructure built in America is expensive and can usually last 50-100 years. However, with changing climate conditions, they will not be able to last as long as they do now and will need approximately $4.1 trillion dollar to rebuild everything. Transportation systems also rely on fuel and electricity. In the aftermath of Hurricane Sandy, the Number 1 trains in New York City still stop at Rector Street rather than South Ferry, it's original destination. These situations beg to be asked, "What are we going to do once it happens?" After reading this report, I'm left with a sense of desperation. I'm left wondering, "We know this is coming our way. What are we going to do once is has happened?" Climate change is affecting us in more ways than one. We need alternative ways of transportation and we need to start building now so that when the temperature increases another three degrees, we're not left in a bind. Whether it is building buildings piece by piece in factories to decrease cost or taking care of what we all use and take for granted, it needs to begin now. In addition, I am a proponent for a more forward-looking view on these issues. As mentioned, in Alaska has a problem with thawing permafrost. It is causing pavement, runways, rail and pipeline displacement. These means of transportation then need money to be reconstructed or maintained. NCADAC needs to come up with solutions directly aimed at fixing the problems that Chapter 5 brings to attention. For example, the problem in Alaska can be addressed by working on the creation of Magnetic Levitation Trains, otherwise known as "Maglevs." Countries such as Japan or Germany have been developing and testing their Maglevs since 2005 and 2009, respectively. These Maglevs are known to be more expensive to construct but require far less maintenance, and thus, less manpower to fix problems. In the long run, these trains are more efficient than what we are familiar with today. They are also no affected by weather conditions, the largest issues that Chapter 5 is concerned about. In recent years, countries such as South Korea or The People's Republic of China have been building these Maglevs but at a lower speed. Where subway systems or railroads have wheels pounding on tracks over and over again,	5. Transportation				Thank you (and your student) for these thoughts. Unfortunately, we are limited in the amount of space to discuss climate change and transportation. We believe the intent of your comments are valuable, but do not fit into the focus of this chapter.

		Maglevs quite literally levitate. They never touch these tracks, lowering the need for fixing tracks. How many times have you been stuck in a subway tunnel because the MTA is having “technical difficulties?” Maglev technology is not new to science. In fact, the first one ever built was in 1979 in Hamburg, Germany. Rather than worrying about what is out of our control, we must focus on the future and what we can do to solve the problems that will arise (or have already risen) once the disasters outlined in Chapter 5 hit. In addition to Maglevs, there are also high speed rails. These high speed rails have been known to hit 300 km/h. This would cut transportation in half, getting people to and from work in record times. Japan, in 1964 created the first high speed rail, more commonly known as the Bullet Train. Shanghai, China, as one of the world’s most infra-structurally developed cities, has made a specific effort to increase the capacity of these rails. The United States has always been at the frontier of scientific development cannot stop now. The US economy depends on our ability to be innovators and leaders, not followers. We’ve come to terms with the problems. Now, it is necessary that we look at the long term problems and find plausible solutions. We will be faced with the inevitable. The moon is leaving us, the sun is enroute towards become a Red Giant where our seas will boil away. Someday, teleportation might be possible. In the face of these adversaries, it is our duty to not just point out problems but to take it upon ourselves to find solutions after these natural disasters have occurred.					
Appendix A of NRC Review		It is nice to see the authors’ social-ecological focus and attention to the role of natural capital in shaping the vulnerability of rural communities.	14. Rural Communities				Thank you for the accolade.
Appendix A of NRC Review		It is surprising that there is no mention of immigrant communities living in rural settings, (for example, colonias in the U.S.-Mexico border). While they are exposed/sensitive to most of the impacts described in the chapter, they are also often disconnected of the formal institutional arrangements that provide rural communities (even if inadequately) with the means to cope and adapt to climate impact. The fact that these communities often include illegal immigrants makes the problem particularly complex.	14. Rural Communities				We appreciate your comment. We agree with your suggestion and have added a small section on vulnerabilities faced by Hispanic immigrants.
Appendix A of NRC Review		While there is some description of responses and risk management, there is not much on adaptive capacity building of rural systems. In particular, a discussion of how the implementation of risk management affects (positively and negatively) long term risk reduction, access to resources and sustainability of the social ecological systems where they live would have significantly enriched the discussion. It could also be of practical interest to planners and decision-makers (e.g. how to design policy that foster climate resilient pathways combining mitigation, adaptation and sustainable development, for example). Even if the evidence in the U.S.-focused literature is not very robust at this point, there is an emerging literature focusing these issues on less developed countries that could inform this discussion.	14. Rural Communities				We appreciate the suggestion, but space is limited and the literature on this topic is sparse. The author team has deliberated and agreed on the most important information to include and feel that the current discussion on adaptation is appropriate and adequate given the availability of literature on this topic. In recognition of the importance of addressing response strategies, this report assesses adaptation, mitigation and decision support responses in more depth in Chapters 26-28. We refer those interested in a deeper treatment of these topics to these chapters and have added the corresponding in-text citations.
Appendix A of NRC Review		Startling to see that discussion of Nr does not mention that some compounds are greenhouse gases. There is a passing mention at 520/17 re N2O but it would make sense to highlight direct contribution of Nr to radiative balance here.	15. Interactions of Climate		521		Thank you for your comment; the text has been revised in regards to this suggestion.

			Change and Biogeochemical Cycles				
Appendix A of NRC Review		Should the reader infer that "cleaning agent" refers to chemical interactions that remove methane from the troposphere? The way these sentences are structured makes the idea of "cleaning" hard to follow for a lay reader. It's a good expository idea. Consider as a replacement for ll. 21-25: "Once released into the atmosphere methane can be removed through a variety of chemical reactions. One of these depends upon hydroxyl radicals which serve as a "cleaning agent" reducing methane concentrations. But pollution in the form of VOCs and oxides of nitrogen are depleting hydroxyl radicals, and in the future this effect is expected to increase the lifetime of methane in the atmosphere, raising its contribution to changes in the average temperature of the atmosphere."	15. Interactions of Climate Change and Biogeochemical Cycles		523	24	Thank you for your comment. To some extent we've edited this paragraph, however the chemical reactions in the entire suite of gases in the trosphere are very complex, and to treat them well would require much text,. Due to this length constraint, the author team deliberated and agreed on the most important information to include.
Appendix A of NRC Review		This is an important and troublesome section. The real finding is multiple stressors rather than the connection between climate and biogeochemical cycles. Perhaps the authors would rewrite along this line (526/23-25): "Climate change is one factor interacting with other forces of human origin to change the natural world's behaviors and rhythms. Those behaviors are reflected in shifts in biogeochemical cycles (which measure the movements of key elements through the complex pathways of the biophysical world). The shifts in biogeochemical cycles are, to a substantial degree, the product of human activities now--we have become a planetary 'force of nature.' Those shifts, in turn, result in a complex set of multiple, interacting stressors that press upon humans and the ecosystems we rely upon for well-being. The complexity of the world reflected in biogeochemical cycles, in turn, must be respected when taking actions intended to moderate or mitigate the adverse effects of human-caused change."	15. Interactions of Climate Change and Biogeochemical Cycles		526		Thank you for your comment. The text here is based on citable, quantitative analyses and no changes have been made.
Appendix A of NRC Review		Caption seems to make better sense if rewritten as "Many Factors are Affected by Changes in Biogeochemical Cycles."	15. Interactions of Climate Change and Biogeochemical Cycles	15.4	527		Thank you for your comment. This figure and caption will be replaced.
Appendix A of NRC Review		"land-based" ignores the potential for managing marine ecosystems as C sinks. Better "land- and marine-based." As noted at 42-43 aquatic habitats (and marine--need a citation for this) remain scientifically uncertain, so "land-based" is appropriate in 9-26.	15. Interactions of Climate Change and Biogeochemical Cycles		529	7	Thank you for your suggestion. Edits have been made in regards to this suggestion.
Appendix A of NRC		This chapter seems to be based on a fair reading of a complex scientific literature. Although specific technical comments are offered below, overall the drafters have done a thorough scientific review. This is a difficult area, with many scientific uncertainties remaining in the nitrogen cycle. Yet there can be no	15. Interactions of				Thank you for the compliment.

Review		doubt that human alterations of the flows of nitrogen (in large measure from the application of fertilizers in agriculture) are causing fundamental changes in the natural world. These changes are implicated in the changing climate, although the global-scale changes in biogeochemistry have even wider implications, such as seasonal hypoxic zones ("dead zones") in coastal marine systems.	Climate Change and Biogeochemical Cycles				
Appendix A of NRC Review		General comment: As in other chapters, there is no discussion of biophysical consequences of land use change. Will this be discussed elsewhere?	15. Interactions of Climate Change and Biogeochemical Cycles				Thank you for your comment. The biophysical consequences, while interesting and potentially critical, are, however, outside the scope of this chapter.
Appendix A of NRC Review		The term "sink" implies permanent removal from the energy system and the C cycle. Burial of plant material to create fossil fuels is as close as it gets to a "sink". Everything else, including forests, represents a transient residence with a defined mean residence time that is less than infinity. We should really strive to define a more accurate term than sink when referring to the MRT of C in various pools, lest we give the false impression that storage in most biogeochemical pools is permanent. Ditto with "sequestration" (pg 524, ln 21).	15. Interactions of Climate Change and Biogeochemical Cycles		521	5	Thank you for your comment; the text has been revised in regards to this suggestion.
Appendix A of NRC Review		This figure is hard to understand and its not discussed in the text. What is the meaning of the labels on the x axis? Also, the colors in the legend do not match the figure.	15. Interactions of Climate Change and Biogeochemical Cycles	15.3	525		Thank you for your comment. The labels are correct as they are, but time permitting, we will try to improve. Not all figures are referred to in the text.
Appendix A of NRC Review		Remove brackets from the sentence that begins, "A Critical Load..."	15. Interactions of Climate Change and Biogeochemical Cycles		528	10	Thank you for your comment. We have, however, retained the brackets. This is similar to how we used a parenthetical sentence to define reactive N on the first page of the chapter.
Appendix A of NRC Review		Here again, shouldn't we offer a more thorough discussion of "sink" and "store"? What is the meaningful time scale? Days, months, years, decades?	15. Interactions of Climate		529	1	Thank you for your comment. Minor edits have been made in regards to this suggestion.

			Change and Biogeochemical Cycles				
Appendix A of NRC Review		Agricultural soils are reported as a C sink of -8 Mt C/y in this table. This is hard to imagine. Under the most highly productive perennial grasses, these soils accumulate about 1 t/ha/y and under most cases of annual cultivation these soils loose at least this amount of C annually.	15. Interactions of Climate Change and Biogeochemical Cycles	15.1	530		The sign for a source is (-), and -8 Mt C/yr +/-50% means it was estimated to be a net source of -4 to -12 Mt C/yr.
Appendix A of NRC Review		CO2 has increased by >40% since 1765 not 30%.	15. Interactions of Climate Change and Biogeochemical Cycles		519	18	Thank you for your comment; Key Message #1 has been revised.
Appendix A of NRC Review		Other than the obvious and non-geographic specific consequences of increased frequency of heat waves and increased ozone levels, there is little discussion of health issues specific to the Northeast. It should be recognized that two of the most important epidemics caused by vector-borne diseases, Lyme disease and West Nile virus, originated in the Northeast. Although the role of climate change in the emergence of these diseases has been speculated without convincing evidence, it is well documented that tick populations are expanding their ranges northward and mosquito populations are regulated by both rainfall and temperature. The Northeast may be more vulnerable to other tick-borne diseases and exotic vector-borne pathogens.	16. Northeast				New text has been added to expand the discussion of public health impacts.
Appendix A of NRC Review		Would it be worth noting that the estuaries are critical habitat for breeding for many species of economic and cultural importance to the region?					It is unclear what text the comment is referring to.
Appendix A of NRC Review		The idea of a 100 or 50 year event in a 30 year time span will confuse most readers.	16. Northeast		565	21	The text has been revised to incorporate this suggestion.
Appendix A of NRC Review		Could a figure like Fig. 16.3 (projected increase in the number of 95 F days by 2041-2070) be construed as overdriving our forecast headlights given all the (likely) unjustified mesoscale detail shown?	16. Northeast	16.3	552		New text has been added to several sections of this report (e.g. Intro to Regions) to provide context about the spatial and temporal uncertainties inherent in any projections. Readers will be pointed to these sections in the final formatted report.

Appendix A of NRC Review		Heat wave issues are mentioned for the Northeast but nowhere else. Could a naive reader conclude that more frequent heat waves will only be a problem in the Northeast?	16. Northeast				In fact, heat waves were mentioned in many places in the report such as the chapters on Climate Change Science, Midwest, & Southwest.
Appendix A of NRC Review		This chapter uses hyperbole and dwells on a litany of negative impacts with no acknowledgement of the fact that this region will likely see the least changes, in terms of temperature, from climate change.	17. Southeast and Caribbean				The text has been revised to incorporate this suggestion.
Appendix A of NRC Review		A map delineating the regional boundaries should be added at the beginning of the chapter.	17. Southeast and Caribbean				The text has been revised to incorporate this suggestion by adding maps this and to other sections of the report.
Appendix A of NRC Review		Line 16 says, "Projections of future precipitation patterns are less certain than projections for temperature." Text describing the certainty/uncertainty of both temperature and precipitation should be added.	17. Southeast and Caribbean		587	14	The text has been revised to incorporate this suggestion.
Appendix A of NRC Review		This paragraph provides examples of roads and the costs associated with addressing their sea level rise vulnerability. Consider moving this information to a box as examples of infrastructure already being impacted, since the specifics provided are not introduced well in the text.	17. Southeast and Caribbean		591	13	The chapter has not been restructured in this way since the amount of text was too little for a separate box.
Appendix A of NRC Review		Depicts trends in water availability. The caption suggests that average annual water yield for the ten-year record of 2001 to 2010 is being compared to the average annual projection for the fifty year period of 2010 to 2060. Additional explanation is need to explain why the base period was chosen, and what the statistical confidence is for the projections.	17. Southeast and Caribbean	17.11	599		The caption has been clarified and additional details are available in the cited reference.
Appendix A of NRC Review		The discussion on vector-borne disease in a warming climate is an underestimate of the potential importance. Other sections in this chapter suggest that southern Florida is likely to become more tropical and less temperate. As a tropical island connected to the mainland, south Florida has the potential for hosting a variety of tropical vector-borne diseases including dengue fever, Venezuelan encephalitis and other untreatable viral infections that could easily expand into the more populated areas of Florida and other southeastern states.	17. Southeast and Caribbean		596		We appreciate this suggestion, but the author team has deliberated and agreed that the text reflects the state of the science. Although there is the potential for spread of various tropical diseases, the authors are aware of no peer-reviewed literature that indicates a likely increase in dengue fever or any other vector-borne disease in the Southeast. The SE Technical Input Report (Ingram et al 2013) came to the same conclusion.
Appendix A of NRC Review		One could take issue with the clause "...[t]he regions role as a net absorber of carbon....]. While most young and maturing forest are indeed "carbon absorbers", land in row crop agriculture is a net source of C to the atmosphere. What is not made clear in this chapter, is when agriculture land and forests are taken together, is the entire region a net absorber of C?	18. Midwest		617	21	The text has been revised to incorporate this suggestion.

Appendix A of NRC Review		Given that the assessment's primary goal is to evaluate effects and vulnerabilities to climate change, a discussion of the effectiveness of bicycles etc. seems a bit out of place.					It is unclear what text the comment is referring to.
Appendix A of NRC Review		Why use Fahrenheit in a scientific assessment?	18. Midwest		631	1	After consideration of this point, we still feel the existing text is clear and accurate. This practice follows prior NCA reports and discussions with communication experts.
Appendix A of NRC Review		There should be more emphasis placed on the role of increasing CO2 in altering moisture dynamics. The current discussion on CO2 effects on crops focuses only on the fertilization effects on photosynthesis. While this is a direct and primary effect on C3, the indirect effects of increased moisture availability during periods of drought appear to be the primary response of C4 to elevated CO2 (e.g. Leakey et al., 2009; De Souza 2013 ; Hussain et al., 2013). Because this is a climate report and crops play such a major role in regulating climate in the Midwest, consider adding a brief discussion on CO2 and water. There is also pretty strong evidence that O3 will reduce water use efficiency, at least of soybean, perhaps this could also be discussed, if not here than in the chapter on agriculture. ¥ Hussain MZ, Vanloocke A, Siebers MH, Ruiz-Vera UM, Cody Markelz RJ, Leakey AD, Ort DR, Bernacchi CJ. 2013. Future carbon dioxide concentration decreases canopy evapotranspiration and soil water depletion by field-grown maize. Glob Chang Biol. doi: 10.1111/gcb.12155. ¥ de Souza, A.P.; Arundale, R.A.; Dohleman, F.G.; Long, S.P.; Buckeridge, M.S.; . 2013. Will the exceptional productivity of Miscanthus x giganteus increase further under rising atmospheric CO2? Agricultural and Forest Meteorology. 171. 82-92. ¥ Leakey, ADB (2009) Rising atmospheric carbon dioxide concentration and the future of C4 crops for food and fuel. Proceedings of the Royal Society B: Biological Sciences 276: 2333-2343.	18. Midwest				We appreciate this suggestion, but space is limited and feel it is best addressed in the agricultural chapter rather than in this regional chapter.
Appendix A of NRC Review		Agree with your remarks here. This is an important area to clarify.	18. Midwest		617	21	We greatly appreciate your positive comment.
Appendix A of NRC Review		"some America's great cities", rather subjective and awkwardly phrased.	18. Midwest		618	5	The text has been revised to incorporate this suggestion.
Appendix A of NRC Review		This is a little difficult to understand, perhaps try an alternate description.	18. Midwest		618	30	After consideration of this point, we still feel the existing text is clear and accurate.
Appendix A of NRC Review		caption: Trend implies a rate of change. Suggest: rephrasing or giving the slope of this line.	18. Midwest	18.1	619		After consideration of this point, we still feel the existing text is clear and accurate.
Appendix A of NRC Review		The CO2 offset in Leakey 2009 is for moisture stress. There is no offsetting affects for temperature.	18. Midwest		620	9	We have added a citation in our chapter assessment that encompasses temperature.
Appendi		Should probably stick with "heat trapping gasses".	18.		626	7	After consideration of this point, we

x A of NRC Review			Midwest				still feel the existing text is clear and accurate.
Appendix A of NRC Review		"Prices" here is a little vague.	18. Midwest		626	30	The text has been revised to incorporate this suggestion.
Appendix A of NRC Review		This could potentially be a bit misleading. This could be interpreted as 10 consecutive days. Recommend rephrasing "the 10 rainiest days can contribute as much as 40% of total precipitation in a given year". Also, given the information in the following sentences, it is important to give a timeframe for the numbers presented here.	18. Midwest		627	7	The text has been revised to incorporate this suggestion.
Appendix A of NRC Review		"Northern reaches" is not the best descriptor.	18. Midwest		629	12	The text has been revised to incorporate this suggestion.
Appendix A of NRC Review		There should be a caveat made here with regards to the period selected. This must correspond to the satellite record, but it is important to clarify if the 1970's had particularly high ice coverage as a result of the well documented period of anomalously cold temperatures.	18. Midwest		631	9	We have clarified the role of the 1970s, but in response to this and other comments, have extended the period to 1962.
Appendix A of NRC Review		Should this be Great Lakes rather than Great Lakes region?	18. Midwest		617	33	The text has been revised to incorporate this suggestion.
Appendix A of NRC Review		The chapter collates a wide range of literature on climate-related stresses to humans and ecosystems of interest to humans. It is noteworthy that there is no attempt to estimate the magnitude of the vulnerabilities, either in terms of measures of well-being such as Disability-Adjusted Life Years or in economic metrics such as dollars or percentage losses of regional GDP. This is a task for research, perhaps.	20. Southwest				We agree with your suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include. This is a topic that perhaps can be addressed better in the 2017 National Climate Assessment.
Appendix A of NRC Review		If the area of the circles is meant to correspond to the numbers, they don't look quite right. E.g., the ratio of diameters of the largest (CA) to the smallest (UT) circles should be 2.65 (square root of the energy generation numbers). But I measure this ratio as approximately 1.7.	20. Southwest	20.3	692		We thank the reviewer for the helpful suggestion, which has been incorporated into the figure.
Appendix A of NRC Review		The import of this comparison is in the covering up of the substructure shown beneath the parked cars in the Feb 1 image. But the two images are not cropped the same, so the force of the comparison is weakened. If there is more image in the Jan 20 figure, so that it can be zoomed out, that would make the figure more forceful.	20. Southwest	20.5	696		Thank you for your comment. Since these are photos taken by public volunteers, few sets depict both before and after, and even fewer are as impactful. None line up perfectly, but we feel the difference is clear without the perfect alignment.
Appendix A of NRC		The larger population at risk with a 3-ft rise is presumably estimated with a model or set of assumptions about settlement density once the rise occurs. Over the past century, however, the density of settlement may have increased markedly. So being clear about what is assumed for the	20. Southwest		697	13	Thank you for your comment. We have revised the text to make it clear that the estimated impacts are based on

Review		future and benchmarking it to what has happened through economic development and cultural preference is worthwhile. The social science point to make is that changing settlement patterns have dramatically increased exposure to sea level rise, forest fires, and drought. That is a point often not considered, despite its relevance to questions of changing land use in the decades to come.					current population levels.
Appendix A of NRC Review		Except for ocean acidification, all of the issues referred to here have been "wicked problems" for decades (water, coastal erosion, forest health). Changes in the various dependencies (shifts in crops as a result of changes in world demand, forest practices that leave more undergrowth, etc.) are just some of the "non-climate" processes that are critical. What does climate change bring to the party? A change in the statistics, such as magnitude and frequency? Moreover, are these non-climate processes, such global economic growth and changes in technology, more likely over the next 50 years? And will they have a greater impact?	21. Northwest				The text has been revised to incorporate this suggestion.
Appendix A of NRC Review		Key message #1: The message is that the timing of snowmelt will change. The text in the evidence base notes that there is "good agreement" but that "trends [are] less certain because of climate variability." Moreover, it is stated that "current and future interannual and interdecadal variations in climate will enhance or obscure long-term anthropogenic climate trends" is a key uncertainty. Now this is all correct, and one might conclude that this is a result to watch but that's too uncertain upon which to base shifts in policies or practices. However, this subtle message is lost in the text of the chapter. Instead, the reader would go away with the conclusion that this is a scientific certainty.	21. Northwest		737		The text has been revised to incorporate this suggestion.
Appendix A of NRC Review		The planet has one ocean and one atmosphere. By continuing to pluralize the ocean the authors lose the opportunity to showcase that the ocean is connected throughout the world, to the atmosphere, land, ice, and seafloor. Climate is more than the average of weather. The authors could showcase this connectedness by careful choice of their words.	24. Oceans and Marine Resources				The chapter focuses primarily on the three ocean basins that border on U.S. (Arctic, Pacific, and Atlantic) and which are referred to commonly in the media and by the general public as oceans. After consideration of this point, we still feel the existing chapter title is clear and accurate for the general public.
Appendix A of NRC Review		This chapter requires a good editing. It is duplicative, does not flow from evidence to interpretation, fails to demonstrate evidence, mislabels figures, and needs a good spell/grammar check. The key messages are wordy and hence require multiple readings to understand the point. They could be simplified to enhance understanding. For example, message three could be stated: Significant marine habitat loss will continue to occur due to climate change particularly in Arctic and coral reef ecosystems. In other areas (are there specific areas identified yet?) habitats may expand with associated shifts in species distribution, abundance, and productivity. Message 4 is very confusing and could be simply stated: Rising sea surface temperatures have been linked with increasing levels and ranges of diseases in humans and marine life. Messages 5 and 6 need work as well.	24. Oceans and Marine Resources				After consideration of this point, we still feel the existing text is clear and accurate.
Appendix A of NRC Review		Throughout this chapter as well as probably the entire report, there are not clear uses of the terms "impacts, " risks" , and "vulnerabilities".	24. Oceans and Marine Resources				After consideration of this point, we still feel the existing text is clear and accurate.
Appendix A of NRC Review		Please do not use the word "manmade". Gender neutral language should be used.	24. Oceans and Marine		836	28	The text has been revised to incorporate this suggestion.

			Resources				
Appendix A of NRC Review		Figure caption is incorrectly stated. The figure shows seas surface temperature anomalies, not sea surface temperature. The figure does not allow the writer/reader to infer the loss of biological diversity as stated in the last two sentences of the figure caption. This conclusion should be developed in the narrative following the introduction of the figure.	24. Oceans and Marine Resources		837	3	The text has been revised to incorporate this suggestion.
Appendix A of NRC Review		Satellite observations of what? Presumably ocean color, but it would be nice to showcase why you need these types of satellite observations.	24. Oceans and Marine Resources		838	2	The text has been revised to incorporate this suggestion.
Appendix A of NRC Review		Prior to this box the only source of ocean acidification that was discussed was atmospheric carbon dioxide. This particular example illustrates other sources of natural, episodic events that create ocean acidification in local/regional waters. The introduction of these natural sources that can interact with human caused change should be mentioned before the box or it should be mentioned in the first paragraph of the box.	24. Oceans and Marine Resources		840	19	After consideration of this point, we still feel the existing text is clear and accurate. Additionally, the chapter focused on broad trends for the topic. We refer those interested in a deeper treatment of the topic to the provided citations.
Appendix A of NRC Review		Has there not been evidence that the polar bear can evolve/adapt to land-based habitat? Wasn't some work that shows the early polar bear had spent considerable time using the habitat on what is now Greenland. The question probably is will the polar bear if given enough time, adapt to other habitats?	24. Oceans and Marine Resources		840	3	After consideration of this point, we still feel the existing text is clear and accurate. Based on both current ecological, physiological, and nutritional evidence, and on paleontological data on polar bear evolution, there is no evidence that polar bears can adapt to the loss of Arctic sea ice.
Appendix A of NRC Review		Is the section titled Coral Reef Ecosystem Collapse a box? I see an "end box" notation but not a "begin box". In any case this section uses language that is too technical. Line 25: "flattening of the three dimensional structure"; Line 28: "the symbiosis between coral and its associated algae partner". Line 27: delete "other". Need to explain these terms and processes.	24. Oceans and Marine Resources		842	18	The text has been revised to incorporate this suggestion.
Appendix A of NRC Review		Out of place; move to right after line 13? The topic of the paragraphs are jumping around from diseases in marine life and diseases in humans.	24. Oceans and Marine Resources		844	24	The text has been revised to incorporate this suggestion.
Appendix A of NRC Review		Suggest rewriting the key message. Suggestion: Altered environmental conditions due to climate change will affect human uses of the ocean (transportation, resource use and extraction, leisure and tourism activities and industries). (Suggest deleting the next sentence Ð I don't think marine activities have ever been "designed"). Human uses of the ocean depend on the current state of the ocean's	24. Oceans and Marine		845	2	The text has been revised to incorporate this suggestion.

		ecosystem services. Climate changes that result in ocean conditions that are significantly different than the current state may significantly disrupt the economies, access, and enjoyment of the ocean areas.	Resources				
Appendix A of NRC Review		Do you want to mention governance of the ocean in your key message? Also should you not mention that there will be opportunities resulting from this climate disruption of the marine environment Ð and there will be some winners in a new climate regime.	24. Oceans and Marine Resources				Thank you for your comment, however policy issues are beyond the defined scope of the National Climate Assessment, a scientific document that provides the basis for decision making, but does not address policy. Winners and losers are mentioned in the fisheries section.
Appendix A of NRC Review		An entire paragraph on the Arctic and security yet no mention of the International Law of the Sea?	24. Oceans and Marine Resources		845	8	Thank you for your comment, however policy issues are beyond the defined scope of the National Climate Assessment, a scientific document that provides the basis for decision making, but does not address policy. Winners and losers are mentioned in the fisheries section.
Appendix A of NRC Review		Are these numbers for marine tourism or tourism in general?	24. Oceans and Marine Resources		845	24	The text has been revised to incorporate this suggestion.
Appendix A of NRC Review		Not mentioning increasing probabilities of more extreme events?	24. Oceans and Marine Resources		845	31	Several references have been added and the text strenthened to provide some details.
Appendix A of NRC Review		"Greater effect" should be replaced with "positive effect".	24. Oceans and Marine Resources		846	15	After consideration of this point, we still feel the existing text is clear and accurate.
Appendix A of NRC Review		This sentence is out of place.	24. Oceans and Marine Resources		846	17	After consideration of this point, we still feel the existing text is clear and accurate.
Appendix A of NRC Review		Seems to be a different topic than lines 23-29.	24. Oceans and Marine		846	20	The text has been revised to incorporate this suggestion.

			Resources				
Appendix A of NRC Review		As far as one can tell, the chapter has illustrated "impacts" not "vulnerabilities".	24. Oceans and Marine Resources		849	16	The chapter touches on both impacts and vulnerabilities,but is focused on impacts since available research on adaptation is limited. In recognition of the importance of addressing response strategies, this report explicitly assesses adaptation, mitigation and decision support responses, in addition to identifying research needs associated with these topics, in Chapters 26-29.
Appendix A of NRC Review		"New information and remaining uncertainties" - lots of grammatical errors in this table.	24. Oceans and Marine Resources		849		The text in the table entry has been rewritten to improve the grammar.
Appendix A of NRC Review		First sentence in "new information and remaining uncertainties" is not discussed in the narrative yet is an important point.	24. Oceans and Marine Resources		851		The chapter focused on broad trends related to the topic of adaptation, which is why at the end of this paragraph we refer the reader to relevant other resources, such as the Griffis and Howard technical report for a more detailed discussion.
Appendix A of NRC Review		Are the authors convinced that there is "high" confidence that adaptation planning can help mitigate the impacts of ocean conditions"? Is hard to see the strong evidence for this rating.	24. Oceans and Marine Resources		855		The chapter focused on broad trends related to the topic of adaptation, which is why at the end of this paragraph we refer the reader to relevant other resources, such as the Griffis and Howard technical report for a more detailed discussion.
Appendix A of NRC Review		As with the other chapters, there is a disconnect between the material in the chapter and the material in the traceable accounts. Frequently, the chapter text is a bit overheated whereas the table material is more circumspect. Second, the chapter makes allusions to ongoing multiple stressors but the takeaway message is that climate change is driving us to destruction. The coral reef example is a classic. Yes, climate change adds to the stress, but reef destruction has been going on for decades. Fish harvesting, invasive species, etc. may be more important drivers. The report could have added more value if there were climate science insights into how climate might change the nature of these stresses, impacts of new threats, etc. Instead, it leads to the illusion that climate is dominant. The New England fisheries text box is another example. This has been a long saga (with NOAA closing the fishery recently). We need to address these issues - is climate change really a driver?	24. Oceans and Marine Resources				As noted in the comment and in the chapter, other human perturbations are important factors influencing marine ecosystems. However, the full range of human pertubations is beyond the scope of the national climate assessment. A sentence has been added to the text to highlight other human perturbations to marine ecosystems
Appendix A of NRC		The fact that the chapter never mentions the U.S. Commission on Ocean Policy is very troubling. USCOP identified many of the same issues, but it took a governance focus rather than a climate change focus. So two smart groups can take essentially the suite of issues, do a sophisticated diagnosis, and come up	24. Oceans and				Thank you for your comment, however policy issues are beyond the defined scope of the National Climate

Review		with very different approaches. Interesting!	Marine Resources				Assessment, a scientific document that provides the basis for decision making, but does not address policy.
Appendix A of NRC Review		An example of how a simple graphic can be misleading. It is a compelling image, but the text in the traceable accounts states "how those responses will cascade through foodwebs and ecosystems is still uncertain... much remains to be learned." "... predictions of ecosystem changes have low confidence." The image of shrinking clams is at odds with the final message that we really don't know what will happen.	24. Oceans and Marine Resources	24.3	840		The review comment is combining two distinct impacts, the effect of acidification on particular species (which is supported by laboratory experiments as highlighted in the figure) and the resulting cascading effects on other species in the larger food-web (which is not well documented from current literature). We feel that the current text properly balances these two issues.
Jeff	Weitz	This from my student Nicholas Burko (nicholas_burko@horacemann.org)I am a current eleventh grader at the Horace Mann School in Riverdale, New York. At the moment I am in Dr. Jeff Weitz's Topics in Physics class and we have read the executive summary of the National Climate Assessment and Development Advisory Committee (NCADAC) as a class. We were each assigned a given chapter of the NCADAC to read and write a response with how we believe the chapter can be improved and or changed. I was assigned chapter ten, which discusses water, land, and energy usage and how they are interconnected. In our class we have discussed various topics in relation to climate and our environment. Some of the topics include: the three e's (energy, environment, economy), tragedy of the commons, risk/stakes, complexity (the whole is greater than the sum of its parts), and storyteller/ analyst. One of the major changes that I believe in is conservation without changing our lifestyle too drastically. With the case of hydraulic fracturing it is a very useful way to bring forth the fossil fuels, however there can be serious issues with hydraulic fracturing. The simple issues are that it can damage the water supply through a leakage in the pipes. Hydraulic fracturing has the ability to change life in the cities and the suburbs, as we know it. This would be occurring because all the trucks and other large vehicles would have to drive through the towns and also on their roads. Driving through the towns negatively affect the three e's because in terms of the environment the huge trucks emit pollution into the air, and in terms of the economy the large trucks driving on the roads will affect their infrastructure and as a result will have to repave their roads. Also hydraulic fracturing can be a nuisance to the neighboring community as the loud construction noises would annoy them and possible take a toll on their work and sleep schedules. I believe that there are other ways to create the energy rather than the process of hydraulic fracturing in order to obtain the fossil fuels. As I will go on to mention later in the document I believe that we should turn our attention to wind turbines and heat resistant solar panels. I find that chapter ten is poorly set up because it jumps around quite a bit. I believe that restructuring the report would greatly benefit the reader. It would be to your advantage to spend more time discussing how our natural resources are dependent upon each other and how the water, land and energy usage correlate. It is my belief that there is not good enough detail and suggestions on how to fix these issues. I will go on in the third and fourth body paragraphs to discuss the suggestions that I believe are the most beneficial for this report. Also I believe the graphs showing the maps and record heat charts do not add any relevant information to this chapter but rather it takes away from the main message. Also the national climate assessment should make this report more accessible to teenagers,	10. Water, Energy, and Land use				A. In recognition of the importance of addressing response strategies, this report explicitly assesses adaptation, mitigation and decision support responses, in addition to identifying research needs associated with these topics, in Chapters 26-29. Many other chapters include assessment of adaptation responses. B. Information has been added to figure captions and discussion of the figures. C. The final report will be available in electronic formats, and will be announced through the social media feeds on globalchange.gov and other outlets. D. The text has been amended to include a wider range of energy projects. E. The section on energy technology options has been revised to incorporate this perspective.

because many of have no clue what the national climate assessment does. If not for Dr. Weitz's class I would have never read the national climate assessment and as a result would not be writing you my views on how to improve the document. There should be advertising through Facebook, Twitter, and mobile applications. This would increase the awareness to teenagers and it is important to do so because we are the future of this document as we will be the ones trying to implement it and the ones writing the next draft in a couple of years.

Reading through chapter ten, energy, land and water usage I noticed that there was no reference to wind turbines. Wind turbines are a great source of natural energy that use very little water and land to function. In the report other theories about how to create energy without affecting our other natural resources are mentioned however they are require much more effort and maintenance. My belief is that wind turbines are the most beneficial way to create energy without hurting our natural resources. Wind turbines can be placed on both land and in water. In terms of the three e's, it appears that the wind turbines are very important because it helps our environment, and energy production while at the same time it lowers the amount of money we need to pay to produce energy. The reason for putting wind turbines into the water is because it does not take up land that can be used for other uses such as farming and other agriculture procedures. People with ocean views may complain about this theory but no matter what you are trying to fix people will always face tradeoffs. In this case the tradeoff is to have a beautiful view of the ocean or have cleaner energy that is better for our environment and our natural resources. If people refuse to put wind turbines into their oceans then they should at least be placed into large open areas near the coast were there is a lot of wind. Unlike solar panels wind turbines do not need direct sunlight or heat; they can function perfectly in mild weather with out direct sunlight. They require only wind to create energy. It is necessary to implement wind turbines into our energy systems because unlike solar panels they do not over heat and require as much maintenance.

Solar panels are mentioned in detail throughout chapter ten, however it is portrayed rather negatively. The reason for this is because it takes up a lot of land that can be used for other things, and requires direct sunlight. One problem with solar panels is that they require direct sunlight but yet they cannot be exposed to a lot of heat because they then require water to cool down the system. I believe that there should be heat resistant solar panels so that minimizes water usage for the panels. If this was the case we would be able to save one of the worlds most important natural resources, water. I also believe that solar panels should be placed on the top of buildings and homes rather than creating solar fields because the fields take up vast amounts of land that can be used for better purposes. Also the energy created rather than being stored by only the home or building the power should be pumped into the energy grid of the city, so that the city as a whole can benefit from it. In recent years solar panels have become increasingly cheaper and more affordable to people with lower incomes, financing plans are also available.

In conclusion, I believe that this national climate assessment could be extremely beneficial for us in the coming years, as we turn our attention to being more environmentally friendly, and trying to save the planet Earth that we all love. I think if you took the times to consider my changes along with all the other people who write in to you I think I provide a new fresh opinion to this because most suggestions will come from men and women who have already established themselves as reputable environmentalist. While I on the other hand am just a junior in high school but my ideas are very important to consider because it will help shape our future. I think it would be extremely beneficial for you to share the national climate assessment as much as possible especially with teenagers. It is in your interest to hear what they have to say because they can provide insights that you not have even considered.

Jeff	Weitz	This from my student Philip Perl (philip_perl@horacemann.org)APPLICATION OF URBAN DESIGN AND PREVENTION CAN LESSEN THE ADVERSE IMPACTS OF CLIMATE AND BUILD MORE CLIMATE RESILIENT HEALTH SYSTEMS INTRODUCTION Human health is extremely affected by climate change. Climate conditions can severely affect and kill a large number of people every year. It also affects the psychological and emotional state of thousands of people. The report drafted by the Federal Advisory Committee shows how climate change is affecting Americans. The message from the report is clear: Our planet is warming up, mostly due to human intervention (1). Chapter 9, which is on Human Health, informs us about the connections between weather and climate change which present major health challenges that range from diseases to emergencies arising from extreme weather events and outbreaks. It tells us how climate affects us geographically and its effects on the usual diseases spread through air and water pollution, which can threaten our health security and burden our economy. It further informs us of key-facts about climate and health and their effects on the vulnerable portion of the society (2). Unfortunately, the chapter does not provide any information on how to combat any of these problems. Furthermore, the facts provided in the chapter are relevant only for America. Because climate change occurs globally we cannot isolate the conditions of one nation to combat all the problems caused by climate change. In order for us to reduce the effects of climate change on human health we need to fight the effects of climate change globally. We can provide solutions to many of our problems in the U.S. by adapting models used as methods for solutions in different regions of the world. This report presents four suggestions to fight the human health issues due to climate change by adopting urban design practices and adapting modern ideas from different countries around the world. SUGGESTION 1 Air pollution and climate change are closely linked. The greenhouse gas CO2 is the major cause of human-induced climate change, and is emitted from the use of carbon-based fuels for various purposes (3). Additional climate changes are caused by some of the air pollutants such as methane and carbon monoxide, which interact with other volatile organic pollutants in the environment to form ozone, as well as various forms of particulate matter such as black carbon. It is these non-CO2 air pollutants that also have direct and sometimes severe consequences for health. To improve health as a result of adapting to climate change is to apply innovative urban design practices to reduce energy consumption and pollution while increasing public health. One simple method is to encourage bicycle use for short trips in the U.S. This can drastically reduce air pollutants. A recent study of only five Midwestern U.S. states showed that eliminating short car trips and completing 50% of them by bicycle would yield 15% less CO2 emissions, a savings of $3.8 billion per year by using less fuel and having fewer health-related problems. It was estimated that the combined benefit from improved air quality and physical fitness for the region would exceed $8.7 billion per year, which is equivalent to about 2.5% of the total cost of health care for the five mid-western states (4). Such a policy could be implemented for all 50 states in the U.S., which would dramatically reduce air pollution plaguing our country. Furthermore, cities with the highest rates of bicycle or foot commuters have lower rates of obesity and diabetes by 20% and 23%, respectively, than cities with the lowest rates of active commuting (4). This brings further benefit from replacing automobiles with bicycles for short-distance travel.	9. Human Health				Thank you for your comprehensive and thoughtful comment. We appreciate the importance of providing actionable solutions to climate change and have provided some discussion of potential co-benefits for health o f climate mitigation strategies. Due to space limitations, the suggestions provided by the commenter would best be addressed in the chapter on mitigation.

SUGGESTION 2

Scientific data shows that where there is a rise in carbon dioxide there is a huge rise in production of ragweed and pollen (3). The major cause of asthma and allergies is the presence pollen and ragweed. Asthma and allergies costs Europe and America an estimated $17.7 and $56 billion per year respectively, including the cost of lost productivity of around $10 billion per year (2, 3).

A single plant usually pollinates only for a few hours or days, mainly releasing pollen during daytime, but pollen can remain suspended in air for tens of hours, causing allergy outbreaks far away from their source at any time of the day. However, pollen concentration decreases rapidly with distance from the source, so that a single tree in a garden can have stronger health impact than the large forest, miles away. By employing urban design practices we can help reduce the pollen and ragweed concentrations in big cities and neighborhoods. The selection of low-pollen ornamental plants for streets and gardens can significantly reduce allergen exposure. The timely mowing of certain types of grass can prevent pollen release, thus almost completely eliminating the corresponding allergens from the air. Recent study from the European Commission shows that planting lots of one sex plant species and not having different types of plants can increase the local pollen count. Hence, we need to increase urban plant biodiversity, replace male plants with female ones where possible, and encourage proper maintenance of green areas (5). These measures can significantly reduce allergy prevalence and improve the quality of life for a large segment of the world population. Furthermore, modern atmospheric composition models can also forecast pollen distribution, which, if available to allergic people, would allow for short-term adjustments of their planned outdoor activities and, application of pre-emptive medication, thus reducing the health impact.

SUGGESTION 3

One of the health threats from climate change is excessive heat, which endangers vulnerable populations such as children, elderly and poor. The combined effects of escalating hazards and growing vulnerable populations will make heat stress a health priority for the coming decades. In the summer of 2003, Europe experienced one of the worst heat wave events with an estimated excess mortality varying between 25 to 70,000 deaths (6). During the 1995 heat wave in Chicago, there was a 10% increase in inpatient hospital admissions with a wide range of underlying medical conditions (7).

By utilizing modern urban design methods, such as solar power energy and better infrastructure designs as in middle-eastern countries that suffer from extreme-heat on regular basis, we can reduce the temperature index by at least 10 degrees (8). This approach has been implemented and shown to be extremely successful in Masdar, a city in Abu Dhabi. As mentioned, it can be a costly affair but using solar power energy removes the effect of using coal and other fossil fuels to heat our buildings. The money that we spend in buying non-renewable sources of fuels can be invested to build solar power stations. This process would also create more jobs for Americans and provide a better mode of living. Furthermore, by maintaining comprehensive heat emergency response plans that anticipate the effects of extreme climate change events as developed by the European nations after the 2003 heat wave disaster, we can also provide similar guidelines for protection of the U.S. population. In short, the emergency resonse system would require: a) Extensive preparations prior to the onset of excessive heat. That means creating a lead agency in charge of anticipating necessary steps to be taken in case of an emergency and have a national disaster preparedness plan. Having a national coordinating agency with members from the health department, social and meteorological services and civil protection would be highly desirable. b) Meteorology-based heat-health warning systems, (HHWS) that prevent

negative impacts of the thermal environment on health during heat waves would need to develop and improve. The essential and common components of HHWS are identifying weather situations that adversely affect human health, monitoring weather forecasts and implementing mechanisms for issuing warnings before and during extreme weather conditions. c))Rapid and coordinated actions during the heat wave should improve and expand so that dissemination of information to the general public, vulnerable groups and medical practitioners through various modes of communication is available and efficient. d) Criteria and procedures for deactivating the emergency response plan must be developed. That means creating a plan for resuming the "usual" way of living once the emergency has been averted. e) Evaluation following the response activities and outcomes would examine whether implemented plans satisfied the expected standards and goals. The outcomes evaluation can be accomplished through surveys of partner agencies to explore their awareness of the plan, what they did and whether it was in accordance with the plan (6).

SUGGESTION 4

As chapter 9 emphasizes, the capacity of the American public health and health care delivery system is decreasing. In 2009, the U.S. had the highest healthcare costs relative to the size of its economy in the world, with an estimated 50.2 million citizens without insurance coverage. We need to look at other alternatives that can provide Americans with better health options. One alternative is universal healthcare that is highly functional and successful in many developed nations throughout Europe and Canada. It can be provided through tax-based financing where individuals contribute to the provision of health services through various taxes (9). We can also have contributions from workers, enterprises and government pooled together to make a service of mixed public and private providers. Prevention is better than cure. By providing preventive health care to all Americans, we can reduce the amount of diseases borne by climate change and in turn reduce debt on the nation's health coverage. This in turn would directly affect the amount of money and infrastructure we would have for combating other more serious diseases, which are independent of climate change.

CONCLUSION

If we want to give current and future generations a fighting chance against climate change, we need to strengthen our resolve to have the ability to better predict the climate and its possible health effects at all levels. This will require adaptation, scientific innovation, and technical knowledge as well as participation and combined effort by medical institutions, meteorological agencies and the government to make our world a better and healthier living space.

To suitably achieve a level of success so people can find a homeostasis between themselves and the environment, decision-makers at all levels need access to the most reliable information available on the diverse connection between climate and health. We need to come up with practical and innovative methods that use better climate forecasts to build better health services. That means being able to derive better climate models and using them more effectively. Most modern climate models include representations of the oceans, land-surfaces and their interactions (6). With higher-order math, physics and understanding of various biological processes from ecosystems and human activities we can compile better information for simulation models. This can yield a projected response of our environment to climate change which not only predicts the exact future state of the weather but also the characteristics and frequency of weather phenomena and seasonal weather patterns. This will further protect public health and achieve better outcomes for our way of living.

		REFERENCES 1) Global Change Research Program, Executive Summary, (pages: 2 – 23) (accessed March 2013): http://ncadac.globalchange.gov/download/NCAJan11-2013-publicreviewdraft-chap1-execsum.pdf2) Global Change Research Program, Chapter 9 (pages: 333 - 384) (accessed March 2013): http://ncadac.globalchange.gov/download/NCAJan11-2013-publicreviewdraft-chap9-health.pdf3) World Health Organization, Technical hazard sheet (accessed September 2012): http://www.who.int/hac/techguidance/ems/drought/en/4) Grabow, M.L. et al. Air Quality and Exercise-Related Health Benefits from Reduced Car Travel in the Midwestern United States. 2012. Vol 120(1): 68-76.5) Science for Environment Policy, Measures to reduce urban pollen count, (pages 1-2) (accessed March 2013):http://ec.europa.eu/environment/integration /research/newsalert/pdf/255na5.pdf6) D'Ippoliti et al. The impact of heat waves on mortality in 9 European cities: results from the EuroHEAT project. Environmental Health. 2010. Vol 9(37): 1-9. 7) McGeehin M.A. and Mirabelli, M. The Potential Impacts of Climate Variability and Change on Temperature-Related Morbidity and Mortality in the United States. EHP. 2001. Vol 109(2): 185 -189. 8) Middle Eastern City Reduces Heat by 10 Degrees through Passive Cooling. (accessed March 2013): http://www.treehugger.com/urban-design/middle-eastern-city-reduces-heat-10-degrees-through-passive-cooling.html9) Schwartz, K. and Graves, J.A. Health Care Reform and the Dynamics of Insuarnce Coverage – Lessons from Massachusetts. NEJM. 2013. Vol 367(13): 1181-1184.					
Beth	Brumbaugh	In this line "chikungunya" disease is capitalized, though the CDC does not capitalize it and it is not capitalized in a similar usage on page 344, line 3.	9. Human Health		353	20	We thank the reviewer for the helpful suggestion, which has been incorporated in the text.
Elizabeth	Perera	1) Heat Waves – The draft needs to recognize the importance of urban heat islands and the difficulty with temperature measurements in urban areas. Often time heat warning systems can be set up but the temperature readings may not be accurate to urban areas where they may be feeling heat this is significantly warmer.Urban Heat Islands, Heat Waves and Health Impacts: McGeehin, Michael A., and Maria Mirabelli. "The potential impacts of climate variability and change on temperature-related morbidity and mortality in the United States." Environmental Health Perspectives 109.Suppl 2 (2001): 185.2) Mercury and Lakes - additional mercury exposure through lake turnover should be added as a possibility based on this source: Magnuson, J. J., et al. "Potential effects of climate changes on aquatic systems: Laurentian Great Lakes and Precambrian Shield Region." Hydrological processes 11.8 (1997): 825-871.3) Shellfish poisoning, algal and climate change needs to be explained here: Moore, Stephanie K., et al. "Impacts of climate variability and future climate change on harmful algal blooms and human health." Environmental Health 7.2 (2008): S4.	9. Human Health				We have addressed the particular vulnerability of urban areas, as a result of the urban heat island effect in our section on heat waves. More comprehensive treatment of this topic is precluded by space limitations.
Hunter	Cutting	This report should discuss and present a cumulative global budget for GHG emissions to keep temperatures from rising more than 2 degrees Celsius over the 20th century average.The report should also present and discuss the U.S. share of such a global carbon budget. The U.S. share should be considered in light of the principle of Common but Differentiated Responsibility (CBDR), one of the cornerstones of sustainable development. It has emerged as a principle of International Environmental					Thank you for the suggestions. While specific policy goals are beyond the scope of the NCA, we have added additional text in the Executive Summary and Mitigation chapters to

		Law and has been explicitly formulated in the context of the 1992 Rio Earth Summit. It informs in particular the United Nations Framework Convention on Climate Change (UNFCCC) to which the United States is a signatory.While a discussion of multi-year emission scenarios and emission rates is important, the general public and policy makers have a much stronger grasp of the budget method for accounting of emissions in a discussion of mitigation options.The U.S. National Academy of Sciences has validated the budget approach for discussing mitigation.See, for example, Limiting the Magnitude of Future Climate Change, a landmark report by the National Research Council, published 2010 by the National Academies Press. In particular, see the section entitled U.S. Emission Targets in the chapter entitled Goals for Limiting Future Climate Change, which presents such budgets and discusses the superiority of this approach.See also the World Energy Outlook, 2009, by the International Energy Agency, in particular Chapter 4 and the section entitled The Cost of Delayed Action and the subsection entitled A Global Carbon Budget Which Lasts A Generation?, which presents and validates the carbon budget approach.See also:Meinshausen et al., 2009. Greenhouse-gas emission targets for limiting global warming to 2 °C. Nature 458, 1158-1162 (30 April 2009) | doi:10.1038/nature08017; Received 25 September 2008; Accepted 25 March 2009 G. Peters, R. Andrew, T. Boden, J. Canadell, P. Ciais, C. Le Quéré, G. Marland, M. Raupach, C. Wilson (2012) The challenge to keep global warming below two degrees. Nature Climate Change. DOI:10.1038/nclimate1783. Access at http://bit.ly/Qpt3ub (from 2 Dec, 1800GMT). Le Quéré, C., Andres, R. J., Boden, T., Conway, T., Houghton, R. A., House, J. I., Marland, G., Peters, G. P., van der Werf, G., Ahlström, A., Andrew, R. M., Bopp, L., Canadell, J. G., Ciais, P., Doney, S. C., Enright, C., Friedlingstein, P., Huntingford, C., Jain, A. K., Jourdain, C., Kato, E., Keeling, R., Levis, S., Levy, P., Lomas, M., Poulter, B., Raupach, M. R., Schwinger, J., Sitch, S., Stocker, B. D., Viovy, N., Zaehle, S., and Zeng, N. (2012) The global carbon budget 1959–2011. Earth System Science Data-Discussions 5: 1107–1157, doi:10.5194/essdd-5-1107-2012. http://www.earth-syst-sci-data-discuss.net/5/1107/2012/essdd-5-1107-2012.htmlUnburnable Carbon http://www.carbontracker.org/unburnable-carbon					better frame the context of U.S. emissions.
John	Nielsen-Gammon	While the Great Plains is mentioned in bold, the supporting text does not mention it. I am aware of no studies showing that the effect of climate change on existing surface and groundwater supplies is "already" negative, considering that the region has experienced a 5%-15% increase in precipitation over the past century (McRoberts and Nielsen-Gammon, JAMC, 2011).	3. Water Resources		125	24	Key message has been revised in response to this comment.
Lauren	Baum	The NCA should take note of a recent study that used an entirely new method of tallying hurricane power and frequency, concluding that hurricanes are, indeed, more of a danger when ocean temperatures are higher.ABSTRACT: Detection and attribution of past changes in cyclone activity are hampered by biased cyclone records due to changes in observational capabilities. Here we construct an independent record of Atlantic tropical cyclone activity on the basis of storm surge statistics from tide gauges. We demonstrate that the major events in our surge index record can be attributed to landfalling tropical cyclones; these events also correspond with the most economically damaging Atlantic cyclones. We find that warm years in general were more active in all cyclone size ranges than cold years. The largest cyclones are most affected by warmer conditions and we detect a statistically significant trend in the frequency of large surge events (roughly corresponding to tropical storm size) since 1923. In particular, we estimate that Katrina-magnitude events have been twice as frequent in warm years compared with cold years ($P < 0.02$).CITATION: Grinsted, A., Moore, J.C., Jevrejeva, S. (2012). Homogenous record of Atlantic hurricane surge threat since 1923. PNAS. Link: http://www.pnas.org/content/early/2012/10/10/1209542109.abstract	2. Our Changing Climate				Given the brevity of our statement on hurricanes, we feel that a discussion of trends in coastal sea-level anomalies and hypothesized links to landfalling hurricanes and global temperature is beyond the scope of the text.

Philip	Maldonado	Also, Page 453, lines 2-4; page 441, lines 35-37; page 462In the following sentence - "For example, Newtok, a traditional Yup'ik village in Alaska, is experiencing accelerated rates of erosion caused by the combination of decreased Arctic sea ice, thawing permafrost and increased intensity of weather events." - it is much more accurate to say "extreme weather events" instead of "increased intensity of weather events", as this aligns with both local and outside scientific observations; there is not necessarily an increased intensity, but rather they are being more impacted by extreme events. This same sentence also occurs earlier on pg.453 and on pg.441 and twice on pg.462.	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources		453	14	The text has been revised to incorporate this suggestion.
Justin	Augustine	Studies are mixed on whether fire will increase, or decrease, in future decades as a result of climate change, depending upon the modeling assumptions used (e.g., hotter and drier versus warmer and wetter). For instance, a number of scientific studies project a decrease in future fire in California's forests, rather than an increase. While temperature has increased , precipitation, including summer precipitation, has also been on an increasing trend for decades – a more substantial upward trend, in fact (Mote 2003, Hamlet et al. 2007, Gonzalez et al. 2010 [Fig. 1b], Crimmins et al. 2011). This factor, increasing summer precipitation, has a profound suppressing effect on fire activity (even with relatively small increases), one that may well outweigh temperature (Krawchuk and Moritz 2011). Some modeling studies predict that fire will increase in California's forests in the future, but the modeling assumptions chosen by the authors of these studies are based upon the presumption of substantially decreased precipitation, including summer precipitation, in the future, despite a century-long trend of increasing precipitation with climate change, and these studies do not explain why they believe that this longstanding precipitation pattern will reverse itself, and decrease substantially, in the future under the same climate change trend conditions under which precipitation has increased for the past several decades. Further, the increases in fire that some studies project, under the assumption of decreased precipitation, are quite modest – generally averaging about 20% by the end of the century (see, e.g., Lenihan et al. 2008) – and such an increase, if it occurred, would not make up for the current fire deficit relative to natural historic conditions (see, e.g., Stephens et al. 2007). Literature CitedCrimmins, S.L., et al. 2011. Changes in climatic water balance drive downhill shifts in plant species' optimum elevations. Science 331:324-327.Gonzalez, P., R.P. Neilson, J.M. Lenihan, and R.J. Drapek. 2010. Global patterns in the vulnerability of ecosystems to vegetation shifts due to climate change. Global Change and Biogeography 19:755-768Hamlet, A.F., P.W. Mote, M.P. Clark, D.P. Lettenmaier. 2007. Twentieth-century trends in runoff, evapotranspiration, and soil moisture in the western United States. Journal of Climate 20:1468-1486.Krawchuk, M.A., M.A. Moritz, M. Parisien, J. Van Dorn, and K. Hayhoe. 2009. Global pyrogeography: the current and future distribution of wildfire. PloS ONE 4: e5102. Lenihan, J.M., D. Bachelet, R.P. Neilson, and R. Drapek. 2008. Response of vegetation distribution, ecosystem productivity, and fire to climate change scenarios for California. Climatic Change 87:S215-S230.Stephens, S.L., R.E. Martin, and N.E. Clinton. 2007. Prehistoric fire area and emissions from California's forests, woodlands, shrublands, and grasslands. Forest Ecology and Management 251:205–216.	7. Forestry				After consideration of this point, we still feel the existing text is clear and accurate. The vast majority of the literature on fire and climate change concludes that fire will increase. The citations referenced by the reviewer refer only to California and do not reflect the majority of publications on fire science. The chapter notes that the potential for increased fire is greater in the western United States than the eastern.
Christopher	Lindsay	Include the example of a code developing organization and how they are responding and adapting to climate risks which is an important message for policymakers to consider and one that ultimately directly benefits jurisdictions. For example, the International Association of Plumbing and Mechanical Officials (IAPMO) leads the way in progressive code development related to Green Plumbing. Our most	28. Adaptation		993	5	We thank the commentor for this suggestion. Regrettably, we have not been able to assess this specific Green Plumbing and Mechanical Code

		recent efforts include the publication of the Green Plumbing and Mechanical Code Supplement which was the first green construction code for plumbing and mechanical applications to be published in the United States. It was created through a open, vetted process that was informed by all of the major stakeholders representing the plumbing industry.The Green Plumbing and Mechanical Code Supplement is a repository of provisions, ready to be adopted by jurisdictions, establishing requirements for green building and water efficiency applicable to plumbing and mechanical systems. This ground-breaking document spells out the best practices for a greener and more sustainable residential and commercial plumbing and mechanical systems in simple, straightforward code language.					Supplement, and it is beyond the scope of our chapter to assess every kind of code specifications and the processes which set them in the context of adapting to climate risks. Indeed, the authors of the NCA Report have written this chapter based upon a variety of sources, all of which were assessed under Guidance on Information Quality Assurance to Chapter Authors of the National Climate Assessment: Question Tools (2/21/2012), to assure for each source (1) utility, (2) transparency and traceability, (3) objectivity, and (4) integrity and security. All sources were assessed for IQA compliance. Since this code was not reviewed nor was it submitted for review, this change was not made.
Shaye	Wolf	How can a chapter on the impacts of climate change on biodiversity and ecosystems not include a discussion of observed and predicted climate-change-related population declines and extinctions? This is a major omission that must be corrected. This section should discuss the key point that species are already experiencing climate-related population declines and local extirpations, and this is one of the most serious threats to biodiversity. At present, this section mentions that there will be changes in species assemblages without making the linkage that a key driver of change in these assemblages will be species declines, functional extinctions, and local extinctions, not just range shifts and phonological shifts. A foundational review on this topic, which was not cited, is Parmesan (2006), as well as new reviews by Cahill et al. (2012) by Hannah et al. (2012). Importantly, Cahill et al. (2012) identified 136 studies which indicated that climate change was associated with local extinctions or declines. This study also identifies the mechanisms by which species are threatened by climate change, some of which are missing from this chapter.Examples of climate-change-related population declines in the United States include the whitebark pine in the Western US (Logan et al. 2010), yellow cedar in Alaska (Hennon et al. 2012), Haleakala silversword in Hawaii (Krushelnycky et al. 2013), amphibians in Yellowstone National Park (McMenamin et al. 2008), and coral reefs off Florida and the U.S. Virgin Islands (Donner et al. 2007).Examples of climate change-related local extinctions (population extirpations) include the American pika in the Great Basin Mountains of Nevada and southeast Oregon (Beever et al. 2011), desert bighorn sheep in California (Epps et al. 2004), and the Bay checkerspot butterfly in coastal California (McLaughlin et al. 2002). Pikas, for example, have been extirpated from more than one third (10 of 25) of historic sites in the Great Basin since the 1990s, equating to a 145 meter/decade upslope range retraction since 1999, and these losses were best explained by climate variables (Beever et al. 2011).This section must also discuss predictions of species extinction due to climate change. Because climate change is occurring at an unprecedented pace with multiple synergistic impacts, climate change is predicted to result in catastrophic species losses during this century. The IPCC concluded that 20% to 30% of plant and animal species will face an increased risk of extinction if global average temperature rise exceeds 1.5°C to 2.5°C relative to 1980-1999, with an increased risk of extinction for up to 70% of species worldwide if global average temperature exceeds 3.5°C relative to 1980-1999 (IPCC 2007). Other studies have predicted that 15%-37% of species will be	8. Ecosystems, Biodiversity, and Ecosystem Services				A new paragraph inserted about polar bears, seals, and wolverines discusses the species already harmed by climate change.

committed to extinction by 2050 under a mid-level emissions scenario (Thomas et al. 2004) which the world has been exceeding, and that one in 10 species could face extinction by the year 2100 if current climate change continues unabated (Maclean and Wilson 2011). A comprehensive literature review found that significant species range losses and extinctions are predicted to occur globally for coral reef ecosystems and in several biodiversity hotspots at a global mean temperature rise below 2°; at 2°C temperature rise, the projected impacts increase in magnitude, number, and geographic spread; and beyond a 2°C temperature rise, entire ecosystems may collapse and extinction risk accelerates and becomes widespread (Warren et al. 2011). Numerous taxon and species-specific modeling studies also provide guidance on extinction risk. For example, Sekerciouglu et al. (2008) predicted that 4.7% to 6.4% of 8,500 land bird species will be committed to extinction by 2100 with 2.8°C global mean temperature increase. For coral reef ecosystems facing the combined threats of ocean warming and ocean acidification, scientists have predicted wide-scale collapse in the next few decades (Hoegh-Guldberg et al. 2007), and have concluded that reducing atmospheric CO2 to less than 350 ppm is needed to protect coral reefs from collapse (Frieler et al. 2012, Veron et al. 2009). For example Frieler et al. (2012) showed that limiting warming to 2ºC above pre-industrial levels would lead to the long-term degradation of coral reef ecosystems in all regions. At 1.5ºC temperature rise above pre-industrial, ~89% (63-100%) of coral reef ecosystems would face long-term degradation assuming no change in thermal tolerance. At 1ºC of warming above pre-industrial levels, which is likely to occur in the next decade or two, 16% (3-29%) of reef locations would be at risk. Even under the lowest of the new IPCC emissions scenarios (RCP3-PD) and optimistic assumptions regarding thermal adaptation, one-third (9-60%) of the world's coral reefs will experience long-term degradation. For polar bears facing rapid sea-ice loss, Amstrup et al. (2010) found that under a business-as-usual A1B emissions scenario, two-thirds of the world's polar bears, including all bears in Alaska, would disappear by mid-century. However, under the "mitigation scenario" whereby mean global temperature rise would not exceed 1.25ºC or, alternately, carbon dioxide were stabilized at 450 ppm at the end of the century, polar bears would have lower extinction probabilities, varying across ice ecoregions: 53% in the Divergent ecoregion, 30% in Seasonal ecoregion, and minimal extinction probabilities in the Convergent and Archipelago ecoregions. Overall, however, the emissions scenario that resulted in the highest probability of maintaining polar bear population stability was the "commitment scenario" where greenhouse gas emissions were fixed at year 2000 levels of 368 ppm CO2.Sources cited:

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Sekercioglu, C.H, S.H. Schneider, J.P. Fay, and S.R. Loarie. 2008. Climate change, elevational range shifts, and bird extinctions. Conservation Biology 22: 140-150.

Thomas, C. D., A. Cameron, R. E. Green, M. Bakkenes, L. J. Beaumont, Y. C. Collingham, B. F. N. Erasmus, M. F. De Siqueira, A. Grainger, L. Hannah, L. Hughes, B. Huntley, A. S. Van Jaarsveld, G. F. Midgley, L. Miles, M. a Ortega-Huerta, a T. Peterson, O. L. Phillips, and S. E. Williams. 2004. Extinction risk from climate change. Nature 427:145–8.

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Warren, R., J. Price, A. Fischlin, S. de la Nava Santos, and G. Midgley. 2011. Increasing impacts of

		climate change upon ecosystems with increasing global mean temperature rise. Climatic Change 106:141–177.(2) Figure 8.4 is a good idea. More examples to add to the map include the studies discussed above. In addition, it is important to highlight the risks to South Florida species from sea-level rise (there are currently no Florida examples). For example, the endangered Lower Keys marsh rabbit has already lost almost half of its habitat in the Florida Keys since 1959 largely due to sea level rise (Schmidt et al. 2012). Another example is the increasing mortality to Pacific walruses in Alaska due to sea-ice retreat from the foraging grounds during the summer which forces females and calves to come ashore , where the young are vulnerable to predators and to being trampled to death in abnormally large herds. In 2009, 133 young walruses were trampled to death in Alaska. See Udevitz et al. (2012).Schmidt, J.A. et al. 2012. Impacts of a half century of sea-level rise and development on an endangered mammal. Global Change Biology 18: 3536-3542. Udevitz, M.S. et al. 2012. Potential population-level effects of increased haulout-related mortality of Pacific walrus calves. Polar Biology. doi: 10.1007/s00300-012-1259-3.					
Kimberly	Hall	As a contributor to the NCA process (I authored a whitepaper on biodiversity and ecosystems that was provided to the Midwest chapter's lead authors), I applaud the overall effort and hard work that went into synthesizing information for this and all other chapters. In the Midwest, the process was very collaborative, and was a great example of how people can come together from different disciplines to share ideas, provide critical review, and work through challenging concepts (such as how to best convey agreement/confidence among different scientists, and uncertainty in future impacts). Along with my colleagues at The Nature Conservancy, I look forward to continuing the dialog, and building from the networks and knowledge base that have expanded strengthen as a result of this process.					We greatly appreciate your positive comment.
Paul	Fleming	I don't agree with the text saying that reductions in per capita use are due to reductions in outdoor water use. Our experience and data analysis would indicate that yes per capita reductions are occurring in many other parts of the US due to a variety of factors, not the least of which is indoor plumbing fixtures national and state legislation, as well as shifts in land use patterns in some areas to smaller lot sizes and more multi-family ratios in urban areas, and the availability of lower water use washing machines and more currently dishwashers. Per capita use patterns in Portland have demonstrated both a reduction in winter use (which primarily indoor) and in summer due to outdoor. If a source is needed in your view we can point to Water Research Foundation studies, AWWA water resources planning manual, and even the Ceres report "Water Ripples: Expanding Risks for U.S. Water Providers" December 2012 would support this.	3. Water Resources	3.5	119		The text has been revised to incorporate this suggestion.
David	Easterling	I find the mismatch in base periods in this chapter to be confusing, especially the use of the 1901-1960 mean. This is the first I've ever seen that base period used in any scientific document. Why is not a more commonly used base period, like 1971-2000 or 1961-1990 used?	2. Our Changing Climate				A special box has been added to explain the choice of base periods.
Paul	Fleming	The same comment about indoor plumbing requirements and low use water appliances should be noted here in addition to those things in the list. On lines 24 & 25 there is a big number given for increases in water demand in the muni sector being due to outdoor landscaping, which totally seems to ignore the role of actual population growth which will over shadow reductions in per capita use by 2100. The reliance on one national study on water demands by Foti et.al. also seems like a bit of stretch, surely there should be other studies of water demand that could be cited.	3. Water Resources		120	7	We are limited by chapter length, but did amend the text to include mention of plumbing code requirements and water efficient appliances.
Kevin	Matthews	Chapter 7 on forestry is extremely weak, inadequate to the needs of policy makers, and disappointing. Frankly, the chapter overall appears to reflect a non-scientific bias that assumes continued logging, prioritizes econimc production, and underestimates cumulative impacts of ecosystem degradation. The choice of references is biased toward maximized perception of econimc opporunities, and maximized uncertainty of impacts from extractive processes.This is all certainly normal for administrative culture behind the "timber curtain," but it is inadequate to deal with the serious challenges and opportunities	7. Forestry				The reviewer makes a number of recommendations on the chapter. For some of the comments, it is important to keep in mind the nature of this assessment document. Policy issues are beyond the defined scope of the

		for foresty in the face of climate change.For instance, Key Message 4 says, "However, development of and better access to practical and timely information for managers to consider in choosing adaptation and mitigation options will facilitate management of public and private forestland."Stating the truism is a reasonable beginning. However, the NCADAC should take on the challenge of actually providing some of this "practical and timely information".With peer-reviewed research showing that we need to have major mitigation strategies underway within five years, simply reporting, in such a large and slow-moving process as the NCADAC, that better information will be needed later on, is not an adequate response to the practical situation.The caption for Figure 7.2, p268, says, "Forest treatments that maintain uneven-aged forest structure and create small openings in the forest can help prevent large wildfires from spreading." This unreferenced claim is truism of conventional forest management, but it is not in fact supported in contemporary research.Potential for biomass energy production is considered - hardly an outcome of climate change, more of a prospective polcity choice - and is discussed in a somewhat boosterish tone, yet the downsides and risks of increased biomass production are merely noted as "debatable".While the chapter does acknowledge that "Over the past few decades, the most prominent land changes within the U.S. have been the amount and kind of forest cover due to logging practices and development in the Southeast and Northwest, and..." (Chapter 13, p472), the word logging is never used again anywhere else in the entire NCADAC draft.Disturbances such as insect consumption and wildfire are considered in this chapter as causes both of loss of carbon storage and of wood production. And in some places (see Figure 7.1, p265) the disturbance of timber harvest is lumped together with those less voluntary forms of forest disturbance.Yet the level of disturbance caused by industrial clearcutting - as great or even greater on a local basis, as in the heavily-overcut private industrial squares in the O&C checkerboard of western Oregon - is not addressed in the section "Increasing Forest Disturbances" that starts on p266.On page 272, carbon emissions due to wildland forest fires are quantified, without acknowledging the science on rapid carbon re-uptake following fire when follow-on disturbance is avoided. Yet carbon emissions due to clearcutting are not quantified.The statement is made that, "In addition, forest management can increase average forest carbon stocks by increasing the interval between harvests or decreasing harvest intensity (Balboa-Murias et al. 2006; Harmon and Marks 2002; Harmon et al. 2009; Jiang et al. 2002; Kaipainen et al. 2004; Seely et al. 2002)."Yet remarkably, the report fails to even mention, let alone quantify, the option of forest conservation as an approach for increasing average forest carbon stocks.The interactions of timber markets and bioenergy markets with forest management are discussed, but the potential interaction of carbon sequestration markets - already in existence - appears to be overlooked.Such a blindered approach to the topic is scientifically unacceptable.To remedy the systematic defects in this chapter, additional authors could be involved to help balance the analysis. Such additional authors might be 1) fully independent from the timber industry and harvest-oriented land management, 2) more sophisticated in terms of long term ecological and ecosystems services dimensions of forest land management, and/or 3) representative of environmental and conservation perspectives.					National Climate Assessment, a scientific document that provides the basis for decision making, but does not address policy. The reviewer comments that the chapter assumes continued logging, prioritizes economic production and underestimates cumulative impacts. The chapter has a page limit. In this revision, the introductory text of the chapter has been revised to depict the nature of forests – urban areas, the interface between urban and rural areas and in rural areas. The values of forests in each of these areas are highlighted, such as clean air, cooling buildings, aesthetics and recreating in parks in urban areas. We appreciate the comment on the importance of providing practical and timely information and have revised the forth section to identify more clearly the concerns and needs of forestland owners for this information. With respect to the caption of Figure 7.2, we have revised the caption to incorporate this recommendation. Due to the size of the region/sector/topic, and the page limit for the chapter, we focused on broad trends rather than delving too deeply or providing such a level of specificity. The reader is also referred several times in the chapter to the technical report on forests (Vose et al. 2012). The text has been revised with the comments on bioenergy in mind. The maximum projected potential for forest bioenergy has been described, and the debate around the policy analyses of bioenergy has been described in additional terms. We have also deleted the text ‘reduce U.S. fossil fuel consumption' in the key message. With respect to the comment on the use of logging, after consideration of this point, we still feel the existing text

							is clear and accurate. The removal of trees is described using terms commonly used; fuel treatments, timber harvest, forest management. With respect to the comments on disturbance ("Disturbances such as insect consumption"); we added text in the Traceable Accounts to explain the categories used in the figure. With respect to the comments on disturbance ("Yet the level of disturbances … p266"), due to the size of the region/sector/topic, and the page limit for the chapter, we focused on broad trends rather than delving too deeply or providing such a level of specificity. With respect to the comment ("on page 272, carbon emissions…not quantified"), after consideration of this comment, we still feel the existing text is clear and accurate. The total carbon emissions include carbon emissions from all types of harvest methods. The estimates on emissions from wildfires are at a large spatial scale; comparable to the total emission levels. With respect to the comment ("the statement is made…Yet remarkably the report fails..stock"), The chapter focused on broad trends for the topic. We refer those interested in a deeper treatment of the topic to the provided citations, including the forest technical report by Vose et al. (2012). With respect to the statement (the interactions of timber markets…); The chapter focused on broad trends for the topic. We refer those interested in a deeper treatment of the topic such as the Vose et al. 2012 report.. With respect to the proposed remedy; the transparent process leading to this report is documented on our website and has included numerous avenues for the public to engage.
Shaye	Wolf	The adaptation chapter must better highlight the key point that adaptation and mitigation are closely	28.				The authors agree. We attempted to

		linked, and that adaptation efforts will be more difficult, more costly, and less likely to succeed without immediate and effective mitigation. The ability for "adaptation" depends in large part on the character, rate, and magnitude of climate change. As emphasized in the 2009 National Climate Assessment, effective mitigation reduces the need for adaptation since it lowers the magnitude and rate of climate change, making adaptation more tractable. In contrast, delays in mitigation amplify the magnitude and rate of climate change that make adaptation efforts less feasible and more costly, and increase the threat of triggering abrupt and irreversible changes that exceed the adaptive capacity of human and natural systems. Some systems—such as Arctic sea ice ecosystems, coral reef ecosystems, and low-lying island and coastal communities--are already reaching the limits of their adaptive capacity. Because the choices made today about emissions reductions will have far-reaching consequences for climate change impacts not just over the next few decades, but for centuries and millennia, the success of mitigation measures will be a critical determinant of the amount of adaptation that is necessary and the feasibility of adaptation efforts.	Adaptation				do this through some text in the introduction and through our case study selection criteria. However, we have inserted more direct text to support these points.
Philip	Maldonado	The sentence - "Observed impacts include..." should be changed to "Observed impacts from both the causes and consequences of climate change include species loss and shifts in species range..." because the citation Louisiana Workshop 2012 specifically explains that the species loss they are experiencing is due primarily to the exploitation of their lands and destruction of their local environment by the fossil fuel industry, which has dredged canals leading to intense land loss, coastal erosion, and saltwater intrusion. Climate change-induced sea level rise acts as a compounding factor. Therefore, it is both the causes and consequences of climate change that are causing the species loss.	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources		445	37	The text has been revised to incorporate this suggestion.
Paul	Fleming	While it is great that WUCA gets recognition here, it is disturbing that Water Research Foundation is not also mentioned when they have put nearly $5 million of their research budgets over the last several years into climate change studies for use by water utilities. directly pointed at municipalities; we can note which studies if it would be useful, but they cover everything from climate science for practitioners, water demands, planning and adaptation, and system operations. Many of these studies are more on point than much of the material generated for the NCA Infrastructure Chapter and background DOE study. This is an omission of some significance.	3. Water Resources		130	16	The text has been revised to incorporate this suggestion.
Kimberly	Hall	I am not able to review the entire document, but I do want to highlight two components of the structure as important advances. First, I think the "Traceable Accounts" are great – a very helpful way of providing the chain of logic and strength of evidence, while still allowing the main text of the chapters to be readable and to maintain flow. I can definitely see using a similar format in my own work in the Great Lakes region, and if this format can be encouraged throughout practitioners in this field, that should help promote cross-sector collaboration. Second, in the report as a whole, I especially appreciated the cross-cutting chapters – in particular the chapter on Water, Energy, and Land Use. Integrating across sectors is critical, and of course represents a major challenge, as we all bring with us the language, assumptions, and priorities associated with our own fields. This Water, Energy, and Land Use chapter does a particularly nice job of alternating between simple yet powerful general comparisons (i.e., the figures for each region that compare bar graphs for uses of water, sources of energy, and land use), while also providing case studies that illustrate complex interactions among these resources in specific places.					We greatly appreciate your positive comment.
Paul	Fleming	these are excellent key messages that we strongly support.	11.		419	13	Thanks for the kudos.

			Urban Systems, Infrastructure, and Vulnerability				
Paul	Fleming	Many utilities have asset management programs that do address risk and vulnerabilities and many of the programs developed to address these serve to address climate change (e.g. seismic upgrades, flood protection or moving of assets away from flood prone areas, building of diverse sources to build in resilience, backup electrical generation or redundant supply backup). I think the impression given is that we utilities are doing very little when in fact that may not be the case for many utilities.	11. Urban Systems, Infrastructure, and Vulnerability		429	31	Thank you for your suggestion. Based on your comment, edits have been made.
David	Easterling	This seems like an odd figure to include in a regional chapter. Especially since no other regional chapter has a similar figure. Its almost as if there is an agenda behind including it, like trying to show that models don't reproduce the observed SE cooling well.	17. Southeast and Caribbean	17.3	587		After consideration of this point, we still feel the existing figure is clear and accurate. It was developed and vetted with climate scientists working across all regions of the US, in addition to those in the Southeast US, to make it as accurate, clear, and fair as possible.
Paul	Fleming	There is a section in here that says, "…by integrating climate change considerations into daily operations….". What type of daily operations are meant here, and how useful is that really when we capture daily things with close to the present day forecasts, and make changes in daily protocols only after extensive planning and research (eg. flood rule curves I think might fall into this)? This seems like a no-brainer set of words to those that don't really understand what is meant by daily operations, could use some significant clarification about what is meant by this. I think this is also a paragraph that should recognize that many adaptation strategies will meet multiple objectives and can be based on a wider set of justifications than the uncertainties inherent with identifying localized climate impacts. This same page is missing a clear statement that there is a strong need to advance collaborative planning and funding to address the linked infrastructure issues identified in Key Message 2/4 as they appear in the traceable accounts on page 432.	11. Urban Systems, Infrastructure, and Vulnerability		430	20	We appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include.
Kevin	Matthews	The figure caption says, "Forest treatments that maintain uneven-aged forest structure and create small openings in the forest can help prevent large wildfires from spreading."This is in direct contradiction to the predominant research findings, that thinning does not correlate to forest fire impacts, which do correlate primarily with drought level.To the extent that there is strong research support for benefits of thinning in specific forest types, such a statement should be qualified by forest type, to be accurate and informative.	7. Forestry	7.2	268		We revised the text to state that this is the case under some conditions: "Figure 7.2: Effectiveness of Forest Management that Selectively Removes Trees Fuel Treatments. Caption: Forest management that selectively removes trees to reduce fire risk, among other objectives (a practice referred to as "fuel treatments" maintain uneven-aged forest structure and create small openings in the forest; this in turn can under some conditions help prevent large wildfires from spreading."

Jonathan	Parfrey	Thirty miles is too coarse a resolution for areas with micro-climates. For the next Assessment, I suggest picking a few cities where researchers look at climate impacts at a 2km (or greater) resolution. Such an analysis would help the public understand how climate change will directly affect their neighborhood, their city, their homes, their lives. People simply don't relate to regional scales. People relate to the city they live-in. Have you ever heard someone say they're from the Southwest? No. They say I live in Orange County or such. A finer scale would also supply policymakers and planners have useful information.	1. Executive Summary		29		There are examples within each chapter of specific cases in the region, for example, see the NE regional chapter. Much more detail is available in the underlying technical support documents that has been linked in the electronic version.
Philip	Maldonado	Forced relacations of tribal communities and indegenous people in the US not only occurred during the 1700s and 1800s, but has continued into modern times. See the following citations for examples of forced relocations during the 20th century: Hesse K (2005) Aleutian Sparrow. Margaret K McElderry Books, New York; Shearer C (2011) Kivalina: a climate change story. Haymarket Books, Chicago	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources		453	7	We have added the suggested citations in our chapter assessment and added a sentence in the text to incorporate this suggestion.
Paul	Fleming	we recommend not using the word risk in this framework or at least clarifying what is meant by risk because the word means different things to different readers. For many, risk implies probabilities (and likelihoods) and this is misleading as there are many different iterative frameworks that can be applied.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		928	1	Revised sentence to better link the decision-making framework with the proposed approach -- iterative adaptive risk management. The final report includes a glossary. The extensive discussion of risk assessment and perception also clarifies the different potential meanings of the term.
Paul	Fleming	This is a fantastic discussion and very well done.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a		928	1	We greatly appreciate your positive comment.

			Climate Change Context				
Aditi	Mishra	The first thing mentioned in this segment is the fact that the greatest regional variations will be in “the southern U.S.” What does this mean for where the energy is refined and produced? States like Texas and those surrounding the Gulf Coast dominate energy production, oils refineries, etc. What would the implications be for energy infrastructure and production in these parts? Should plants and refineries be moved from Texas? Is the Keystone pipeline such a good idea when it’s leading the oil to a place prone to the most climate variability in the future?Next, it’s great that the section under consideration recognizes that factors other than climate change also affect energy demand. However, there is very little discussion of the “implications” of the statistics given and conclusions made. What would the overall effect be of seasonal energy demand changes? The effect of these changes on energy prices, the ability or choice of shifting energy production to another part of the country, the option of making the grid more accessible to energy from alternative sources, and the push towards alternative sources of energy could all be considered in more detail.While the chapter talks a lot about adapting major infrastructure to vulnerability, this section could have been a chance for the authors to mention how energy security could be reached by lifestyle changes on citizens’ parts. If energy is going to become harder to produce, we should adapt our houses and practices to using less energy. What about green building? What about investment in public transport by local governments? Most of the changes need to be made on a national level, but some effective measures can also be taken on a local level.	4. Energy Supply and Use		171	11	The referenced section of the chapter pertains to changes in seasonal energy demands (including increased summer temperatures that will increase electricity use), rather than issues relating to energy supply (which seems to be the focus of the comment).
Kevin	Matthews	The draft NCADAC report clearly recognizes the basic fact that mitigation (the net reduction of greenhouse gas emissions) and adaptation (adjusting infrastructure and systems to avoid damage from climate change) are directly connected:"This 'systems approach' tries to connect, for example, how adaptation and mitigation strategies are themselves dynamic and interrelated systems that intersect with the sectors described here, like the way adaptation plans for future coastal infrastructure are correlated to the kinds of mitigation strategies that are put into place today." - Draft NCA p105, Introduction to the SectorsHowever, the mitigation and sector-specific chapters of the draft report - where the rubber hit the road - are seriously substandard - lost inside the box of business-as-usual - compared to the excellent and more mature climate science section, Chapter 2.Chapter 7 on Forestry, for instance, is so scientifically unbalanced as to be non-informative. On page 272, carbon emissions due to wildland forest fires are quantified, without acknowledging the science on rapid carbon re-uptake following fire when follow-on disturbance is avoided. Yet carbon emissions due to clearcutting are not quantified. The statement is made that, "In addition, forest management can increase average forest carbon stocks by increasing the interval between harvests or decreasing harvest intensity (Balboa-Murias et al. 2006; Harmon and Marks 2002; Harmon et al. 2009; Jiang et al. 2002; Kaipainen et al. 2004; Seely et al. 2002)." Yet remarkably, the report fails to even mention, let alone quantify, the option of forest conservation as an approach for increasing average forest carbon stocks. And so on.The President's science advisor, John Holdren, wrote in a Whitehouse blog entry on January 11, 2013 that the report "does not make recommendations regarding actions that might be taken in response to climate change."Yet, given that mitigation, adaptation, and impacts are "themselves dynamic and interrelated systems," what kind of relevance can the sector analysis provide without addressing mitigation?What kind of relevance can the mitigation chapter (Chapter 27) have, relative to the needs of the nation in 2013, if it doesn't define specific strategies to meet specific scenarios? What kind of relevance can the mitigation chapter have if the concept of climate wedges, for instance (or some alternative approach) is not even discussed in the abstract?If we're in 2013, pretending to add up potential damages due to climate change as if industrial business-as-usual can					Thank you for your comment, however policy issues are beyond the defined scope of the National Climate Assessment, a scientific document that provides the basis for decision making, but does not address policy. In recognition of the importance of addressing response strategies, this report explicitly assesses adaptation, mitigation and decision support responses, in addition to identifying research needs associated with these topics, in Chapters 26-29. Many other chapters include assessment of adaptation responses.

		actually continue indefinitely - as if, for example, a practical issue to be concerned about is a shortened Arctic oil drilling season due to melting permafrost - well, I guess we really have our work cut out.If the draft report acknowledged the technical reality that there is now in effect a fixed budget of CO2e that can be put into Earth's atmosphere - a fixed total carbon budget with a size somewhere in the range of half to one-fifth of the stated reserves of the top 100 fossil fuel companies - then perhaps with a little "systems thinking" it could determine that obstacles to oil and gas drilling that has to be stopped anyway are not in themselves a big cause of concern.For instance, when the need to reduce fossil fuel production is quantified and projected, then it becomes clear that a shortened Arctic oil drilling season due to melting permafrost is not a significant issue of concern.I grant that to say that we're actually _going_to_ leave 50%-80% of already-known reserves in the ground is probably one of those dreaded "policy issues," at times considered off-limits to the rank and file of federal science and bureaucracy.However, in 2013, to simply say that we _have_to_ leave 50%-80% of already-known reserves in the ground, in order to have a reasonable chance of stabilizing the global climate at a survivable level, is not policy. In 2013, expressly outlining functional mitigation strategies is simply science. If the U.S. "Third National Climate Assessment (NCA) Report" doesn't define what would need to be done technically, in order to meet reasonable _potential_ policy goals (as well as international agreements, etc.), then what federal project will?At the same time as the draft NCADAC report shows stunningly how bad things will get if we don't act, in its current form it seems to embody the very institutional blinders that are tending to prevent us from acting.As a prelude to acting, or even making the policy choices to act, it is reasonable for top-level decision makers to have a quantified menu of mitigation options before them.In addition, without establishing a menu of quantified mitigation options, the NCADAC internalizes the irrationality of concern over adaptations that could become moot due to mitigation tactics (as in the example of Arctic drilling concerns, noted above). Adaptive approaches will ultimately have to be prioritized according to how they synergize or conflict with effective mitigation approaches. The NCADAC must not shy from dealing substantively and quantitatively with a complete suite of mitigation approaches, which together would be sufficient _at_a_minimum_ to quantitatively meet specific, scientifically defensible, potential emissions reductions targets for 2020, 2030, 2040, and 2050.					
Paul	Fleming	We recommend the addition of “and how to engage them” after “stakeholders” at the beginning of line 16.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		929	15	Modified text as suggested.
Kimberly	Hall	I was surprised to see that Chapter 3 (Water Resources), did not include information about changes in the Great Lakes region, even in the section beginning on page 116, “Lakes and Rivers at Risk.” Given that the Laurentian Great Lakes hold roughly 20% of the world’s accessible freshwater, they should be included in this section, as protection of this resource is critical, even though they occur in a part of the	3. Water Resources		116	7	Thank you for the suggestion. We have included a graphic demonstrating changes in stratification in Lake Superior.

		country where water is more abundant than the west (where many examples in this chapter are focused). As described in the Midwest chapter, water temperatures in the upper Great Lakes are increasing even faster than air temperatures, due to positive feedbacks with loss of ice cover. The figure in this section shows changes in stratification in Lake Tahoe – possibly some of the work looking at this indicator in the Great Lakes (observed and projected changes in stratification timing) could be included here as well.					
Paul	Fleming	We recommend replacing “help with analysis” to “support the process” because we anticipate this being necessary at different times in the process.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		929	30	Modified text as suggested.
Paul	Fleming	You may consider changing “public” to “stakeholders.”	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		930	3	Modified text as suggested.
Philip	Maldonado	The sentence in these lines should include the idea that communities are facing relocation as a consequence of climate change and other related factors, including the causes of climate change. While some communities, like Newtok, are being forced to relocate due to climate change impacts such as permafrost thaw, other communities, like those in Coastal Louisiana, are being forced to relocate due to a combination of multiple factors such as relative sea level rise (both climate change-nduced and subsidence) and dredging of canals by the fossil fuel industry that has led to the tremendous loss of land and erosion.	12. Impacts of Climate Change on Tribal, Indigenous, and Native Lands and		453	11	The text has been revised to incorporate this suggestion.

			Resources				
Justin	Augustine	Van Mantgem et al. 2009 used a cutoff for large trees (i.e., 40 cm) that is generally associated with small or medium sized trees. Using a different cutoff/definition for large trees (e.g., 60 cm or 90 cm) would not have found such an increase in mortality (see raw data for Van Mantgem et al. 2009).	7. Forestry				We appreciate the suggestion. The authors of the NCA Report have written it based upon a variety of sources, all of which were assessed under Guidance on Information Quality Assurance to Chapter Authors of the National Climate Assessment: Question Tools (2/21/2012), to assure for each source (1) utility, (2) transparency and traceability, (3) objectivity, and (4) integrity and security. All sources were assessed for IQA compliance. We are unable for this assessment to do reanlaysis of raw data.
Paul	Fleming	There are many more benefits than simply cost coming from decision support processes such as benefit of challenging and bringing to light the long-term and engrained assumptions generally unaware of by planners and decision makers in current planning processes. We recommend removing the word cost.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		930	10	Modified text as suggested.
Jerry	Brown	Chapter 1, page 4, lines 3 and 4: Not true about large reductions in permafrost areas. “Sea level has risen, and there have been large reductions in snow-cover extent, glaciers, permafrost, and sea ice”. Not true about large reductions in permafrost.	1. Executive Summary		4	3	Amended to remove permafrost here.
Paul	Fleming	We recommend adding “quantity” to the list of examples.	26. Decision Support: Supporting Policy, Planning, and Resource Manage		931	10	Modified text as suggested.

			ment Decisions in a Climate Change Context				
Kimberly	Hall	In Chapter 3 (Water Resources), sections on flooding tend to skip over Midwestern examples and interactions – in the Midwest region, we are expecting and experiencing more spring rain, which has led to more drainage infrastructure being installed to remove water from farm fields. More storms combined with more rapid drainage from land leads to more water in surface waters, and greater potential for downstream flooding (this chapter could reference the box in the Agriculture chapter titled "It's all about the Water!, as this has a nice illustration of drainage pipes in agricultural systems). Water quality issues are also extremely important in Midwest region, with increased storm intensities expected to exacerbate issues related to nutrient, contaminant, and sediment loadings to rivers and lakes, and to promote more overflows of combined sewage and stormwater handling systems. The stormwater piece is included on page 129, but I'd like to see stronger ties back to protecting clean water for people and nature.	3. Water Resources		126	2	The text has been revised to include reference to the Midwest chapter. In addition, we've edited the text to reinforce the key messages' reference to public health and safety and ecology.
Shaye	Wolf	The mitigation chapter must include and emphasize the critical point that climate change impacts will be more severe the higher the emissions trajectory. Today's greenhouse gas concentrations are already resulting in severe and significant climate change impacts, often occurring at unprecedented rates, that are stressing the capacity of human and natural systems. Additional contributions of global greenhouse gas emissions, especially over the next few decades, make the possibility of meeting the international climate target of 2°C less likely, enhance positive feedback loops that amplify warming, and increase the probability of dangerous climatic changes. This point should be illustrated with a figure and table of (a) impacts at today's concentration of greenhouse gasses and (b) impacts predicted under a range of lower versus higher emissions scenarios. The emissions scenarios should include those that lead to reduced concentrations relative to today, such as Hansen et al. (2008)'s 350 ppm CO2 scenario, and the range of RCP scenarios including the RCP 2.6 which yields a reasonable probability of staying below 2°C and RCP 8.5 which is similar to our current trajectory (vanVuuren et al. 2011). This information and graphic is essential for clearly communicating to the public and decision-makers that mitigation choices made today have long-term consequences for human society, natural systems, and the planet. At present, the mitigation chapter under-informs the public about the risks associated with different mitigation choices.As an example of the information that should be included in this section, the chapter should highlight the differences in impacts expected from scenarios that have a high probability of warming below a 2°C temperature rise above pre-industrial (the current international target) versus higher and lower emissions scenarios. A 2°C temperature rise is projected to result in significant risks to food and water security in many regions of the world, the disappearance of the Arctic summer sea ice which jeopardizes the Arctic sea-ice ecosystem and native communities, a high probability of triggering the irreversible melting of the Greenland ice sheet, an increased risk of extinction for 20-30% of species on Earth, the dieback of 30% of the Amazon rainforest, and "rapid and terminal" declines of coral reefs worldwide with serious consequences for the half billion people who depend on coral reefs directly for their livelihoods (Jones et al. 2009, Veron et al. 2009, Warren et al. 2011, Hare et al. 2011, Frieler et al. 2012). One recent study concluded that limiting global mean temperature rise to 1.2°C is needed to preserve at least 50% of the world's coral reefs from collapse due to ocean warming (Frieler et al. 2012). As summarized by a recent study, the impacts associated with 2°C temperature rise have been "revised upwards, sufficiently so that 2°C now more appropriately represents the threshold between 'dangerous' and 'extremely dangerous' climate change" (Anderson and Bows 2011). Because a 2°C	27. Mitigation				The climate science and impacts chapters make this point about climate change risk and the implications of the scenarios considered. This chapter, focused on the U.S., makes the point that the U.S. mitigation effort is not consistent with the tighter scenarios considered in the study.

target would commit the world to significant harm, some climate scientists and governments have urged a target of 1.5°C to avoid dangerous climate change (Hansen et al. 2008, Rockström et al. 2009), which roughly corresponds to reducing the atmospheric CO2 concentration to 350 ppm (Hare and Schaeffer 2009). Limiting warming to 1.5°C has been called for by the Alliance of Small Island States, the Least Developed Countries, and Executive Secretary of the United Nations Framework Convention on Climate Change Christiana Figueres. Reducing CO2 below 350 ppm can restore sea ice, re-establish the balance of ice sheets and glaciers to avoid runaway sea level rise and protect alpine water supplies, and limit the collapse of coral reefs, and if achieved in the coming decades, will reduce the risk of triggering irreversible changes in the climate system (Hansen et al. 2008). According to leading climate scientists, this target will preserve "a planet similar to that on which civilization developed and to which life on Earth is adapted" (Hansen et al. 2008). Thus, this section should also illustrate the climate impacts expected from an emissions scenario that limits warming to 1.5°C, as well as the impacts expected from higher scenarios such as RCP 4.5, 6.0, and 8.5 (the trajectory we are most closely following).Sources cited.

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		climate change upon ecosystems with increasing global mean temperature rise. Climatic Change 106:141–177.					
Jerry	Brown	Chapter 22 Page 761, Figure 22.1. Figure is deceiving since it is not obvious if emissions take into account the diverse ecosystems, soils, and permafrost terrains. In general this chapter would be best served by including several maps of Alaska indicating the diverse nature of the landscapes (ecosystem or ecoregions as in see Markon Fig 3 and one of the permafrost conditions in Jorgenson et al 2008). Why Stewart 2013 reference? Was it in press in July 2012? Same for Markon et al 2012.Page 764. line 9-11, insert “ice-rich” in front of permafrost (that is the so-called cement). Need to back check Overeem et al. 2011to see if they state specifically that permafrost is thawing due to warmer air temperatures. I believe they were referring to warmer waters only. There is no conclusive proof that cold permafrost bluffs are thawing due to increase in summer air temperatures. Accelerated erosion is not controlled simply by air temperature.Page 764, line 8. Fig 22.3 insert in credits for photos “counter clockwise”Pages 767, line 41 to 768, line 1: conclusion from Marchenko are overstated: Permafrost remains below the active layer in many of these interior regions. Key finding on page 780 is more appropriate. Also suggest checking with Vlad Romonavsky for refinement in interpreting this statement based on the direct quote below: Ground temperatures at the depth of the active layer for twelve decades from 1980-2100 were calculated. Results of the simulation show that by the end of the 21st century, the mean annual ground temperatures (MAGT) at the bottom of the active layer could be above 0°C within the vast territory south of sixty-eight latitude North except for the high altitudes of the Alaska Range and the Wrangell Mountains. At the same time, the modeling results show how different types of ecosystems affect the stability and thermal state of permafrost. While in the northern part of the Brooks Range areas of permafrost degradation have appeared by the end of simulation period, some patches of stable permafrost still could survive in interior Alaska. Page 768, Fig 22.5. Original figure provided by S. Marchenko and the Geophysical Institute Permafrost Laboratory, University of Alaska, Fairbanks based on temperatures in the upper meter. It’s a jump of faith to say all soils and ecosystems across Alaska will react in the same way to air temperature change. “Big thaw” for the Arctic region is an exaggeration as the modeled depth is only within the upper meter. Page 774: line 12; would be good to have a specific reference about spring runoff. The ground is frozen at this point and doubtful if there is relationship. Page 774; line 25: increased thaw under lakes and ponds is a long term process and not likely to have a near term effect. Otherwise cite a reference; possible from Mackenzie River region.Page 777. Coastal erosion, see page 764.I believe the chapter would be enhanced by a reference to Hugh French’s chapter on neighboring Canadian permafrost:French, H, 2012. Geomorphic Change in Northern Canada, Chapter 11. In Changing Cold Environments: A Canadian Perspective, First Edition. Edited by Hugh French and Olav Slaymaker. John Wiley & Sons, Ltd. pp. 200- 221.	22. Alaska and the Arctic				The text has been revised to incorporate some of these suggestions. However, the assumptions and process of the climate projection in Fig. 22.1 are described in Chapter 2 on the climate system (where this figure also appears) and in its associated technical report (Stewart et al. 2013). Coastal permafrost thaws in response to both air and water temperatures is already mentioned and "The big thaw" seems accurate to convey to lay readers the effects of thawing of near-surface permafrost, to which this figure refers. Although the generalizability of model results can always be questioned, the statement mentioned by the reviewer based on the reference to Marchenko's model is accurate ("some models project..."); see also the traceable accounts for more explicit definition of "near-surface". Regarding lake thaw, the sentence describes what hunters report, and the cited references are sufficient. We added the suggested reference (French 2012) to the traceable accounts.
John	Nielsen-Gammon	Is there some sort of unwritten rule that states that any mention of potential positive effect of CO2 on plant growth must be balanced by a mention of possible counteracting negative effects in the same sentence? By studiously adhering to this unwritten rule, you are making it clear that I and other readers should not rely upon this chapter for an evenhanded account of the role of future CO2 increases in	6. Agriculture				This comment was addressed in the revision of the report.

		plant growth. In fact, it seems that weeds have some magical property that implies that they are the only type of plant species that will undergo an unqualified net positive benefit as a result of increasing CO2 concentrations. How about at least providing an assessment of which areas are more likely than not to see a net overall agricultural benefit from the combination of CO2, temperature, and precipitation changes?Examples: p 235, 13-14 p 237, 1-3 p 237, 7-11 p 237, 11-13 p 237, 14-15 p 238, 14 p 238, 17-18 p 238, 18-21 Figure 6.10					
Shaye	Wolf	The mitigation chapter (and the National Assessment at large) does not adequately inform the public and decision-makers about the range of possible mitigation options since the lowest emissions scenario presented is the SRES B1 scenario, which leads to 550 ppm CO2 in 2100 and will not achieve the 2°C international target determined to be necessary for avoiding dangerous climate change. The failure to present available emissions scenarios that lead to lower greenhouse gas concentrations than the B1 is an unacceptable omission. The climate modeling community has already produced a suite of new emissions pathways--the Representative Concentration Pathways—that include emissions scenarios lower than the B1 that can achieve a 2°C or lower target. These low emissions scenarios should be presented and discussed so that the public and decision-makers understand that these alternate scenarios are achievable, will lead to significantly lower impacts, and will provide a greater probability of avoiding dangerous climate change.In presenting these low emissions scenarios, the mitigation chapter should also discuss the timing and magnitude of the emissions reductions needed to achieve these pathways. For example, in order to preserve a likely chance of limiting temperature rise to 1.5° or 2°C above pre-industrial levels, recent scientific assessments have found that global emissions must peak within the next several years, decline very sharply thereafter, reach zero net emissions by 2050, and become net-negative after 2050 (e.g., net-negative means that more carbon is removed from the atmosphere than is produced) (Baer et al. 2009, Höhne et al. 2009a, 2009b, Rogelj et al. 2011, UNEP 2010a, UNEP 2011). Scientists have estimated that cumulative CO2 emissions must not exceed 1000 GtCO2 (gigatonnes CO2) between 2000 and 2050 in order to have a 75% chance of staying below 2°C (Meinshausen et al. 2009, NRC 2011) and must not exceed 750 to 824 GtCO2 between 2000 and 2050 to meet a 350ppm CO2/1.5°C target (Ackerman et al. 2009, Baer et al. 2009). Because pathways for 1.5°C and 2°C require staying within a tight cumulative carbon budget, continuing increases in greenhouse gas emissions and corresponding delays in reaching a global emissions peak make it increasingly difficult to meet these targets. For example, global emissions from 2000 to 2010 accounted for roughly 360 GtCO2, which is a third of the allowed emissions until 2050 consistent with a 75%	27. Mitigation				The chapter does a short comparison of the range of RCP's with the SRES scenarios analyzed in the impacts-related components of the NCA. The climate science chapter makes the point that future climates are strongly dependent on which emissions trajectory the world ends up on. It is beyond the scope of the NCA to suggest particular policy options that would be required to meet any policy target.

		chance of staying within 2°C and nearly half of the allowed emissions consistent with staying within 1.5°C (Höhne et al. 2009a). Thus, global emissions in the past decade have eliminated a large portion of the available carbon budget, and every year at current emissions (~33 GtCO2) consumes a significant share and makes meeting this budget less feasible. Achieving emissions pathways that limit warming to 1.5°C or 2°C is still technologically feasible, but this goal is being jeopardized by U.S. and international failures to slow greenhouse gas emissions and forge a binding international greenhouse gas reduction agreement (Blok et al. 2012). Sources cited: Ackerman, F., E. A. Stanton, S. J. Decanio, E. Goodstein, R. B. Howarth, R. B. Norgaard, C. S. Norman, and K. A. Sheeran. 2009. The Economics of 350 : The Benefits and Costs of Climate Stabilization. Baer, Paul et al., S. K. 2009. A 350 ppm Emergency Pathway, EcoEquity and Stockholm Environment Institute. Blok, K., N. Höhne, K. van der Leun, and N. Harrison. Bridging the greenhouse-gas emissions gap. Nature Climate Change 2: 471-474. Höhne, N., C. Ellerman, and R. de Vos. 2009a. Emission pathways towards 2°C, Ecofys. Höhne, N., M. Schaeffer, C. Chen, B. Hare, K. Eisbrenner, M. Hagemann, and C. Ellermann. 2009b. Copenhagen Climate Deal - How to Close the Gap, Climate Analytics and Ecofys. Meinshausen, M., N. Meinshausen, W. Hare, S. C. B. Raper, K. Frieler, R. Knutti, D. J. Frame, and M. R. Allen. 2009. Greenhouse-gas emission targets for limiting global warming to 2 degrees C. Nature 458:1158–62. NRC. 2011. Climate Stabilization Targets: Emissions, Concentrations, and Impacts over Decades to Millennia. Washington, DC: National Academies Press. Available at http://www.nap.edu/catalog/12877.html. Rogelj, J., W. Hare, J. Lowe, D.P. van Vuuren, K. Riahi, B. Matthews, T. Hanaoka, K. Jiang, and M. Meinshausen. 2011. Emission pathways consistent with a 2ºC global temperature limit. Nature Climate Change 1: 413-418. UNEP. 2010a. The Emissions Gap Report: Are the Copenhagen Accord pledges sufficient to limit global warming to 2°C or 1.5°C? United Nations Environment Programme. UNEP. 2011. Bridging the Emissions Gap. United Nations Environment Programme (UNEP). vanVuuren, D. P., J. Edmonds, M. Kainuma, K. Riahi, A. Thomson, K. Hibbard, G. C. Hurtt, T. Kram, V. Krey, J.-F. Lamarque, T. Masui, M. Meinshausen, N. Nakicenovic, S. J. Smith, and S. K. Rose. 2011. The representative concentration pathways: an overview. Climatic Change 109:5-31.					
Kimberly	Hall	Midwest chapter, page 618 – small point, the reference to salt damage on line 18 should probably specify “road salt,” as some readers from geographies where salt is not typically applied to roads (or where there is not a lot of snow) may not be clear on the source of the salt.	18. Midwest		618	18	The text was deleted due to other revisions and is no longer present.
Paul	Fleming	This is a key point. We recommend adding a statement that encourages moving through the planning	26.		933	16	The significantly revised discussion

		process because in many circumstances ideal information will not be available in the near future, if at all, but that shouldn't necessarily be a reason for inaction.	Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				emphasizes that, despite lack of "ideal" information, information and decision processes (such as adaptive management or other "ongoing" learning processes) enable planning and actions to be initiated.
Kimberly	Hall	Midwest chapter, third paragraph (p 618, lines 17-28). I found the graphics in the This Water, Energy, and Land Use chapter that compare bar graphs for uses of water, sources of energy, and land use to be very informative – the Midwest Chapter authors could refer readers back to these graphics, as they do a nice job of simplifying some key differences across the regions that provide context for impacts and vulnerabilities.	18. Midwest		618	17	We have added the suggested citation in our chapter assessment.
Kimberly	Hall	Midwest chapter, page 619, line 18. This line points out that much of our agriculture in the Midwest is not currently irrigated – I'd like to see some information here on how this might change as conditions in summer/early fall change under future climates. Do we expect more irrigation as drought stress increases? What might the impacts of that be on water supplies, water quality, and the flow regime needed to sustain ecological systems?	18. Midwest		619	18	This comment is inconsistent with the author team's thorough assessment of the science, and the lack sufficiently robust data.
Aditi	Mishra	Overall, this Table is somewhat unclear. It works because the difference between percent changes in heating days and cooling days is very stark, so one can tell that overall, the demand for energy will increase solely due to increased cooling days. But the format of the table makes this hard to understand. Perhaps a visual graph would have been better? The time frame of 2041-2070 and 1971-2000 are a bit strange too. Is there any reason why they were chosen in particular? Why those particular 30 years in the future?	4. Energy Supply and Use	4.1	173		Table 4.1 is intended to convey the general message that the number of Cooling Degree Days will increase and the number of Heating Degree Days will decrease in most regions across the country. Specific regional-level projections are included to show that the changes will not be uniform across the country. The timeframes shown were those included in the original NARCCAP (North American Regional Climate Change Assessment Program) regional climate simulations. Due to page length limitations, it is not possible to divide this table into multiple figures.
Shaye	Wolf	The mitigation chapter should include a more comprehensive discussion of the key point that the federal government under the Environmental Protection Agency already has the authority and ability to make significant reductions in greenhouse gas emissions under exiting law—the Clean Air Act. A more thorough discussion of EPA' mitigation authority under the Clean Air Act, progress made to date under the Act, and the unrealized potential for mitigation under the Act (for example, the ability to regulate emissions from existing power plants and airline emissions) should be included in the text and in Table 27.2. This is critical for informing citizens about the federal government's ability and regulatory	27. Mitigation		964	28	Sentences have been added to summarize the Act's history and importance for current Administration actions. However, more detailed description of the provisions of the Act are beyond the scope of the chapter.

		responsibility to make significant and immediate emissions reductions under existing law (no need to wait on Congress). Key points regarding EPA's authority to further reduce greenhouse gas emissions under the Clean Air Act and Clean Water Act are discussed below. A comprehensive review of this topic is also available in Siegel K., K. Bundy, and V. Pardee (2012) Strong Law, Timid Implementation: How the EPA Can Apply the Full Force of the Clean Air Act to Address the Climate Crisis, UCLA Journal of Envtl Law and Policy 30: 185. The Clean Air Act has reduced key air pollutants that cause smog and particulate pollution by more than 60 percent since 1970 while the economy has more than tripled. Moreover, the economic benefits of Clean Air Act regulation — in the form of saved lives, reduced hospital admissions and greater workforce productivity — have exceeded costs by at least 30 times. The Clean Air Act is one of nation's most popular laws. Recent polling data indicate that the majority of Americans already support the use of the Clean Air Act to reduce carbon pollution in the same manner as it is applied to other air pollutants. Furthermore, 57 percent believe that greenhouse gas emissions from power plants are already regulated under the Clean Air Act (see polling data at http://www.lcv.org/media/press-releases/polling-on-climate-feb-2013.pdf). Primary actions that the EPA can take to regulate greenhouse gas emissions are (1) enact a national pollution cap for greenhouse gases under the National Ambient Air Quality Standards Program of the Clean Air Act, (2) fully utilize all additional Clean Air Act authorities for complementary greenhouse gas reductions, and (3) use the Clean Water Act to address ocean acidification. Each of these is discussed below.(1) Enact a National Pollution Cap under National Ambient Air Quality Standard (NAAQS) programThe Clean Air Act controls the most widespread and important pollutants through (1) designation as "criteria air pollutants," (2) the establishment of a science-based pollution cap, or National Ambient Air Quality Standard (NAAQS), and then (3) the preparation of State Implementation Plans by all 50 states to meet that cap. This program, set forth at sections 108-110 of the Clean Air Act, is in many ways the heart of the statute, and helps drive further reductions from the Clean Air Act's other complementary programs. To date, the EPA has listed six pollutants as criteria air pollutants: ozone, particulate matter, sulfur and nitrogen oxides, carbon monoxide, and lead. Reductions in these pollutants have been particularly impressive: between 1980 and 2010, emissions of these six pollutants decreased by 63 percent while the Gross Domestic Product grew by 128 percent. Emissions of carbon dioxide, which was unregulated, increased by 21 percent over this same period. The EPA can readily add heat-trapping pollutants to the criteria list. The EPA has already issued an endangerment finding for six major greenhouse gases. In addition, greenhouse gases are unquestionably emitted by multiple types or sources. Greenhouse gases thus meet the requirement for inclusion as criteria air pollutants. Once listed, the EPA can set a national pollution cap – a NAAQS – for carbon dioxide and other climate pollutants. Each state would then be empowered to develop a plan to reduce its climate pollution, choosing the combination of measures most beneficial given its particular circumstances. SIP implementation fully activates state governments to achieve the federal standard, an important component of effective pollution reduction because many major sources of greenhouse gases, such as land use and transportation planning, are largely under state control. The SIP program also has the advantage that the federal government, the states, and emitters already know and use the existing system which has served the public well for decades. These parties have substantial capacity and expertise relating to the NAAQS and SIPs for traditional pollutants, which can and should be put to use reducing greenhouse gases. Moreover, existing state climate efforts – greenhouse gas inventories, climate action plans and emissions reduction targets – could be incorporated into SIPs. (2) Fully utilize all additional Clean Air Act authorities for complementary greenhouse gas reductionsStationary sources of greenhouse pollution, including power plants and industrial facilities, produce about two-thirds of U.S. greenhouse emissions. Under the new source performance standards (NSPS) program, the EPA sets minimum nationwide pollution standards for various types of industrial facilities. The new source review (NSR) program complements these industry-wide rules by requiring individual major sources of					

pollution to evaluate and adopt site-specific pollution control measures before beginning construction.The NSPS program, under section 111 of the Clean Air Act, requires industry-wide standards for both new and existing stationary pollution sources. The EPA must set standards at the level achievable through the use of the “best demonstrated technology.” To date, the EPA has issued NSPSs for various pollutants emitted from about eighty categories of industrial sources. The largest stationary sources of greenhouse pollution are thus already covered by existing NSPS for other pollutants. The “best demonstrated technology” standard enables the EPA to significantly reduce pollution immediately and to achieve increasingly deep reductions over time. The program can also be implemented quickly, both for new and existing sources.These characteristics make the NSPS program a natural choice for limiting climate pollution from stationary – “smokestack” – sources. Yet, the EPA has been vexingly slow to apply this portion of the Clean Air Act. The first greenhouse gas NSPS for electrical power generating facilities were only proposed in April 2012, and it has recently been reported that the rule may be delayed still further than the April 13, 2013 statutory deadline for its finalization. These standards need to be rapidly finalized and applied to new as well as existing facilities, and NSPS need to be developed for the many other major sources of climate pollution.The NSR program, under section 165 of the Clean Air Act, requires preconstruction review and permitting of any new or modified major stationary pollution source. This program requires that any new “major emitting facility” obtain a permit prior to construction that defines and requires adoption of the “best available pollution control technology” (BACT) “for each pollutant subject to regulation” under the Act. Because greenhouse gases are now subject to regulation under other sections of the Act, they are also subject to the NSR program. In a purported effort to begin implementing the NSR program for greenhouse gases without creating untenable administrative difficulties, EPA adopted a so-called “Tailoring Rule” that limits its application to only the largest facilities. However, despite its potential to address climate pollution in the planning phase for a new facility, the application of the NSR program to greenhouse gases has been disappointing thus far due to EPA’s timid and otherwise problematic implementation of the program. For example, EPA has declined to bring additional sources within the scope of the Tailoring Rule despite a lack of evidence that administrative constraints preclude broader implementation. Where the Tailoring Rule applies, moreover, EPA has enforced BACT limits timidly, often requiring only modest tune-ups or efficiency requirements rather than more aggressive design changes. And EPA has affirmatively exempted so-called “biogenic” CO2 emissions from NSR regulation, despite recent scientific studies showing these emissions can contribute to climate disruption. The NSPS program holds enormous promise for greenhouse gas reductions if only the EPA would correct these implementation problems and move forward with ambitious pollution reduction measures.Mobile sources emit most of the remaining climate pollution in the United States. Once again, there are numerous provisions of the Clean Air Act that could rapidly and effectively reduce this pollution, but – once again – the EPA has failed to take full advantage of these options. The EPA in conjunction with the National Highway Traffic Safety Administration has issued greenhouse gas standards for cars, light trucks, and medium-heavy duty trucks. These standards are an improvement over the status quo but do not achieve the greater reductions that are both feasible and necessary. The Clean Air Act also contains provisions that apply to other mobile sources, such as ships and aircraft. To date, EPA has failed to take any action to limit climate pollution under these provisions. In particular, aviation emissions are projected to grow rapidly and may be particularly detrimental because they are released higher in the atmosphere. EPA has a mandatory duty to issue such rules for aircraft, and yet the agency has already dragged its heels for well over five years since receiving petitions to do so from states and environmental organizations.Because the United States is a major contributor to global climate pollution, it is crucial to focus on the reductions in climate pollutants that can be implemented domestically, regardless of international agreements. Yet, the ultimate survival of the planet does depend on international action. The Clean Air Act presents a mechanism for dealing with international

		sources of greenhouse pollution as well pursuant to section 115. This section allows EPA to require a state to modify its SIP to address emissions of “any pollutant or pollutants” causing international harm. Notably, section 115 also requires reciprocity: the foreign country must give the United States essentially the same rights with regard to emissions limits that arise within that country. Of course, a binding, ambitious, and truly global international agreement would be preferable to a patchwork of bilateral agreements. That said, bilateral and regional trade agreements sometimes coalesce and build into global agreements, and it is quite possible that the United States could help jump-start meaningful international climate negotiations by demonstrating leadership in enacting ambitious and binding section 115 agreements with our major polluting counterparts.(3) Use the Clean Water Act to address ocean acidificationAs EPA has already acknowledged, the Clean Water Act can and should be used to address ocean acidification. While the threat to our oceans is dire, the good news is that our water pollution laws already provide a framework to address this critical issue, and these approaches can complement other scientific and policy strategies. First, Clean Water Act water quality standards can assist in detecting ocean acidification and protecting coastal waters. Since its beginning, the Clean Water Act has contemplated changes in acidity as a water pollution threat. Indeed, pH is explicitly recognized as a pollutant under the law. 33 U.S.C. § 1314(a)(3). All states also provide for the protection of aquatic life uses of ocean waters. While these standards can provide basic guidance for water quality, there are other biological indicators (growth, calcification, recruitment) and ocean chemistry parameters (aragonite saturation, pCO2) that could be useful in detecting the impacts of ocean acidification. Accordingly, EPA should be directed to develop water quality standards that are more specific to ocean acidification and its biological impacts. Second, biennial water quality assessments are an important tool for monitoring ocean acidification and its consequences. Under the Clean Water Act, every two years states conduct a water quality assessment to identify waters — including ocean waters — with water quality problems. In 2010, EPA recommended that states solicit information on ocean acidification and begin monitoring and assessing ocean acidification with a focus on vulnerable waters, such as those with corals, shellfish, and fisheries. In its latest water quality report for marine waters, the State of Washington classified the entire Puget Sound as “waters of concern” because of concerns about ocean acidification’s threat to local shellfish and fish. Early detection of areas vulnerable to ocean acidification can help us manage the problem.States already have coastal monitoring programs, and these should be updated to describe environmental baselines and monitor for ocean acidification. The water quality assessments are conducted by states with EPA oversight and provide an excellent opportunity to improve our scientific understanding of ocean acidification and monitor its impacts. It can also help us identify waters, such as the Puget Sound, that are especially vulnerable and need early action. Thus, under the Clean Water Act there should be increased monitoring and assessment of coastal and estuarine waters for ocean acidification and its biological impacts for consideration during the periodic marine water quality assessments.Third, identification of waters impaired by acidification can be used to address ocean acidification. As a part of the water quality assessments, the Clean Water Act provides that states and tribes should identify impaired waters — any waters not attaining water quality standards — and add them to their “303(d) lists.” 33 U.S.C. 1313(d). In 2010, EPA affirmed that waters that are not meeting water quality standards, including marine pH, due to ocean acidification should be included on the 303(d) lists. Accordingly, states and the EPA should designate coastal waters as impaired by ocean acidification under section 303(d) of the Clean Water Act. Designating waters impacted by acidification can raise awareness about the problem of ocean acidification, engage public participation, and promote solutions. For example, impaired waters are afforded new protections, called TMDLs (total maximum daily loads), that identify pollution sources and acceptable levels of pollutants — which could ultimately work to abate local and regional sources of ocean acidification. This provision of the law was intended to address pollution problems that come from broad or difficult to identify sources, and indeed it has already been used for					

		atmospheric deposition of mercury and acid rain. For example, to address atmospheric mercury pollution, seven northeastern states joined together to develop a regional clean-up plan and TMDL to reduce mercury entering waterways. In sum, the Clean Water Act provides excellent tools for action on the state, regional, and national levels to address ocean acidification. It would enhance monitoring, assessment, and identification of ocean acidification. This statute should be implemented immediately, and it can complement other efforts to reduce carbon dioxide pollution — including the Clean Air Act.					
Kimberly	Hall	Midwest chapter, page 621, paragraph starting on line 20. The points made regarding the use of agricultural best management practices having carbon sequestration and energy use benefits could be expanded to include a wider range of benefits (improved water quality due to reduction in the loss of sediments and nutrients from farm fields, reduced risk of downstream flooding if the practices also contribute to slowing/absorption of stormwater). These are really win-win-win actions, and we know how to implement them - so seems useful to highlight the benefits more broadly.	18. Midwest		621	20	The text has been revised to incorporate this suggestion.
Kimberly	Hall	Midwest chapter, page 622, lines 11-16, and 20-27. These sections under the heading of Forest Composition refers to biodiversity much more broadly – not just biodiversity in forests. This seems to suggest that all of the Midwest's biodiversity is in the forested systems, which of course is not true – and in particular I think discounts the fact that Midwest stands out as a region of very high species diversity for freshwater species, especially freshwater invertebrates. I don't know if this order of topics has been standardized across chapters, but it seems like addressing ecosystems/biodiversity first (and having lines 11-16 and 20-27 go in that section) would help address this.	18. Midwest		622	11	The text has been revised to incorporate this suggestion.
Ken	Lindeman	Thank you for the opportunity to provide comments on draft Chapter 28 (Adaptation). - Pg 983. Line 30. Highly endorsed, Solid messaging tactics. - Pg 983. Lines 37-39. Critical point. This is a major, underdiscussed challenge; there are now hundreds of excellent adaptation guides but they are typically not being applied in terms of the toughest political and socio-econ challenges involving property in flood zones (e.g., short term revenues vs. long term costs, and other externalities). Florida and many other states offer many local examples with state and some local administrations that do not even recognize climate change science. There are some local govs working on this but, even in these cases, it is very difficult (understandably) to politically suggest anything that contradicts BAU policies re property in flood zones. - Pg 989. Line 1. Possible additional ways the federal government could facilitate climate change adaptation: laws and emission regulations, implementation of sustainability practices across various industry sectors, compare our national climate adaptation practices to other countries in Europe, Australia etc. to identify areas and methods of possible improvement - Pg 989. Line 24. "Completed climate adaptation plans": was expecting comprehensive plans, but they read like climate adaptation actions. - Pg 992. Table 28.3: The row for Satellite Beach Florida states: "Collaboration with the Indian River Lagoon National Estuary Program led to the incorporation of sea level rise projections and policies into the city's comprehensive growth management plan (Gregg et al. 2011)." This is not fully correct. Gregg et al. did not say that SLR was in the city's comp plan, they correctly said: the city and the IRLNEP "…are working to incorporate…". This matters because the city council did not first approve such language until Jan 2013 after various additional events and two years of work by the Comprehensive Planning and Advisory Board. The SLR language was added to the Coastal Element of the Comprehensive Land Use Plan and is now under review by planners at the Florida State Dept of Economic Opportunity.	28. Adaptation				Thank you for your comment. We appreciate knowing which resources and comments you particularly appreciated in the text. We have also made the proposed changes to the Satellite Beach, FL example and added information about the importance of multi-disciplinary collaboration in adaptation processes. However, due to space limitations, we were not able to add a table on climate websites or on the various decision tools. The decision tools are detailed more in the Decision Support chapter of the NCA. Also, many of the common information providers are listed.

		Significantly, the current language makes multiple references to the new state Adaptation Action Areas (AAAs) in accordance with Sections 163.3164(1) and 163.3177(6)(g)10 Florida Statutes. The AAA language was achieved in the Florida Legislature by innovative work by leads from the Southeast Florida Climate Compact. In Satellite Beach, a different region, the language was spearheaded by city residents on the Comprehensive Planning and Advisory Board, at times, under substantial pressure to not address these issues. Within the state of Florida, it currently appears that Broward County, Florida is the first county and that Satellite Beach is the first city with AAA language in a comprehensive plan. - Pg 994. Table 28.4. Highly endorsed. - Pg 999. Line 15. Could include a section on cross-disciplinary partnerships as an effective and common approach to adaptation planning. - Pg 999. Line 20. There are many tools available to help decision makers, would be useful to include a section on how to choose an appropriate tool. - Pg 1000. Lines 15-20. Would be useful to include a table of the online resources & climate websites that share best practices. For example, Southeast Climate Consortium, Climate Access etc. Could also mention web-based resources for climate adaptation in a table. These may be somewhat similar to the table above. Ex. CakeX, Virtual Climate Adaptation Library, Georgetown Clearinghouse, others.					
Rachel	McLoughlin	This figure seems confusing at first glance. I would be concerned that some people might not understand that the bands of probability correspond to the coastline across from them. However, I am not sure what would be a better way of presenting this information.	16. Northeast	16.5	555		After consideration of this point, we clarified the figure.
Paul	Fleming	We have major concerns with the statement on page 934 line 13 and the risk assessment discussion on page 935, lines 4-28. Using and recommending a probabilistic assessment is not the best approach for many questions being analyzed for decision-making, and can be manipulated and used inappropriately as fact. Though it can be a good way of communicating how the frequency of a given type of event could change in the future, it can also be used to imply predictability of climate model projections. For example, the Bureau of Reclamation's first draft of the Colorado River Basin Supply and Demand study presented a BCSD climate model mean and corresponding hydrologic result as the main result from their analysis. This was immediately interpreted by many (and used accordingly) as what the future of the Colorado river would be. There are significant issues associated with this approach, not to mention major political implications, mainly that the model average is the only future we should plan for and is most likely to occur. Some issues with a probabilistic assessment of climate projections we have encountered include: the idea that model agreement means model predictability; creating a false sense of certainty, and limited understanding about, future conditions; continued deterministic-type planning; and not challenging decision-makers to ask the question of what if something else happens instead? In our experience, the key is to consider multiple different futures and what that means to the system you manage and the decisions you need to make. Another assumption with recommending a probabilistic approach is that the people analyzing this information fully understand the capabilities and limitations of climate model projections, which is generally not the case. This analysis will inform billion dollar decisions that, in the case of some infrastructure projects, will be in place for 100+ years. We encourage you to rethink this section and recommendations with this in mind.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		934	4	We have deleted the statement and highlighted the importance of recognizing the uncertainties associated with climate change predictions and the need for robust decision making in our discussion of risk management strategies as part of the framework.
Paul	Fleming	This is a great section. We have recognized the importance of having science translation on both sides of the table. That is, from the science side and at the organizational level to support the incorporation of climate information into organizational thinking and decision-making.	26. Decision Support: Supporting Policy,		940	3	Section maintained.

			Planning, and Resource Management Decisions in a Climate Change Context				
Anis	Ragland	Thank you for the opportunity to comment and for your consideration of my comments. I hope they are useful.Overall, the chapter was informative and touched upon some of important relationships between land-use/land-change (LULC) and climate. General trends, patterns and illustrative examples were synthesized well although, as I discuss later, were not always the most relevant for decision-makers at a national level. The credibility of the information/science and the legitimacy of the assessment process are strengths of the assessment and this chapter. My suggestions for areas of improvement fall under the headings of salience and topics that would benefit from elaboration or inclusion. Salience: My biggest critique of the chapter (and perhaps this is also applicable beyond this chapter) is that I see it as having limited relevance for national policy-makers despite the intention to be policy-relevant. The NCA website states: “The NCA aims to incorporate advances in the understanding of climate science into larger social, ecological, and policy systems, and with this provide integrated analyzes of impacts and vulnerability.” I believe chapter authors were asked to write from the perspective of decision-makers as well (Executive Summary, p. 17).Since the immediate target audience of the NCA is the President and the Congress, and this chapter deals with LULC issues at a national level, I tried to put myself in the shoes of a national policy-maker. In this respect, I find the chapter in need of strengthening, particularly through the inclusion of more concrete and relevant data (on patterns, trends, projections and impacts) at the national scale. More concrete facts and figures are needed to help policy-makers think strategically about the impacts of current and future policies. Questions that come to my mind are of the form: What changed? By how much? What caused it? What are the risks? What are the policy levers that influence a phenomena? How much will action/inaction cost? How much will it save? It is impossible to go into much depth on any of these questions; but selecting some key facts relevant to national interests would make the assessment more useful to national decision-makers.Currently, the chapter reads like a literature review and is broadly informative at a level appropriate for someone who has little to no prior knowledge and experience with climate change (this is not necessarily bad). In this respect, I could see the chapter being useful and informative to many in the general public or as a reference for policy-makers who wish to identify relevant literature for further research on a specific issue. To be fair, the “Recent Trends” section does a reasonable job of including relevant facts and figures. Perhaps this is easier to do given that they are based on observed phenomena. The sections that look into the future and at the impacts of climate on LULC are lacking in specific facts and figures that are relevant to national-level decision-makers. Specific instances where facts and figures seem lacking are addressed in my comments on specific sections of the chapter. Topics for elaboration or inclusion:Social, environmental and economic policies and laws that affect LULC: This may not be politically feasible or within the scope of the assessment but a review of some of the major national policies and laws that have significant effects on land-use decisions by public and	13. Land Use and Land Cover Change				Thank you for your comment, however policy issues are beyond the defined scope of the National Climate Assessment, a scientific document that provides the basis for decision making, but does not address policy.

		private actors would be useful. Policy-makers who are looking to address LULC issues need to know what the existing policies and laws are that shape LULC and what the impacts of these policies and laws have been. The impacts of the policies may be much harder to include and are likely to be politically sensitive; however, just knowing what the relevant national policies are can be a good guide for policy makers to understand the political and economic drivers of LULC.Linkages to other parts of the assessment: If I understand correctly, the NCA will be trying to allow for a much more fluid and dynamic navigation of the different sections and topics covered in the assessment through the use of hyperlinks. This is a good idea and I would recommend leveraging this to prioritize information included in the Land Use and Land Cover Change chapter. Where possible, regionally and sectorally specific information should be included in the relevant chapters and links to those chapters and sections be placed in this chapter. National (and specific) trends and patterns of LULC, which I have suggested is lacking in this chapter, should be prioritized in this chapter. Given the nature of this chapter to be cross-sectoral, there are many places in the chapter where regional, sectoral and response strategy chapters could be linked. Perhaps these links to other relevant chapters will be inserted later. Some places that might get overlooked where you may wish to add connections to this chapter are in the executive summary in the following places: Pg. 4 lines 23-34: The paragraph talks about sea level rise which would affect coastal land-use and land change. Pg. 5 lines 22-39: The paragraph talks about changes to ecosystems, landscapes and built environment.Pg. 8 line 34: Recommendation 5 – "Climate change threatens human health and well-being in many ways, including impacts from increased extreme weather events, wildfire, decreased air quality, diseases transmitted by insects, food, and water, and threats to mental health." Chapter 13 would appear to be relevant to this recommendation.Pg. 9 line 2: Recommendation 6 – "Infrastructure across the U.S. is being adversely affected by phenomena associated with climate change, including sea level rise, storm surge, heavy downpours, and extreme heat." Chapter 13 would appear to be relevant to this recommendation.Sea level rise: The chapter does not discuss in any substantive way the impacts of sea level rise on LULC. Perhaps this is because there is a whole chapter on Coastal Zone Development and Ecosystems; however, since there is overlap, there should be some mention of coastal zone LULC changes from sea level rise, and a link to chapter 25. Persistence/reversibility: A potentially useful dimension to include related to the science behind LULC and climate is the question of persistence/reversibility (which is one of the criteria for identifying key vulnerabilities according to the Executive Summary, p.17). I would like to see some more information about the risks of irreversible land changes.					
Shaye	Wolf	The chapter's failure to discuss the US's role in international mitigation efforts is a significant oversight. The US's role in climate negotiations at the international level is instrumental in determining the global emissions trajectory, due to the US's global leadership position and large contribution to global emissions. The US is by far the largest contributer to historical emissions and is the second highest emitter of greenhouse gases in the world after China (although China's per capita emissions are much lower than the U.S.), and the US accounts for ~20% of global emissions. Because of the importance of international mitigation efforts, this chapter should discuss the (a) status of international negotiations on forging a binding climate treaty under the United Nations Framework Convention on Climate Change, (b) the US's role in that negotiating process and its mitigation pledge under the Copenhagen Accord, which has been rated as "inadequate," and (c) the projection that the earth will experience a likely temperature rise of 3.5°C or more under current international pledges, putting us in the realm of dangerous climate change. Key points on UNFCCC negotiations are discussed below, and NOAA	27. Mitigation				We quote the NAS regarding the need for a strong US role in reducing emissions. Further discussion of the international negotiation process is beyond the current scope of the chapter, which has been focused on US domestic actions.

provided a helpful and comprehensive summary of these international negotiations, available at http://www.nmfs.noaa.gov/stories/2012/05/07_coral_documents_page.html.In the UN Framework Convention, signed and ratified by the United States, the world agreed to take the actions necessary to avoid dangerous climate change. Parties to the Convention also agreed as a matter of fairness that the world's rich, developed countries, having caused the vast majority of emissions responsible for the problem, would take the lead in solving it. It was not until the 1997 meeting in Kyoto, Japan, that the first concrete, legally binding agreement for reducing emissions was signed: the Kyoto Protocol. The Protocol requires the world's richest countries to reduce emissions an average of 5 percent below 1990 levels by 2012, while developing nations also take steps to reduce emissions without being subject to binding emissions targets as they continue to raise their standard of living. However, the United States has been a major barrier to progress in the international negotiations. After the Clinton administration extracted many concessions from the rest of the world in exchange for the United States signing on in Kyoto, the Senate rejected the equity principles behind the Convention, saying the United States shouldn't agree to reduce its own emissions unless all other countries — regardless of their responsibility or ability — were similarly bound. Citing the same reasons, President George W. Bush repudiated the Kyoto Protocol entirely. Thus the United States is the only industrialized country in the world that has yet to ratify the Kyoto Protocol. The United States negotiating team under both the George W. Bush and the Obama administrations has pursued two primary objectives in the international talks: to refuse any legally binding emissions reduction commitments until all other countries— but particularly China and India — do so, and to push back the date for a new agreement. Not surprisingly, the United States had failed to meet its (never ratified) Kyoto pledge to reduce emissions to 7.2% below 1990 levels by 2012; to the contrary, U.S. emissions have increased by 10.5% since 1990 (EPA 2012).Moreover, Kyoto Protocol's first commitment period only sets targets for action through 2012, and there is still no binding international agreement governing greenhouse gas emissions in the years beyond 2012. While the 2009 U.N. Climate Change Conference in Copenhagen called on countries to hold the increase in global temperature below 2°C as a goal for avoiding dangerous climate change, the non-binding "Copenhagen Accord" that emerged from the conference, and the subsequent "Cancún Accords" of 2010 and "Durban Platform" of 2011, failed to enact binding regulations that limit emissions to reach this goal. The non-legally binding Copenhagen Accord of 2009 and Cancún Accords of 2010 recognize the objective of limiting warming to 2°C above pre-industrial, but do not enact binding regulations to achieve this goal (http://cancun.unfccc.int/cancun-agreements/main-objectives-of-the-agreements/#c33; unfccc.int/resource/docs/2009/cop15/eng/11a01.pdf). According to the Durban Platform, developed and developing nations agreed to a process to develop a "new protocol, another legal instrument, or agreed outcome with legal force that will be applicable to all Parties to the UN climate convention." This legal instrument must be developed as of 2015 and will not take effect until 2020 (unfccc.int/resource/docs/2011/cop17/eng/l10.pdf).Achieving a target of limiting warming to 1.5°C or 2°C is still technologically feasible, but this goal is being jeopardized by US and international failures to make ambitious emissions reductions at the national level and forge a binding international greenhouse gas reduction agreement (Blok et al. 2012, Vieweg et al. 2012). The US's pledge under the Copenhagen Accord to reduce emissions by -17% relative to 2005 emissions in 2020 (equivalent to -3% relative to 1990) is rated as "inadequate" to reach a 2°C target (http://climateactiontracker.org/countries/usa.html). Moreover, the US has yet to issue regulations to limit GHG emissions in accordance with its pledge under the Copenhagen Accord. At present, if all countries were to meet their non-binding pledges under the Copenhagen and Cancún agreements to cut greenhouse gas emissions, these inadequate national pledges would lead to 2.5°C to 5°C warming (Rogelj et al. 2010, UNEP 2010, UNEP 2011), with a likely rise of 3.5°C or more (Höhne et al. 2012). See http://www.climateactiontracker.org/ for helpful updates on the status and progress of international

		mitigation efforts.The gap between expected emissions in 2020 based on implementation of current international mitigation pledges and global emissions consistent with the 2°C target is called the "emissions gap" or "gigatonne gap." The United Nations Environment Programme has provided a series of scientific reports focused on how to bridge the emissions gap to meet the 2°C target (UNEP 2010, 2011), and these should be referenced in this chapter.Sources cited: Blok, K., N. Höhne, K. van der Leun, and N. Harrison. 2012. Bridging the greenhouse-gas emissions gap. Nature Climate Change 2: 471-474. Höhne, N., B. Hare, M. Vieweg, M. Schaeffer, C. Chen, M. Rocha, and H. Fekete. 2012. Reality gap: Some countries progress in national polices, but many risk failing to meet pledges. Climate Action Tracker Update, 24 May 2012. Climate Analytics, Ecofys, and Potsdam Institute for Climate Impacts Research. Rogelj, J., W. Hare, J. Lowe, D.P. van Vuuren, K. Riahi, B. Matthews, T. Hanaoka, K. Jiang, and M. Meinshausen. 2011. Emission pathways consistent with a 2ºC global temperature limit. Nature Climate Change 1: 413-418. UNEP. 2010. The Emissions Gap Report: Are the Copenhagen Accord pledges sufficient to limit global warming to 2°C or 1.5°C? United Nations Environment Programme. UNEP. 2011. Bridging the Emissions Gap. United Nations Environment Programme (UNEP). Vieweg, M., B. Hare, N. Höhne, M. Schaeffer, M. Rocha, J. Larkin, H. Fekete, K. Macey, and J. Cutschow. 2012. Governments still set on 3°C warming track, some progress, but many playing with numbers. Climate Action Tracker Update, 3 September 2012. Climate Analytics, Ecofys, and Potsdam Institute for Climate Impacts Research.					
Anis	Ragland	I think this section is a really good synthesis of important recent trends. It is also rich with facts and figures which are useful from a national decision-maker perspective. The level of specificity here is lacking in other sections. To enhance some of the numbers in the text, you may wish to consider including maps of population growth shifts. Perhaps even more informative may be the use of geospatial analysis to create a map that integrates/overlays population growth changes with land use changes.	13. Land Use and Land Cover Change		472	27	This is an interesting suggestion. Our hope in preparing these graphics and presenting them in the way we did was to provide a presentation of facts about land-use and land-cover changes that would serve as a useful reference to the entire study, including the other sectoral and regional chapters. For that reason, we chose to present data in a relatively "raw" form, rather than perform sophisticated analyses that might have served our chapter better (as suggested here).
Aditi	Mishra	The first line in the page talks about how hydropower plants depend on the seasonal change in snowmelt cycle. Would the decrease in snowmelt be offset by the increase in average precipitation? How big of a difference would increasing precipitation make to hydropower?When the page mentioned that "the most significant water-related stresses" would be in the Southeast, Southwest and Great Plains region, what does that imply for agriculture? Those areas are the corn-belt and agricultural hubs of the US, what does having less water mean? Would agricultural patterns shift to the	4. Energy Supply and Use		176		Although these comments point to a number of detailed potential impacts on energy systems from climate changes, the page limits from the National Climate Assessment has led the chapter authors to balance issues

		north, as the northern areas get warmer? Also, what kind of time frame are we talking about? Are these areas already stressed by water supply? By what percent is the amount of water needed from irrigation increasing per year due to these stresses? Also, how long will it take before we're out of major groundwater supplies?The number 6.6 feet when talking about projected sea level rise by 2100 with respect to policy decisions is a bit random. How was it determined? Why a number with decimals when there's no certainty of the exact amount of sea level rise? Some discussion about whether or not policy-makers would be willing to negotiate on such a large number would be nice too. Claiming a higher number calls for more rigorous adaptation strategies, and those are harder to convince people on. California example is good though, puts the situation in perspective.					related to the breadth of changes and issues related to detailed changes in energy supply patterns and use patterns across the U.S.
Kimberly	Hall	Midwest Chapter, page 624. The caption for Figure 18.5 suggests that some of the difference in deaths across the different heat waves can be attributed to "increased mitigation efforts" – actually, I would say that's climate change adaptation, though from a disaster response standpoint, the terminology has historically been "mitigation" (here readers may interpret this as mitigation = reductions in emissions). I find this graphic pretty confusing – what is the death rate in an average year now from heat stress? The figures plot future increases (the bars for each emission scenario) and actual values (lines for particular years) on the same axis, which I find confusing. I think I would split this out – small graphic showing the B1 vs A2, next to a table linking info about the heat wave (i.e., number of days with temps over some temp threshold) and the death tolls in the three years shown. Then it becomes clear that something went RIGHT in Chicago to produce the reduction in deaths in 2006 given a very similar heat wave – so it is likely that there was an effective response by the City (which should be applauded!). Of course, that same level of response may not be sufficient to protect people as conditions continue to get more extreme.	18. Midwest	18.5	624		We thank the reviewer for the helpful suggestion and have removed the figure in favor of text explanation.
Paul	Fleming	Key Message #4 Include maintenance in the list since it is the backlog of maintenance that creates financial burdens that limit the ability to do some of the other things listed in this key message.	28. Adaptation		983	30	The addition of maintenance to this key message does not fit with the intent of the sentence. In addition, a number of the examples highlight the concept of maintenance. As such, no change was made.
Anis	Ragland	This section could be strengthened by using more concrete facts and numbers. For example, by how much does (or might) land conversion from forests or grasslands change in relation to population density changes? (pg. 476 line 14). Or, how will croplands and forests change under high population and economic growth scenarios (pg. 476 line 27)? An example of where the information is not as relevant to the national scale of analysis of the chapter is on pg. 476 line 8 where the text mentions rates of change in urban areas. The facts that are given are about regions rather than a national aggregate. Instead of discussing in very general terms how different assumptions change projected outcomes, it would be more useful to see what the best projections are and what those assumptions are in concrete terms. One specific question that I have is: How are CO2 emissions expected to change from anticipated LULC (given certain assumptions about economic and population trends)? This would be relevant for the last section of the chapter on mitigation. Suggestion for a potentially useful graphics: Include a national map with GIS data (at a smaller spatial resolution than a region) showing projected rate of land cover change 2010-2050.	13. Land Use and Land Cover Change		476	1	Because we relied on published assessments and projections, and because those publications did not take the step of evaluating the impacts on emissions, which is a relatively complicated assessment to make, we cannot include that here. We have added national summary quantities in parentheses in response to the suggestion.
Paul	Fleming	The measurement of success can be incorporated into utility practices (and some of them have been such as how to deal with outages for instance) by using best practices such as benchmarking.	28. Adaptation		983	37	The material presented in this key message is meant to be positive, not normative. As such, the authors did not feel it was appropriate to make this edit since it would change the wording to be more normative.

Kimberly	Hall	Midwest Chapter, page 626, Energy section. As noted above, I really like the comparative figures in the Water, Energy, and Land Use chapter, and think this chapter could reference the regional bar graphs there to help illustrate where our energy comes from in the Midwest, and how that relates to water and land use.	18. Midwest		626		The text has been revised to incorporate this suggestion.
Paul	Fleming	This might be the place to incorporate the language of Chapter 26 on Decision Support Page 925, Key Message #3, lines 35-37 which notes, "….increasing support through the USGCRP for research to develop decision support tools; and incorporating assessment of decision support resources for sectors and regions into the ongoing National Climate Assessment process." I looked for language in this chapter that captures this recommendation for specific strategy for ongoing assessment and couldn't really find it.	30. The NCA Long-term Process: Vision and Future Development		1047	27	Agree in part. Added the following language not on original lines 27 through 30 on page 1047 as suggested (as it is too specific for this visionary section) but to original line 21 on page 1048 immediately following "datasets": "…--including their use in decision support tools--....."
Anis	Ragland	Further to my comments on the whole chapter, this section might be a good place to talk about key national policies and laws that drive or shape land-use decisions. For example, are there important land management laws, zoning policies, agricultural and energy policies that play a big part in land use decisions. This Further, although this section is meant to address effects of land-use and land-cover choices on communities and ecosystems, the text mostly deals with the former and does not really address the latter. Another example of where greater specificity could be included is on pg. 478 line 14: "The effects on property loss of increases in the frequency and sizes of fires under climate change are also projected to increase in the coming decades because so many more people will have moved into increasingly fire-prone places." As a policy-maker, I would want to know what are the estimated economic and environmental impacts of increasing frequency of fires?	13. Land Use and Land Cover Change		478	6	Thank you for your comment, however policy issues are beyond the defined scope of the National Climate Assessment, a scientific document that provides the basis for decision making, but does not address policy.
Kimberly	Hall	Midwest Chapter, page 627. Increased Rainfall and Flooding – these impacts can also have strongly negative impacts on the integrity and diversity of aquatic habitats, and thus put fish and other species (and the recreational fishing stakeholders that are supported by fish) at risk. As storm intensities increase, more sediments, nutrients, and contaminants (from agriculture, or urban land uses, or overflows of combined sewage and stormwater facilities) can enter these systems, and extreme events can scour streams, reducing habitat diversity. I'd like to see these types of impacts included in the heading (line 4) and text. Ecosystems are mentioned on page 630, but ecological impacts could be more thoroughly integrated in this very important section.	18. Midwest		627		The text has been revised to incorporate this suggestion, but space is too limited to integrate more information.
Anis	Ragland	Could information about the specific proportions of land uses by regions be added? It seems that this figure is related to (or the graphic format of) Table 13.1. If so, perhaps you may want to find a way to make a link between the figure and the graph and say something about their relationship to one another. I also would have liked to have seen the sizes of land cover relative to other regions. The graph only shows proportions for each region but not as a proportion of the land cover for the whole country. Having this data may be helpful in thinking about priorities and strategies on a national level in terms of policies that affect a certain land cover.	13. Land Use and Land Cover Change	13.1	473		The data in Figure 13.1 are not the same as the data in Table 13.1. Please see table references for data sources. In regards to the suggestion to add additional information and graphics, we appreciate this suggestion, but space is limited. The author team has deliberated and agreed on the most important information and illustrations to include.
Kimberly	Hall	Midwest Chapter, page 630. The drought paragraph at the end of this section should be expanded to include consideration of low stream flows/high water temperatures, and the needs of freshwater species – coldwater fish, and temperature sensitive but relatively immobile freshwater invertebrates are particularly at risk. Further, this section could link back to earlier sections that note that much of	18. Midwest		630		We accept that these other changes are possible but feel that we have provided examples of possible drought impacts, and given that aquatic

		agriculture is not currently irrigated – what happens to stream flow if increases in summer/fall drought stress promote more use of irrigation?					ecosystems are not a focus of our chapter, this would not be consistent with the chapter as a whole.
Shaye	Wolf	The regional sections provide helpful summaries but they are missing critical figures and sections that make them significantly less useful. All regional sections should include the following: (1) Each coastal region should include a similar map of projected sea level rise for that region showing the areas that will be affected by 1 to 6 feet of sea level rise. The NOAA coastal impacts viewer and other widely available mapping tools provide this information. (2) Each region should include a map illustrating observed and projected (2030, 2050, 2075, 2100) temperature rise and precipitation change. (3) Each region must include a discussion of that region's mitigation activities. At present, the regional sections only provide a summary of regional adaptation activities. In a climate impacts assessment, failing to include a summary of regional activities to reduce greenhouse gas emissions is a major omission.	Introduction to Regions				The authors of the regional chapters were free to structure their chapter in response to their consensus on the salient impacts and vulnerabilities – there was deliberately no requirement to provide the level of consistency as the comment requests. Such a proscribed approach would not work across the vast regional differences.
Anis	Ragland	I did not find this figure to be very understandable. The caption explains that the graphic shows number of buildings lost from the 25 most destructive wildland-urban interface fires in CA history from 1960 to 2007. The connection of these fires to climate change is not clear. Further, this seems like information that would be of more interest to someone interested in the California region rather than at the national level.	13. Land Use and Land Cover Change	13.4	478		After consideration of this point, we still feel the existing text is clear.
Anis	Ragland	Could a national land cover projection be included with this graphic or somewhere else? Is there some place where the description of the land cover categories is included? This would be helpful in better understanding the figure.	13. Land Use and Land Cover Change	13.3	478		We appreciate the suggestion to add definitions and national projections, but space is limited. The author team has deliberated and agreed on the most important information to include. All definitions can be found in the figure references.
Paul	Fleming	• This NCA represented a significant change and improvement in how assessments are developed. The USGCRP and NCA staff designed an engagement process that did a much more thorough and extensive job of engaging with other segments of society in soliciting technical inputs and in contributing to and writing chapters of the report. • Future NCAs must continue to meet the statutory obligations of the Global Change Research Act. They should, however, go beyond these obligations and be viewed as a both a process and a series of products that can help build adaptive capacity and inform decision-making through the nation. • This would require the creation of a sustained assessment process that continues and expands the broad-based engagement that was a hallmark of this NCA process, interim products that address critical and salient climate issues facing the U.S., stronger partnerships with non-federal stakeholders, and access to resources to support ongoing activity. • The resources required to meet the obligations of the Global Change Research Act should be leveraged to create products and processes that not only inform federal agency actions on climate change, but supplement that important need with the opportunity to inform decisions and build adaptive capacity throughout society.	30. The NCA Long-term Process: Vision and Future Development				Agree, but comment is rhetorical. No changes were made to the chapter in response to this comment, as the essence of the comment is addressed throughout the chapter already.

Ben	Strauss	This is a strong chapter covering critical topics. It could be strengthened by inclusion of estimates of the quantity of low elevation coastal housing in the US. At least one source for this information is already cited in the chapter, but not used for this purpose: Strauss et al 2012. (The same source also provides land area and population estimates which could be valuable as well.)	25. Coastal Zone Development and Ecosystems				There are a number of such estimates out there, and they are not easily comparable across the nation. We have used a new reference (and with that new figures) - Crowell et al. 2013 - that does the best job at estimating the current population in the FEMA 100-year flood zone; projections under higher sea levels and different population growth scenarios differ widely. We have not used the Strauss et al. 2012 numbers here as they were done using a different methodology than Crowell, and because they do not account for population growth (under different scenarios, we were requested to use across the assessment). We have decided thus to stick with the best available CURRENT figures, and explain what could account for increases in population in high-hazard areas. In the course of discussing this issue with FEMA we learned of a forthcoming paper that will add significantly to this discussion, but it is not yet available to quote.
Lidia	Delgado	I am not sure if the --end box -- on line 8 after the caption was left by accident or if it means anything. Thanks	5. Transportation	5.4	205		Thank you for your comment. The text --end box--demarcates a division between the box on Hurricane Sandy and the rest of the chapter. This has been removed in the final electronic version of the NCA.
Aditi	Mishra	When talking about future energy systems, it's great that this chapter explicitly states the uncertainties involved in making projections. We really don't know what the energy mix would look like in the near future. However, as energy sources do get more diversified, maybe the authors could have mentioned how we can make the grid adapt to these changes, especially at peak demand? The grid currently only takes electricity for cooling, but this would have to change as the number of cooling days increase. The grid should be able to switch from solar to wind to fossil fuels with ease to meet future demand.Once again, something could be said here about how homeowners can adapt. Solar panels are incentivized by the government and becoming cheaper. People can even sell their energy surplus to utilities and make money producing their own energy. Green buildings are cheaper in the long run as they save more money than it costs to implement them. All of these things could put less pressure on the grid in the future.	4. Energy Supply and Use		180		We agree that there are countless uncertain factors that will affect the shape of energy systems in the future. This makes it all the harder to anticipate the way(s) that climate change will affect energy production and use in the U.S. As we indicate in our discussion of Key Message #5, the manner in which U.S. energy systems evolve will have important implications for effects of climate change on energy supply and use. There may be many developments that can support greater resiliency in the face of climate impacts, and it is

							also possible that developments in future energy systems may make climate impacts more disruptive.
Aditi	Mishra	This is a very convoluted table and it adds very little to the overall coherency of this chapter. It's hard to determine what the numbers correspond to, there are no clear connections between them, and the data is very hard to visualize. While it is comprehensive and there are not too many ways to show this kind of data, making smaller, more clear graphs would be better than putting everything in one table.	4. Energy Supply and Use	4.3	181		This table is intended to be a summary of the changes in the key design factors for energy systems in the future. The purpose is to show that historical design factors will not be valid in the future. Due to page length limitations, it is not possible to divide this table into multiple figures.
Rachel	McLoughlin	Which are the twelve Northeastern states referenced in this chapter? There are different definitions of the "Northeast", and it may be helpful to explicitly state them.	16. Northeast		549	40	The text has been revised to incorporate this suggestion. A map of all regions has been included in the 'Introduction to regions' chapter and a Northeast map will be inserted for the final report version of this draft.
Martha	Noble	The National Sustainable Agriculture Coalition commends the authors of Chapter 6 - Agriculture in the 2013 Draft National Climate Assessment. In general, we agree with most of the Key Messages and findings of the Assessment for agriculture, with one major exception. We do not agree that U.S. agriculture is adapting well to recent changes in climate. Indeed the opposite may be true as we see increased reliance by farmers on "silver bullet" solutions such as GE crops resistant to herbicides and insect pests to deal with pests and insects. The widespread use of GE crops resistant to multiple herbicides has lead to widespread selection of weed species resistant to multiple herbicides and pests with resistance to multiple pesticides.Many individual livestock and poultry operations have grown to a size and concentration that the burden of their waste exceeded the capacity of the land and water to absorb nutrients and other substances without severe degradation. And the trend has been for many of the largest of these operations to locate in Western states where surface and groundwater depletion is a critical issue.The decoupling of conservation compliance measures from crop insurance - the single largest Farm Bill commodity crop subsidy - has led to the expansion of corn and other crops across fragile grasslands in the Western Cornbelt and the dewatering of Prairie Potholes. Predictions for an overall decrease of rainfall in many regions, coupled with predictions for increased intensity of rainfall that does occur, do not bode well for soil quality. Indeed, it appears that many lessens of the Dust Bowl era of the last century have been forgotten.NSAC has also been concerned about cutbacks in Agricultural Research Service regional center and programs at a time when longterm regional research - including development of new plant varieties using classical breeding techniques - is most needed.On February 4, 2013, USDA issued a report entitled Climate Change and Agriculture in the United States: Effects and Adaptation. A key finding in that report is the role that sustainable agriculture practices and systems can play in the adaptation of agriculture to a rapidly changing climate. The report states:"Adaptation measures such as developing drought, pest, and heat stress resistance in crops and animals, diversifying crop rotations, integrating livestock with crop production systems, improving soil quality, minimizing off-farm flow of nutrients and pesticides, and other practices typically associated with sustainable agriculture are actions that may increase the capacity of the agricultural system to minimize the effects of climate change on productivity. For example, developing drought and heat resistant crops will improve the ability of farmers to cope with increasing frequencies of temperature and precipitation variability. Similarly, production practices that enhance the ability of healthy soils to regulate waters resource dynamics at the farm and watershed scales will be particularly critical for the	6. Agriculture				Thanks for the comments. The revisions made in the process of addressing the comments address these concerns.

		maintenance of crop and livestock productivity under conditions of variable and extreme weather events. Enhancing the resilience of agriculture to climate change through adaptation strategies that promote the development of sustainable agriculture is a common multiple-benefit recommendation for agricultural adaptation."NSAC agrees that sustainable farming systems, including organic systems, can and must play an important role in addressing climate change. These systems have been proven to help farmers and ranchers reduce GHG emissions and increase storage of carbon in agricultural soils. These systems can increase the resilience of farming and ranching operations to deal with the climatic changes that appear likely under global warming scenarios. They are also excellent systems for minimizing other conservation and environmental impacts from agricultural production. Farmers and ranchers can also help reduce GHG emissions by incorporating into their farms and ranches renewable energy systems that do not depend on fossil fuels.Thank you for your attention to our comments.					
Shaye	Wolf	Thank you for including a section on oceans and marine life in this assessment. The paragraph describing ocean acidification on page 839 is missing critical information and is unclear. It should include the useful information on the magnitude, rate of change, and impacts of ocean acidification presented on pages 69 to 70 of the assessment. Other specific suggestions: (a) Instead of the “ocean absorbs some of the human-caused emissions,” we recommend “the ocean absorbs one quarter of human-caused emissions.”(b) The paragraph should point out that ocean surface waters have become thirty percent more acidic since the pre-industrial era, and ocean acidity could increase by 150% to 200% by the end of the century if CO2 emissions continue unabated (Orr et al. 2005, Feely et al. 2009, Hönisch et al. 2012).(c) The section should point out that the effects of ocean acidification are already being observed in wild populations, including reduced coral calcification rates (De’ath et al. 2009), reduced shell weights of foraminifera in the Southern Ocean (Moy et al. 2009), dissolution of pteropods in the Southern Ocean (Bednarsek et al. 2012), and mass die-offs of larval Pacific oysters in the Pacific Northwest (Barton et al. 2012). Meta-analyses of the effects of ocean acidification include Kroeker et al. (2010) and Kroeker et al. (2013).Kroeker, K. J., R. L. Kordas, R. N. Crim, and G. G. Singh. 2010. Meta-analysis reveals negative yet variable effects of ocean acidification on marine organisms. Ecology Letters 13:1419–34. Kroeker, K. J., R.L. Kordas, R. Crim, I.E. Hendriks, L. Ramajo, G.S. Singh, C.M. Duarte, and J-P Gattuso. 2013. Impacts of ocean acidification on marine organisms: quantifying sensitivities and interaction with warming. Global Change Biology (accepted for publication).	24. Oceans and Marine Resources		839		After consideration of this point, we still feel the existing text is clear and accurate. Additionally, the chapter focused on broad trends for the topic. We refer those interested in a deeper treatment of the topic to the provided citations.
Rachel	McLoughlin	This line states that "average annual precipitation varies by about 20 inches". What are the high and low values?	16. Northeast		550	11	While the comment suggests a good specific example, the authors feel the existing examples are appropriate and adequate.
Justin	Augustine	Some of the content in Chapter 8 (e.g., Box 1) fails to provide important context regarding high-severity fire and its impacts to wildlife. High-severity fire is necessary to the well-being of many species and therefore should not be presented as only a negative (see, e.g., Hutto 1995, Hanson and North 2008, Hutto 2008, Bond et al. 2009, Saab et al. 2009, Hanson et al. 2010, Malison and Baxter 2010, Swanson et al. 2010, Bond et al. 2012, Lee et al. 2012, Seavy et al. 2012, Buchalski et al. 2013). Moreover, Mexican spotted owls (one of the species identified in Box 1) are not “devastated” by high-severity fire. They have evolved with such fire, and a four year study of the effects of one stand replacement fire to the species stated the following: "each year as the vegetation underwent successional growth, owls and other birds re-occupied the canyons. Over the course of the study, [researchers] found Mexican Spotted Owls in 8 of 9 survey sites. Although owls were rarely observed in burned areas, [researchers] often found them in unburned areas adjacent to burned habitat. Based on [the] results, it appears that	8. Ecosystems, Biodiversity, and Ecosystem Services				Text changed to reflect that this was an unusually severe event and also to clarify that fires can be a positive force and a natural disturbance. It is the unusual severity of fires that is the problem.

		the fire shifted Spotted Owl territories, and that some owls were using burned areas for nocturnal foraging while breeding in adjacent unburned areas." (See "Stand Replacement Fire and Its Effect on Birds" discussing research at Hawksaloft.org)Similarly, "preliminary research by [J. Patrick Ward, a biologist at Colorado State University] and others suggest that . . . the Mexican spotted owl appear to be able to reinhabit even the most severely burned areas. 'We're finding out that the Mexican spotted owl is actually pretty robust, and can actually benefit from fire,' Ward said." (See "Wildlife species show resilience to burns, researchers say," EENews, March 1, 2012)The above research (and much more) demonstrates the importance of acknowledging the ecological value of fire, especially high-severity fire. While the prevailing assumption is that high-severity fire is harmful to owls and other species, the reality is far different and much more nuanced. This is especially so given that fires themselves are highly diverse in terms of their post-fire make-up (i.e., the percentage, as well as spatial arrangement, of unburned, low-severity, moderate-severity, and high-severity area), as well as their temporal aspects (i.e., wildlife use of post-fire areas is highly dependent on the amount of time that has passed since the fire occurred). Failing to address these nuances results in a highly biased and incomplete picture of the value of high-severity fireIn addition, while some scientists believe that recent, large fires are outside the historical range of natural variation, that assertion has been significantly challenged over the past decade (see, e.g., Brown et al. 1999, Baker and Ehle 2001, Beaty and Taylor 2001, Veblen 2003, Baker 2006, Odion and Hanson 2006, Baker et al. 2007, Sherriff and Veblen 2007, Klenner et al. 2008, Odion and Hanson 2008, Baker 2012, Williams and Baker 2012a, Williams and Baker 2012b). For example, Baker 2012 found that in dry mixed-conifer forests of the eastside of the southern Cascades in Oregon, historic fire was not predominantly low-severity and was instead 24% low-severity, 50% mixed-severity, and 26% high-severity [Table 5]. The Baker 2012 paper, as well as the recent Williams and Baker studies (2012a, 2012b), addressed prevailing assumptions – e.g., the assumption that low-severity fire heavily dominated and maintained forests that were mostly open and parklike – and found them to be unsupportable at the landscape level. (Williams and Baker 2010, Williams and Baker 2011, Baker 2012, Williams and Baker 2012a, 2012b). The Williams and Baker 2012a study was based on over 13,000 records from surveyors across about 4 million acres of land in three states and these records are as good or better than the kinds of data other studies reply upon, and the accuracy and validity of the survey data were validated in an extensive scientific trial (Williams and Baker 2011). Consequently, it is important to acknowledge this significant research and to not continue to assert that large fires (i.e., what Chapter 8 calls "mega fires") are outside the natural range of variation.Literature Cited Baker, W.L. 2012. Implications of spatially extensive historical data from surveys for restoring dry forests of Oregon's eastern Cascades. Ecosphere 3(3): article 23.Baker, W.L. and D.S. Ehle. 2001. Uncertainty in surface-fire history: the case of ponderosa pine forests in the western United States. Canadian Journal of Forest Research 31: 1205-1226.Baker, W.L., T.T. Veblen, and Sherriff, R.L. 2007. Fire, fuels and restoration of ponderosa pine-Douglas-fir forests in the Rocky Mountains, USA. Journal of Biogeography, 34: 251-269.Beaty, R.M., and A.H. Taylor. 2001. Spatial and temporal variation of fire regimes in a mixed conifer forest landscape, Southern Cascades, USA. Journal of Biogeography 28: 955–966.Bond, M. L., D. E. Lee, R. B. Siegel, & J. P. Ward, Jr. 2009. Habitat use and selection by California Spotted Owls in a postfire landscape. Journal of Wildlife Management 73: 1116-1124.Bond, M.L., R.B. Siegel, and D.L. Craig. 2012. A conservation strategy for the Blackbacked Woodpecker (Picoides arcticus) in California—Version 1.0. U.S. Forest Service, Pacific Southwest Region, Vallejo, CA.Brown, P.M., M.R. Kaufmann, and W.D. Shepperd. 1999. Long-term, landscape patterns of past fire events in a montane ponderosa pine forest of central Colorado. Landscape Ecology 14: 513-532.Buchalski, M.R., J.B. Fontaine, P.A. Heady III, J.P. Hayes, and W.F. Frick. 2013. Bat response to differing fire severity in mixed-conifer forest, California, USA. PLOS ONE 8: e57884.Hanson, C. T. and M. P. North. 2008. Postfire woodpecker foraging in salvage-logged and unlogged forests of the Sierra Nevada. Condor 110: 777–782.Hanson, C.T., D.C. Odion, D.A. DellaSala, and W.L. Baker. 2010. More-comprehensive recovery				

		actions for Northern Spotted Owls in dry forests: Reply to Spies et al. Conservation Biology 24:334–337.Hutto, R. L. 1995. Composition of bird communities following stand-replacement fires in Northern Rocky Mountain (U.S.A.) conifer forests. Conservation Biology 9:1041–1058.Hutto, R. L. 2008. The ecological importance of severe wildfires: Some like it hot. Ecological Applications 18:1827–1834.Klenner, W., R. Walton, A. Arsenault, L. Kremsater. 2008. Dry forests in the Southern Interior of British Columbia: Historical disturbances and implications for restoration and management. Forest Ecology and Management 256: 1711-1722.Lee, D.E., M.L. Bond, and R.B. Siegel. 2012. Dynamics of breeding-season site occupancy of the California spotted owl in burned forests. Condor 114: 792-802.Saab, V.A., R.E. Russell, and J.G. Dudley. 2009. Nest-site selection by cavity-nesting birds in relation to postfire salvage logging. Forest Ecology and Management 257:151–159.Seavy, N.E., R.D. Burnett, and P.J. Taille. 2012. Black-backed woodpecker nest-tree preference in burned forests of the Sierra Nevada, California. Wildlife Society Bulletin 36: 722-728.Sherriff, R. L., and T. T. Veblen. 2007. A spatially explicit reconstruction of historical fire occurrence in the Ponderosa pine zone of the Colorado Front Range. Ecosystems 9:1342-1347.Swanson, M.E., J.F. Franklin, R.L. Beschta, C.M. Crisafulli, D.A. DellaSala, R.L. Hutto, D. Lindenmayer, and F.J. Swanson. 2010. The forgotten stage of forest succession: early-successional ecosystems on forest sites. Frontiers Ecology & Environment; doi:10.1890/090157.Veblen, T.T. 2003. Key issues in fire regime research for fuels management and ecological restoration. Omi PN, Joyce LA, technical editors. Fire, fuel treatments and ecological restoration: conference proceedings. USDA Forest Service: Fort Collins, CO. Proceedings RMRS-P-29. p 259-276.Williams, M.A. & Baker, W.L. 2010. Bias and error in using survey records for ponderosa pine landscape restoration. Journal of Biogeography37, 707–721.Williams, M.A., Baker, W.L. 2011. Testing the accuracy of new methods for reconstructing historical structure of forest landscapes using GLO survey data. EcologicalMonographs, 81: 63–88.Williams, M.A., W.L. Baker. 2012a. Spatially extensive reconstructions show variable-severity fire and heterogeneous structure in historical western United States dry forests. Global Ecology and Biogeography. DOI: 10.1111/j.1466-8238.2011.00750.Williams, M.A., W.L. Baker. 2012b. Comparison of the higher-severity fire regime in historical (A.D. 1800s) and modern (A.D. 1984-2009) montane forests across 624,156 ha of the Colorado Front Range. Ecosystems DOI 10.1007/s10021-012-9549-8.					
Paul	Fleming	We commend the NCADAC for viewing the creation of the NCA as an opportunity to meet statutory obligations while addressing multiple other objectives. The inclusion of chapters on adaptation, mitigation and decision-support represent an important evolution of the NCA from a document primarily about the physical sciences and impacts to a document that addresses how society can respond to the challenges and opportunities that climate change presents.In addition, the process established for this NCA was a much more inclusive effort that attempted to tap into the wealth of knowledge and experience that exists on this issue throughout all segments of society. From a formal request for information for technical inputs, to creating NCAnet to involving people and professionals from beyond academia and and federal agencies in writing chapters of the NCA, the process for this NCA marked an evolution from past National Climate Assessments.We encourage you to continue this evolution and to build a sustained assessment process that addresses statutory obligations while furthering the Nation's adaptive capacity to managing climate change.	Introduction: Letter to the American People				Thank you for recognizing the efforts of the NCA authors to enhance the quality of this report.
Rachel	McLoughlin	"75% percent" is redundant, probably a typo	16. Northeast		551	16	Thank you for your identification of a typo.
Sarthak	Agrawal	This summary concisely explains the very real threat climate change presents to ecosystems. However, from the perspective of the American public, a slightly greater focus on the economic and human impacts may make the document more understandable for laypeople.Given that this is a public document accessible to the public, it may even be beneficial to state what impact climate change may	1. Executive Summary				Unfortunately, comprehensive data on the economic implications of climate change impacts are not available. A new section has been added to the

		present to day-day life for individuals. At the very least, it would make this science more accessible if there was a clear note in the chapter that explained where individuals concerned about (personal) economic impacts could find them.					Executive Summary describing this problem.
Rachel	McLoughlin	What constitutes "very heavy events"? Are there specific amounts of precipitation?	16. Northeast		551	17	The text has been revised to incorporate this suggestion.
Shaye	Wolf	The key message "Altered environmental conditions due to climate change will affect, in both positive 26 and negative ways, human uses of the ocean, including transportation, resource use 27 and extraction, leisure and tourism activities and industries, in nearshore and 28 offshore areas. Many marine activities are designed based on historical conditions. 29 Thus, climate changes that result in conditions substantially different from recent 30 history may significantly increase costs to businesses as well as disrupt public access 31 and enjoyment of ocean areas" is an inaccurately phrased. The text support on pages 845-846 (as well as entire chapter and body of scientific literature) clearly indicates that altered environmental conditions will lead to primarily negative impacts. It is misleading to say "positive and negative" which suggests that there is a balance of good and bad, with the positive front-loaded, when negative effects are predominant. Please change.	24. Oceans and Marine Resources		835		After consideration of this point, we still feel the existing text is clear and accurate.
Aitran	Doan	To Whom It May Concern: As an ecology student reading the 2013 National Climate Assessment, I found certain sections helpful in reaffirming the information I have been learning in the classroom. The layout of each chapter, beginning with key messages and progressing to more detailed explanation, is effective in giving the reader a strong sense of the structure and information ensuing. However, despite the familiarity of the scientific concepts, I sometimes find myself boggled amidst intimidating jargon and terms. As I struggle to grasp the science and start dissecting every sentence, I lose sight of the main themes and the big-picture purpose of the chapter. When that happens, I fail to see how one section transitions to the next. I wonder if there might be a different way to present the information to that it would not appear so intimidating and complex; I can only imagine how much greater the frustration some readers who do not have any prior scientific background would feel. With that said, I understand that learning the science is crucial to understanding the environmental issues that confronts that world and that the task that the Committee faces in providing the knowledge to the public in a reader-friendly manner can be daunting. Thus, I applaud all involved for their efforts. Sincerely, Aitran Doan					Thank you very much for your positive comments. The electronic format of the final report will help readers to discover relevant information that is present across multiple chapters.
Lidia	Delgado	This is a good image but the resolution of the image is a bit poor. Thanks	7. Forestry	7.2	268		Unfortunately, the photo is hazy because of the fire.
Shaye	Wolf	The section on coral reefs should discuss the evidence indicating that deep and immediate greenhouse gas emissions reductions are critical to prevent coral reefs from degradation and collapse from the combined effects of ocean warming, ocean acidification, and other stressors. Due to the synergistic impacts of ocean acidification, mass bleaching, and other stresses, reefs are projected to experience “rapid and terminal” declines worldwide at atmospheric CO2 concentrations of 450 ppm (Veron et al. 2009). Studies indicate that reducing atmospheric CO2 to less than 350 ppm to protect coral reefs from collapse (Veron et al. 2009, Frieler et al. 2012). Frieler et al. (2012) estimated the frequency of coral bleaching at different levels of global warming and showed that limiting warming to 1.5ºC above pre-industrial levels is unlikely to protect most of the world’s reefs from degradation. Using degree heating	24. Oceans and Marine Resources		842		The text has been revised to incorporate this suggestion.

		months and the outputs of atmosphere–ocean general circulation models, the study projected that long-term degradation of coral reef ecosystems would occur in all coral reef cells at 2ºC global mean temperature rise above pre-industrial, assuming no change in thermal tolerance (Figure 2). At 1.5ºC temperature rise above pre-industrial, ~89% (63-100%) of coral reef ecosystems would face long-term degradation assuming no change in thermal tolerance (Figure 2). At 1ºC of warming above pre-industrial levels, which is likely to occur in the next decade or two, 16% (3-29%) of reef locations would be at risk. Even under the lowest of the new IPCC emissions scenarios (RCP3-PD) and optimistic assumptions regarding thermal adaptation, one-third (9-60%) of the world's coral reefs will experience long-term degradation. Frieler, K. et al. (2012) Limiting global warming to 2ºC is unlikely to save most coral reefs. Nature Climate Change doi: 10.1038/NCLIMATE1674. Veron, J.E.N. et al. (2009) The coral reef crisis: the critical importance of <350 ppm CO2. Marine Pollution Bulletin 58:1428–36.					
Rachel	McLoughlin	I think this paragraph and the subsequent section regarding hurricane vulnerability does a good job of stating that these specific storms provide a good measure of the region's vulnerability without specifically linking the storms to climate change. I think this distinction is important because individual storms cannot be linked to climate change, but an increased risk of storms is. The only improvement I can think of would be to explicitly state somewhere that, while individual storms cannot be linked to climate change, it is important to assess vulnerabilities to storms because of the increased risk.	16. Northeast		553	26	The text has been revised to incorporate this suggestion.
Nicholas	Sundt	The text refers to "USGCRP 2000," correctly indicating that the first assessment was "Climate Change Impacts in the United States" (2000). The 2000 report leaves no ambiguity about that, saying that it was produced by the USGCRP to "fulfill its mandate under the Global Change Research Act of 1990. The National Science and Technology Council has forwarded this report to the President and Congress for their consideration as required by the Global Change Research Act."However, the current draft also cites "Karl et al. 2009" implying that the report "Global Climate Change Impacts in the United States" was the second National Climate Assessment pursuant to Section 106 of the Global Change Research Act. This is incorrect.The second assessment pursuant to Section 106 was the court-ordered assessment produced in a very short period of time and published in 2008. It was called the Scientific Assessment of the Effects of Global Change on the United States. In fact on page 1 it says "this report addresses the requirements for assessment in the Global Change Research Act of 1990." And on p 18-19 it says "This report is pursuant to the Global Change Research Act of 1990," specifically quotes the entirety of section 106, and then says: "This scientific assessment addresses each of the three components of this requirement." Furthermore the actual title of the report is "Scientific Assessment of the Effects of Global Change on the United States" – which exactly mirrors the section 106 language calling for a "scientific assessment" that "analyzes the effects of global change" (though nothing in the law limits the assessment to the U.S.). Of all the assessments so far (including the 2009 assessment), this is the only one that uses the term "global change" in the title.In contrast, the 2009 report by Karl et al (Global Climate Change Impacts in the United States) says absolutely nothing about being produced pursuant to the Global Change Research Act. Its transmittal letter says only "Members of Congress" and does not mention the President – even though the GCRA requires a report to both the President and Congress.The current assessment draft – unlike the 2009 report -- is appropriately very specific about its relationship to the requirements of the GCRA: "The NSTC is required, under the 1990 Global Change Research Act (GCRA, Title 15 USC Sec 2921 2012), to provide such reports periodically to the President and the Congress. The report, which assesses current scientific findings about the observed and projected impacts of climate change on the United States, relies heavily on the findings of the U.S. Global Change Research Program (USGCRP) (USGCRP 2012). USGCRP activities include observations, monitoring, modeling, process research, and data management focused on discerning global change	1. Executive Summary		15	12	Although the commenter is entirely correct in pointing out these technical details, it is important to note that this Administration considers the 2009 GCCI report to be the "reset" button for the four-year requirements of the GCRA.

		impacts and informing response options such as adaptation and mitigation. After government review, this report is expected to become the third National Climate Assessment (Karl et al. 2009; USGCRP 2000). As required by Section 106 of the GCRA, the NCA integrates, evaluates, and synthesizes the science of climate and global change and the observed and projected impacts of climate change on the U.S."					
Rachel	McLoughlin	Is this "New York" and "600 miles of coastline" referring to the city or state of New York?	16. Northeast		555	10	The text has been revised to incorporate this suggestion.
Thomas	Valone	RE Executive Summary, the two figures 1.1 and 1.2 fail to give meaningful information to the public. Whether soot from exhaust or methane from arctic peat adds to the problem, the base mechanism of rapid temperature (7F or 4C) and sea level (tens of meters) rise is now being forced until we actually lower the global CO2 level below the baseline of 290 ppm, which has been the MAXIMUM CO2 level ever reached for the past 400,000 years (see the annotated climate graph on our homepage thanks to Dr. Jim Hansen http://www.integrityresearchinstitute.org/CO2andClimateBeastgraph.jpg)on our planet. With CO2 is now pushing 398 ppm and climbing more predictive information is vital for the public to prepare for the expected temperature rise and longer term sea level rise.	1. Executive Summary				Thank you for your comment, it is unfortunately somewhat unclear what change you are requesting.
Rachel	McLoughlin	What specifically does "life-saving cooling" refer to?	16. Northeast		556	25	The text has been revised to incorporate this suggestion.
Shaye	Wolf	This chapter should discuss the importance of the US Endangered Species Act in providing mitigation and adaptation benefits to listed species facing climate change threats. First, recovery plans provide an opportunity for the recovery team to analyze climate change threats on a species-specific basis and implement concrete, on-the-ground actions to minimize those threats. Secondly, critical habitat designation provides important climate change adaptation benefits. The ESA allows FWS to designate critical habitat both within and outside of a species' current range if those areas are needed for the conservation of the species (16 U.S.C. § 1532(5)). Because many species are shifting their ranges under changing climate conditions (Parmesan 2006), proactively protecting habitat outside of the species' current range, including areas that will become important under changing climate conditions and corridors to facilitate movements to new areas, will help species to persist in a changing climate. In its critical habitat designation for the Quino checkerspot butterfly (Euphydryas editha quino), FWS acknowledged the importance of higher-latitude, higher-elevation habitat and landscape connectivity to facilitate migration and survival of the butterfly under changing climate conditions. FWS included two new critical habitat units at higher latitudes and elevations to buffer butterflies against global warming-induced extirpations (Federal Register 74: 28776-28862), illustrating the feasibility of analyzing species' current and future habitat requirements in a changing climate. Third, the Section 7 consultation process provides an important opportunity to minimize both greenhouse gas-related and non-climate-change-related threats to listed species from federal activities, providing both mitigation and adaptation benefits. Thus, the chapter should discuss the important role of the Endangered Species Act in minimizing climate change threats to listed species.	8. Ecosystems, Biodiversity, and Ecosystem Services				A new paragraph was added at the end of the adaptation section to address this critique.
Appendix A of NRC Review		In general, the Preface, Executive Summary, and Introduction explain well the purpose of the report and what is in the document					Thank you for the positive comment.
Appendix A of NRC		The overall introduction to regional information is well written. The introduction to each region sets the stage for how that region has unique information needs and how they need to adapt and what are their particular vulnerabilities. The lead authors of each of these areas are well-known experts in their					Thank you for the positive comments.

Review		knowledge of the region, coming from academia, local, and federal agencies. Each region has unique attributes and information needs. The format for the regional sections was easy to understand and often pointed to the need for additional research. The "traceable accounts" and "key message" boxes provides easy-to-understand information with references that provide more detailed information. Adaptive and vulnerability information is spelled out in great detail, with clear estimates of observational and modeling trends. The examples of the interaction between climate scientists and stakeholders helped to make the information more relevant to particular regions.					
Appendix A of NRC Review		The language of the sectoral chapters of the report is mostly of a succinct summary form which is nicely brought together through its use of "key messages" interpreted at the end of a section, along with discussion of uncertainties and confidence assessment. Because these key messages and the "confidence" assessment are such a great approach they should be a major focus for further improvement. Some of the deficiencies to note include:					Thank you for the positive comments and specific suggestions, which are adressed under the individual comments.
Appendix A of NRC Review		a) between sections there is a less uniform structure than would be desirable;					Each chapter was written by a separate team of authors, and we have attempted to make the sections of the report similar instructure and content. However, we determined that the great diversity of information in the report could be best served by allowing some flexibility instead of enforcing uniformity.
Appendix A of NRC Review		b) some of the messages are given in such a hedged "on the one hand on the other hand" statement (or with such generality), that they have to be true. For example, see p.281 "could help" (or as a made up example similar to several in the report, "climate change may happen and if it does it could have an impact on agriculture"). It would be better to offer suggest positive, unhedged statements and then an appropriate degree of confidence given for them;					As a scientific document, the NCA has focused on portraying accurately and thoroughly the current state of knowledge, and has avoided adoption of particular statements (with associated uncertainty) that may change in the future.
Appendix A of NRC Review		c) not being clear as to what the confidence applies to (e.g. bottom of p 252). In some cases, the key message is subdivided for assessing uncertainty; and that seems like a good idea that might be further applied. (e.g. On p 279, the assessment appears to be only talking about Western U.S. but the key message also has a Eastern U.S. component).					The Traceable Accounts have been revised and wherever possible the confidence has been provided for individual clauses of the key message.
Appendix A of NRC Review		d) Semantically misinforming phrasing: on p 280 "..confidence is high...climate change is projected to reduce forest CO2 intake". There are similar constructions in many places earlier, (e.g, p 79,81,82,84). If something has been projected (e.g. by a model), it has been projected -- no doubt about it. What is uncertain is whether the projection is correct. The phase above and other similar ones would work by simply dropping "projection" , i.e. "...climate change will reduce forest CO2";					Thank you for the suggestion. The Traceable Accounts have been revised for clarity wherever possible. Because these are a place for the authors to explain their thinking in greater technical detail, they have not been written with the same style as the rest of the report.
Appendix A of NRC Review		e) p 79 key message "...has occurred since 1980." It is meaningless to talk of changes starting from a particular year, although Ô98 the big ENSO year seems popular among climate sceptics.					The text has been revised, and a discussion of choice of base periods has been added to the climate chapter.
Appendix A of		General point is that the key messages are an important communication device whose wording should be more carefully constructed than appears to now be the case					Thank you for the suggestion. We have revised the key messages to

NRC Review							communicate as well as we can.
Appendix A of NRC Review		Assuming the main purpose of the NCA is to inform decision makers about choices for dealing with climate change and its expected effects, it is useful to see the report through the lens of some distinctions developed in the IPCC Special Report on Extreme Events (2012) and in NRC (2013): Climate and Social Stress: Implications for Security Analysis. Both those reports are focused on how to think about effects of climate change. These reports distinguish events, exposure, and vulnerability (and its elements: susceptibility to harm, coping, response, and recovery). The NCA appears to focus strongly on assessing events and exposures but does much less about assessing vulnerability. Yet for many decision makers, vulnerability is central because they want to reduce the harm caused by unavoidable, unpredictable events. Insufficient attention to vulnerability is thus a shortcoming of the NCA overall (though not of every chapter). This is not entirely the fault of the report's authors;the USGCRP has not done much to build the base of research, data, and observations that is needed for assessing the vulnerability of sectors and regions. The consequences of this shortcoming of the Program are evident in the NCA report.					Thank you for the comments. The authors have used a risk-based framing and included information on vulnerability wherever adequate information was available.
Appendix A of NRC Review		The draft largely focuses on negative impacts and risks posed by climate change, moving from experiences of weather-related impacts to modeled future trends in climate. The report does cover climate related risks of the sectors listed in Section 106. There is limited discussion of science uncertainty; for example limited discussion on the skill of models to make forecasts at different scales that would be useful for adaptation planning					Additional discussion of models and uncertainty was added to the Climate Science chapter and Executive Summary. Wherever possible, the authors have included impacts and chages that may be positive.
Appendix A of NRC Review		The report largely does not put these trends in the context of other large changes expected to happen over the next century (economy, technology, health, and infrastructure).					Wherever possible, the report has been revised to include discussion of the multi-stressor context for climate changes and impacts.
Appendix A of NRC Review		The report is generally well written, but long and sometimes repetitive. The graphics while clear sometimes are not transparent as to the uncertainty or validity of results shown					We hope that the revisions throughout the report in response to public comments have improved these issues.
Appendix A of NRC Review		While the report is long, there are many areas that could be covered and could add value. The report could put response to climate change in the context of other societal priorities, and the priorities, capacities and institutions for each sector. The report largely does not highlight win-win steps to adaptation and mitigation or a prioritization of steps that should be taken. The sector chapters provide the opportunity to discuss such steps for adaptation which could be woven in an e-document with the adaptation chapter to make priorities clearer (otherwise each chapter is too short to develop ideas while at the same time the document is too long); it may be that this should be planned into an ongoing assessment process since it may be to difficult at this stage of preparing the report.					Thank you for the comments. In revising the report, the authors have wherever possible noted the multi-stressor context for climate change and other impacts, and have attempted to highlight the intersections of adaptation and mitigation more clearly. It is noted that this is an area that can be improved in the future.
Appendix A of NRC Review		There needs to be a serious scrubbing in terms of terminology, grammar, and readability.					The final report will have been copy-edited for these issues.
Appendix A of NRC		The key messages are in general more circumspect than the language in the body of the chapters. The authors need to be more thoughtful as to the "takeaways" in each chapter. There is a greater degree of certitude than is warranted. Many figures and text boxes are specific problem areas. Shrinking clams,					Thank you for the comments. In revising the report, the authors have tried to consider as well as possible

Review		increasing floods, etc. are eye-catching and they will become the prime messages, despite the caveats at the end.					what the "takeaways" might be.
Appendix A of NRC Review		The level of detail, literature reviewed, and breadth of issues discussed is generally appropriate for this assessment. While the authors did a good job of presenting individual facts, they were not always so careful in summary statements. Some of the key points were in jargon that would not be understandable to the public (without reading the main text, which should not be necessary). Some summary statements were phrased in an unscientific manner, and could be viewed as promoting an agenda rather than presenting factual summaries of the consensus of the scientific community (see specific comments below). There were also some issues where the effects of climate change were not sufficiently placed into the context of other human stressors - e.g. increased damage from sea level rise due to losses of protecting mangroves/wetlands/etc. The nature of impacts as INTERACTIONS of stressors was sometimes mentioned, but then not made clear for particular examples given. Treatment of CC as embedded within multiple other human drivers need to be consistent and clarified throughout.					Thank you for the comments. In revising the report, the authors have worked to present balanced, clear language, and to represent climate change in the context of other stressors.
Appendix A of NRC Review		Perhaps the report needs more emphasis on the effects of climate change elsewhere in the world on the U.S. A parochial example comes from the Michigan cherry industry which has several times, including last year, lost >90% of the crop as a result of an early warm period followed by frost. The infrastructure of the industry can remain viable when cherries are imported from Poland and the Ukraine. If those crops are also damaged then not only do the growers have a very bad year but processors and others in the supply chain may shift away from cherries altogether. The world is increasingly telecoupled and these connections can both reduce vulnerability and offer new risks.					Thank you for the comments. Additional discussion of the international context has been added to the Executive Summary, though extensive inclusion of the international context was not possible for this report.
Appendix A of NRC Review		Perhaps there is a need for explaining how the science gets done. Many people who are persuadable but skeptical have a limited understanding of how we do science when studying complex systems. To the extent they have any science background it is often high school physics and chemistry where relatively simple, relatively linear and relatively isolated systems are the centerpiece. Some key points might include: (i) The study of climate change is not new—Tyndall's work on heat trapping properties of CO2, Arrhenius s calculations of climate forcing from fossil fuel burning. What has changed is better understanding of process, better data, better models. (ii) Every major conclusion requires multiple lines of evidence. Models are very important but they are only one of about 7 lines of evidence that climate change is anthropogenic. (iii) Scientists are very careful about data. Much of the data is noisy and none is error free. Working out how to extract the signal from the noise is a major part of the scientific effort, and has been at least since Galileo.					Thank you for the suggestion. While there is limited space for a full treatment of this topic, much useful description of the way the science has been conducted is presented in the Commonly Asked Questions. Additional discussion has also been added to the Climate Science chapter and Executive Summary about the use of models and scenarios.
Appendix A of NRC Review		It is fine to use model (in)consistency to indicate if the simulated projections are statistically significant and in a particular direction. But this is not the same as being able to say that the statistically significant change will in fact occur. One needs to test the downscaling methods using historical observational data. For instance, instead of using all observational historical data for calibration, it is better to use part of the historical data (e.g., before 1980) for model calibration, and use data from 1981-2010 to validate the downscaling methods in individual areas and regions. The NCA Report should at least show the multi-model mean differences, when data are available (e.g. for 1981-2010 minus 1951-1980; for 2041-2070 minus 1980-2000). Similarly, for emission scenarios (either SRES or RCP), observational historical data were used for their development (or calibration). The more appropriate approach would be to use part of the historical data (e.g., before 1980) for scenario development, and use data from 1981-2010 for validation. The NCA Report should demonstrate if the same methodology (in SRES or RCP) could realistically project the emission from 1981-2010 if we were at 1981 (with data available from 1980 and earlier). A potentially useful reference: Racherla et al., 2012: The added value to global model projections of climate change by dynamical downscaling: A case study over the continental U.S. using the GISS-ModelE2 and WRF models. JGR-Atmospheres, 117, doi: 10.1029/2012JD018091.					Thank you for the comment. Additional discussions of model uncertainty, the range of models used, and emissions scenarios have been added to the Executive Summary and the Climate Science chapter. The author team has deliberated and determined a clear, scientifically valid way to present the information.

Appendix A of NRC Review		For climate scientists who, by definition, must take a systems perspective, the report is myopic in many regards, missing some key interconnections and history, and instead seeing everything through a climate change "lens". This is not to say that climate change is unimportant, or that human activities are not driving much of this change. But we need an honest assessment of the interplay between the environment, policies, economics, and technology. Our models are not especially good at regional-scale predictions on decadal time scales, but this does not mean that the NCA cannot add value to the decision making process under uncertainty. The challenge is how to use uncertain science to inform these decisions and policies, while recognizing that science cannot provide definitive answers. One needs to be cautious about taking simple regulatory approaches (that worked for sulfate emissions) to a much more complex and dispersed "wicked problem." The impact of human activities on the environment goes far beyond the release of greenhouse gases into the atmosphere. Extinctions, declines in ecosystem services, etc. are driven by a range of activities, not just climate change. The report makes mention of these processes as its first crosscutting theme, but in general it assumes that climate change has (or will have) primacy. Multiple stressors are critical, but by taking such a climate-centric perspective, the report distorts the reality of these complex stressors and inadvertently sets up a perspective that reducing emissions will "solve" these problems. For example, the Northwest chapter discusses changes in forests (increasing fires, shifts in species composition, etc.) and declines in salmon populations without a straightforward acknowledgment that the dominant processes today are forest harvest practices and fire suppression (for forests) and hydroelectric dams (for salmon). By overemphasizing the role of climate change, the report may encourage one-sided solutions.					Thank you for the comment. In revising the report, the authors have wherever possible included discussion of the multi-stressor context of climate change.
Appendix A of NRC Review		This complexity, when coupled with the uncertainty of our models (especially on a regional, decadal scale), reduces the utility of the assessment for policy makers and decision makers. Most decisions are looking 10-30 years out; even when the models project significant shifts, most of these are 50 years (or more) in the future. In this case, the whole issue of discount rates kicks in as well as the fact that other important (and equally uncertain) processes are equally critical (e.g., population decline, changes in energy technology, global-scale economic downturns, etc.). The report is amazingly optimistic about the quality of the regional-scale projections. The present CMIP process shows that the variability between the models within a scenario is as large as the variations between scenarios. When you go beyond temperature into variables such as precipitation, the models diverge even more and that they cannot replicate the observational record on a regional scale. This is not a criticism of the modeling community; these are difficult processes on challenging time and space scales. IPCC SREX chapter 3 is a good summary of climate extremes and the confidence in past trends and projections: [REF: IPCC/SREX. Chapter 3. Seneviratne, S. I., et al. "Changes in climate extremes and their impacts on the natural physical environment." Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (2012): 109-230]. IPCC AR4 Chapter 11 (WG1) provides an assessment of regional climate change including temperature and precipitation indicating areas where the sign of precipitation change differs between models: [REF: Christensen, J. H. , et al. (2007): Regional climate projections , Climate Change, 2007: The Physical Science Basis. Contribution of Working group I to the Fourth Assessment Report of the IPCC , University Press, Cambridge, Chapter 11.]					Thank you for the comment. Additional discussions of model uncertainty, the range of models used, and emissions scenarios have been added to the Executive Summary and the Climate Science chapter. The author team has deliberated and determined a clear, scientifically valid way to present the information.
Appendix A of NRC Review		From a decision support perspective, the present models really can only add another highly uncertain process to an already complex decision process. The uncertainties and variability are just too large. However, if the models could be used to identify how the statistics (frequency, persistence, intensity, etc.) of critical processes might change under climate change scenarios, that would be more valuable than detailed projections. There are some hints of this through the report, but how robust are these projections? And without any estimates of the statistics of the projections themselves (in addition to the statistics of the particular processes, such as extreme precipitation), they are not of much value. As an example: A city planner from Chicago wants to know how freeze/thaw cycles might change under					Thank you for the comment. Additional discussions of model uncertainty, the range of models used, and emissions scenarios have been added to the Executive Summary and the Climate Science chapter. The author team has deliberated and determined a clear, scientifically valid

		climate change, to make decisions about whether or not the city should change its repaving practices. Models might be able to make some projections but the confidence of these projections would be extremely low. A planner still might be able to use such knowledge, but it would need to be weighed against a variety of other uncertain projections (e.g., city finances, changes in traffic patterns, vehicle loads, etc.).					way to present the information.
Appendix A of NRC Review		In the section about trends in flood magnitude. Fig. 2.20 (derived from Hirsch and Ryberg 2012) purports to show how flood magnitude trends change as a function of climate. Such information could be extremely useful to land use planners, insurance companies, water system managers, etc. But the Hirsch and Ryberg paper specifically states that: "The coterminous U.S. is divided into four large regions and stationary bootstrapping is used to evaluate if the patterns of these statistical associations are significantly different from what would be expected under the null hypothesis that flood magnitudes are independent of GM [global mean] CO2. In none of the four regions defined in this study is there strong statistical evidence for flood magnitudes increasing with increasing GMCO2." They go on to state: "However, human influences associated with large numbers of very small impoundments and changes in land use also could play a role in changing flood magnitude. Unfortunately, at time scales on the order of a century, it is difficult to make a quantitative assessment of the changes in these factors over time." That is, floods are both a natural phenomenon and a human phenomenon (land use, water management etc.) Although the draft has lots of waffling words ("suggests," "possible" "contributed" etc.) the fact is that the public will ignore these nuanced phrases and come away with the impression that floods will increase. If the draft cannot get these facts right and if it glosses over model capabilities and limitations, then one must be skeptical of its outcomes.					Thank you for the comment. The description of flood magnitude in the Climate Science chapter has been greatly revised in response to specific comments on that chapter.
Appendix A of NRC Review		Climate change is bound up in a poorly-understood complex of policy, economic, and environmental linkages. The notions of risks, vulnerabilities, and impacts and how they work together to help guide policy and investment are covered a bit in the Adaptation chapter, but they need to be woven throughout the report. For example, Hurricane Sandy is frequently brought out as an example of the types of disasters that will occur as the climate warms. Along with the NOAA time series of billion dollar disasters, the report convolves climate processes with complex financial and infrastructure processes. Smith and Katz show that the loss per billion dollar event has not increased (and perhaps has decreased), although the number of billion dollar events has increased somewhat. Thus storms are not necessarily getting more severe (in fact, we have been in a relative drought in terms of land-falling category 4/5 hurricanes) but it is likely that there is more infrastructure at risk and thus there are more events exceeding the billion dollar threshold. We need to temper our conclusions with the uncomfortable fact that our exposure has increased.					Thank you for your comment. In revising the report, the authors have included, wherever appropriate, discussion of vunerabilities and multi-stressor impacts, as well as adaptation and mitigation.
Appendix A of NRC Review		This introduction is very nicely written Ð very powerful, clear and unambiguous, particularly the first two paragraphs.	Introduction: Letter to the American People				Thank you for your comments.
Appendix A of NRC Review		"... that is severe enough that some communities..." would sound better as "... so severe that some communities..."	Introduction: Letter to the American People		1	20	Changes have been made to this sentence.
Appendi		Final paragraph, final sentence: Should this sentence include some reference to our national response?	Introduct		2	1	Because this is a scientific assessment,

x A of NRC Review		E.g., "...represent steps forward in advancing our understanding of that challenge, its far-reaching national and global implications, and the responses we are and should be making to reduce the threat"?	ion: Letter to the American People				it is important to avoid policy recommendations.
Appendix A of NRC Review		Perhaps add something like: "So, too, have fishermen and coastal planners ..."	Introduction: Letter to the American People		1	8	The existing language is sufficient.
Appendix A of NRC Review		Generally reads as a scientific summary, with an effort to use non-specialist language. The latter is not entirely successful, so the accessibility to lay (including policy) readers is not as high as it might be. This may not be a problem if there are other summary documents in preparation.	1. Executive Summary				There will be summaries for the regional and sectoral chapters so this may help.
Appendix A of NRC Review		The theme of a mismatch between infrastructure and the actual magnitude of weather fluctuations is one that can be extended easily. Managed systems, including agricultural and forest lands and fisheries, are also structured in specific ways, such as reliance on irrigation, and these structures are also vulnerable because they are part of the infrastructure of those managed systems. In addition, unmanaged systems such as watersheds and protected areas have an internal ecological structure ("natural infrastructure") that is also disrupted by events in a changing climate. This is a time when many are focused on infrastructure (e.g., because of Sandy), so the extension of the concept to ecosystems of importance to humans is worth considering in a high-level summary.	1. Executive Summary				Although ecosystem services are discussed, ecological infrastructure is not a term used in the report.
Appendix A of NRC Review		"variation" not variability seems to be intended	1. Executive Summary		3	25	Language has been modified in response to this comment.
Appendix A of NRC Review		Sentence is garbled. Delete 2nd "and" in 24?	1. Executive Summary		6	22	Change has been made.
Appendix A of NRC Review		Table should have a brief caption indicating the basis for selecting observations for inclusion -- e.g., to illustrate trends unfolding over times of decades.	1. Executive Summary	Table 1.1	11		The table has been replaced with an infographic of regional impacts. The caption of the figure has been revised to indicate that the impacts described are already occurring.
Appendix A of NRC Review		Not clear what is meant by "local economies"; the other items in the list might have in common that they are sources of stresses. If that is what is intended, the passage should say so.	1. Executive Summary		12	8	The text has been revised to indicate that climate change is one of multiple factors affecting the economy.
Appendix A of NRC Review		This paragraph suggests to the lay reader that the relative contributions of China, India, and other emerging economies play a key role in the evolution of American climate conditions. Is that taken up in the chapters?	1. Executive Summary		19	3	The relative contribution of the U.S. to global emissions is addressed in the Executive Summary. There is also discussion of the role of other countries in the Mitigation chapter.

							There is also a section on the international context, within the section on Context and Background.
Appendix A of NRC Review		The lack of confidence language raises concern.	1. Executive Summary				The traceable accounts are the main place where the authors have been asked to include confidence language.
Appendix A of NRC Review		Report Findings is missing a key finding re R&D needs.	1. Executive Summary				This is true, but no changes have been made in response. There is a new section on topics for future assessments in the Context and Background section however.
Appendix A of NRC Review		Inconsistent in treatment of future precipitation. P4 refers to increased precip vs P5 to "reduced water supply".	1. Executive Summary				Actually, these findings are not inconsistent. For example, it is possible to have an increase in total precipitation and have a decrease in water supply reliability if runoff is decreased in the summer due to increased heat.
Appendix A of NRC Review		Verb tenses are inconsistent, particularly in health section vs others.	1. Executive Summary				Thanks for pointing out this problem. The document has been edited and the verb tenses have been made consistent.
Appendix A of NRC Review		refers to Greenland and Antartica without clear implications for U.S.	1. Executive Summary		7		Sea level rise is a global phenomenon that affects the US - this is widely understood.
Appendix A of NRC Review		Health Section : Increased risk of zoonotic disease in many regions should be mentioned.	1. Executive Summary		8	34	This topic is not a significant component of the health chapter and is therefore not included in the Executive Summary.
Appendix A of NRC Review		Is drought an issue in the Great Lakes?	1. Executive Summary		7	3	Drought is definitely an issue in the Great Lakes, though it is not clear what the net effect of climate change will be over time.
Appendix A of NRC Review		Should the conclusion on climate change be supported here only by temperature changes. Citing multiple lines of evidence from multiple types of observations seems more compelling even in this brief statement.	1. Executive Summary		8		The first Report Finding focuses on rising temperatures. Language has been added about the many independent lines of evidence. Other Report Findings address other evidence of climate change impacts.
Appendix A of NRC Review		The vulnerability of increased irrigation to drought and the conflicts over water use should be noted even here to highlight the cross-sectoral interactions. They are too often ignored.	1. Executive Summary		9	33	The authors believe that this topic is well summarized by the existing language. There are multiple references to cross-sectoral

							interactions.
Appendix A of NRC Review		It seems odd to single out only disaster modification among ecosystem services.	1. Executive Summary		10		After consideration of this point, the authors still feel the existing text is clear and accurate. .
Appendix A of NRC Review		not clear what was satellite and what wasn't, given the longer time frame	1. Executive Summary		4	28	The authors have been very careful to be precise on this topic, and are comfortable with the existing language.
Appendix A of NRC Review		This traditional Executive Summary is not effective at communicating to a broad range of readers the information contained in the draft report, particularly given the controversy and complexity of the issues covered. The text requires more than a basic understanding of climate change and its associated vocabulary.	1. Executive Summary				The authors have significantly changed the Executive Summary in response to comments. Sections have been added (About this Report, Context and Background) to guide the reader and provide more background. The authors have reviewed the Executive Summary to ensure it is accessible to a wide range of readers.
Appendix A of NRC Review		Several phrases early in the Summary assign responsibility for climate change to human activities, but the text lacks background information to inform/prepare the lay reader to digest these assertions For example, p. 3, l. 6: The phrase "which is primarily driven by human activity" needs more justification/introduction. Suggest adding "predominantly the burning of fossil fuels".	1. Executive Summary				Changes have been made, including adding a graphic on this topic.
Appendix A of NRC Review		Authors should consider adding a sentence or two very early, i.e. paragraph 1 or 2, describing the connection/relative scales of "human-induced warming" and "a naturally varying climate".	1. Executive Summary				Additional framing on this topic of variability and trends has been added to the Context and Background section.
Appendix A of NRC Review		Discussion of risk and uncertainty is not addressed in the Executive Summary, until p. 13, l. 1. These issues should be addressed earlier in the text.	1. Executive Summary				Additional framing on this topic of variability and trends has been added in the Context and Background section.
Appendix A of NRC Review		Is there any information to show that we are on track to exceed A2 either from the U.S. contribution or globally? Information in this section should be supported by some part of the 1100 page report	1. Executive Summary		6	21	Evidence related to these statements is in the climate science and mitigation chapters.
Appendix A of NRC Review		What does "local economies" mean. How is "local economies" a stress factor? They are part of the context for understanding the impacts.	1. Executive Summary		12	8	The text has been revised to indicate that climate change is one of multiple factors affecting society, the economy and the environment.
Appendix A of NRC Review		Such as? Which recent events? Need to give an example.	1. Executive Summary		12	18	The text has been revised to delete this language.
Appendix A of NRC		The whole bullet 4. on tipping points is vague regarding what these break-points might entail. A concrete example would be useful.	1. Executive Summary		13		The section on tipping points has been revised. After consideration of this comment, we still feel the text is clear.

Review							
Appendix A of NRC Review		The most important content in the executive summary is found in the Report Findings section. Perhaps move this to the beginning so that it's the first thing readers encounter. The content that is currently at the beginning of the executive summary reads like the introduction to the report, rather than a summary of its most important points.	1. Executive Summary				The Executive Summary has been significantly restructured.
Appendix A of NRC Review		second paragraph: The sentence that begins "Some of the key drivers of health impacts include..." is quite long and a bit hard to understand. Either use bullets or divide the sentence into several sentences.	1. Executive Summary		5	9	The authors believe the existing language is acceptable; bullets are not consistent with this narrative style.
Appendix A of NRC Review		third paragraph: "Iconic species" will not be understood by many lay readers, and the last phrase of the sentence ("...the potential for extreme events..." is vague.	1. Executive Summary		5	28	The authors believe the existing language is acceptable.
Appendix A of NRC Review		fourth paragraph: Perhaps add "leading to contaminated water supplies," or something like that at the very end of the paragraph.	1. Executive Summary		5	30	This suggestion has been accepted.
Appendix A of NRC Review		second full paragraph: There's a verb missing: "Voluntary efforts, the recent shift from coal to natural gas... and federal programs are underway and have..."	1. Executive Summary		6	22	Language has been modified in response to this comment; voluntary efforts are no longer mentioned.
Appendix A of NRC Review		Crosscutting themes and issues, #1: The last sentence states, "As illustrated by recent events..." Ð please specify.	1. Executive Summary				The text has been revised to delete this language.
Appendix A of NRC Review		Report finding #4: At the end of the last sentence, the authors state that heat-trapping gases are strongly reduced. This seems to be the wrong word Ð dramatically or greatly perhaps?	1. Executive Summary				This language was amended.
Appendix A of NRC Review		Report finding #4, second sentence: "Same" should be changed to "some." Should human choices be added to the sources of uncertainty cited in the last sentence?	1. Executive Summary				This change has been made. A new section on uncertainty has been added to the Context and background section.
Appendix A of NRC Review		Report finding #5: Many lay readers won't understand what is meant by "food security." And a couple examples of "unfamiliar health threats" would be helpful.	1. Executive Summary				Changes were made in response to these suggestions. Examples were provided to the Report Finding on health. The reference to food security has been removed from this Report Finding, although it does appear in RF #8.
Appendix A of NRC Review		Report finding #5: Much of this section may be difficult for many lay readers. For example, "probability of occurrence of a certain type of event" could be stated more simply as "how often an event will happen," and "exceeding a particular threshold" could be re-stated as "how severe it will be."	1. Executive Summary				The text referred to has been deleted during revisions

Appendix A of NRC Review		Characterizing the impacts simply as "disruptive" here conveys a very different notion than the message conveyed by the report itself. "Disruptive" suggests something that is temporary, where one ultimately settles into a new equilibrium (e.g., it is disruptive to move from one city to another). While there will certainly be disruption, it is the significant costs incurred as a result of that adjustment period that are important. That idea is not captured by characterizing the changes simply as disruptive.	1. Executive Summary		3	11	The existing language reflects the authors intent to focus on careful, measured language.
Appendix A of NRC Review		This sentence is unclear. It is not clear how using scientific information will provide economic opportunities.	1. Executive Summary		3	14	The language has been slightly modified in response to this comment. Clearly, better knowledge of potential future conditions does allow for preparedness and resilience.
Appendix A of NRC Review		It is not clear what the word "stresses" is intended to convey in this paragraph. For example, what are "stresses" on "existing social, institutional and legal agreements"? The word is used multiple times in this paragraph, but I don't think the lay reader will have a clear idea of what it means here.	1. Executive Summary		5	1	Modifications have been made to this paragraph since the word "stresses" appears 3 times.
Appendix A of NRC Review		There is a discussion here of negative health impacts. It should also be acknowledged that warming could yeld some positive health impacts as well, for example, in areas where exposure to cold (or inadequate access to heat) has negative health impacts.	1. Executive Summary		5	8	After consideration of this point, the authors still feel the existing text is clear and accurate.
Appendix A of NRC Review		What does it mean to maintain "a robust public health infrastructure"? One might interpret this as some type of public provision of health services (nationalized health care??). Is that what is intended?	1. Executive Summary		5	19	This language does not imply a need for nationalized health care. The health chapter discusses the importance of a functioning public health system as a critical component of resilience.
Appendix A of NRC Review		Replace "worst" with "largest"? The largest changes are not necessarily the most costly (i.e., worst) ones. For example, large changes for which there is low-cost adaptation may not impose large costs.	1. Executive Summary		6	18	The use of the word "worst" as opposed to "largest" is deliberate in this case.
Appendix A of NRC Review		The reference to economic opportunities provided by being prepared is unclear. This is the second place in the exectutive summary where this idea is mentioned, and in both places one is left wondering what this is intended to convey. It almost sounds like individuals can be opportunistic and take advantage of (make some money off) other people's vulnerability to climate change. That is probably not what is intended, so some clarification is needed here and above.	1. Executive Summary		6	41	The intent (and actual language) recommends preparedness, which is not the same as profiting from the vulnerability of others.
Appendix A of NRC Review		When referencing the costs that are already high, it would be helpful to be a little more specific about what costs have actually been already observed/documented (as opposed to those costs that are projected to occur in the future).	1. Executive Summary		8	30	A new section has been added to the Executive Summary on topics for future National Climate Assessments. This section discusses the value and challenges of assessing economic impacts. The report does include economic information in particular chapters.
Appendix A of NRC Review		There is no mention of "threats to mental health" in the discussion up to this point, so it is surprising to see it here as part of a major finding. And there is nothing in the paragraph here that clarifies what is meant by this. It is also unclear what "unfamiliar health threats" (line 41) refers to. And if they are reemerging, then how can they be unfamiliar? Some clarification is needed here.	1. Executive Summary		8	36	The Report Finding has been modified to remove the reference to mental health in the title – it still appears in the text with an example.

Appendix A of NRC Review		The statement that yields of major crops are expected to decline, "threatening both U.S. and international food security" may be true, but it doesn't follow logically. A reduction in U.S. crop yields does not necessarily constitute a threat to food security. To threaten food security, the impact has to be large and not offset by an increase somewhere else. So just saying there will be a yield reduction is not sufficient to support a statement about a threat to food security.	1. Executive Summary		9	37	The reference to food security has been removed from this Report Finding but it does appear in a later one in a better context.
Appendix A of NRC Review		The text references "large social, environmental, and economic consequences". However, most of the discussion in the report identifies impacts but does not QUANTIFY those impacts, especially economic impacts, and so it is hard to determine (from the report) which impacts will be large and which will be small, which will be economically significant and which will not, etc. The report very thorough documents impacts that have been shown to exist (under either current climate or projected future climate) but does not provide much information on which of these many actual or potential impacts are most significant/important. This is obviously much more difficult to determine, but it is essential for focusing attention on particular concerns.	1. Executive Summary		10	24	The report includes substantial information about the relative magnitudes of impacts, even if they are not usually quantified. Key vulnerabilities and impacts are addressed in the Report Findings and in the chapters' Key Messages.
Appendix A of NRC Review		In the Northeast row, it's surprising not to see mention of the economic impact on, for example, recreation.	1. Executive Summary	Table 1.1	11		This is not one of the key findings in the NE chapter; the Exec Summary focuses on findings within the subsequent chapters.
Appendix A of NRC Review		Again, the word "stresses" is used here, while in line 6 the terminology "multiple factors" is used. Are all factors necessarily "stresses"? It seems the key point is that other things are changing as well, and these other changes combine with the climate changes to determine outcomes.	1. Executive Summary		12	3	The authors agree. This paragraph is intended to introduce the themes below.
Appendix A of NRC Review		This is the first reference to a "risk-based framing" for the chapters in the report. This, along with the instruction to focus on most significant impacts, seems to be a key framing issue for the report as a whole. As such, it seems this statement should appear at the very beginning of the executive summary rather that at the very end.	1. Executive Summary		12	24	Major changes have been made to the "framing issues" - they are now in a new section called "Context and Background".
Appendix A of NRC Review		The introduction paragraph to this section on p. 12 (lines 2-5) lists three themes, but then one turns the page and finds two additional themes. Is there a reason to highlight themes 1-3 in the opening paragraph but not 4-5?	1. Executive Summary		13	1	Good point, changes have been made to the Context and Background section.
Appendix A of NRC Review		The point could be made here that, not only are tipping points difficult to predict, but their existence can have important implications for management decisions. They make it much more difficult (and important) to design appropriate mitigation and adaptation policies.	1. Executive Summary		13	1	A change has been made about the difficulty of predicting tipping points in the new section on this in the Context and Background.
Appendix A of NRC Review		The discussion of this cross-cutting theme seems out of proportion to the others. It could be condensed considerably. For example, everything from line 19 and below could be deleted without losing the main point.	1. Executive Summary		13	19	This section has been revised and shortened – it is now within the Context and Background section.
Appendix A of NRC Review		It is not clear why this brief paragraph is going to be in a box, while the discussions of the other scenarios (e.g., sea level rise scenarios) are not. It is also not clear why it is inserted here and how it relates to the discussion of emissions scenarios on p. 18.	1. Executive Summary		20	8	Within the scenarios section, there are two sub-categories, climate scenarios and sea level rise scenarios. Whether or not there are boxes around certain topics should not be a major consideration, given that this report will appear in multiple formats.
Appendi		There is no reference to this figure in the text.	1.	Figure	21		References to figures in the text have

x A of NRC Review			Executive Summary	1.2			been handled in a consistent manner within each of the report formats that are developed; for this draft figures were generally not referenced in the text.
Appendix A of NRC Review		These pages discuss emissions, climate and sea level rise scenarios. The text states that the report uses scenarios (p. 18, line 11-12) and explicitly states which emission scenarios are used (p. 20, lines 9-11), but there does not seem to be any explicit statement about what climate or sea level rise scenarios are used. In addition, the previous discussion (p. 12, lines 26-28) highlights the importance of "socio-economic" scenarios (e.g., about population growth and development), yet there is no discussion about what scenarios are assumed for these factors. The reader is left with an unclear picture of what role scenarios really play in the report, and, if they play a critical role, how those scenarios are fully specified (beyond just emissions).	1. Executive Summary		18		Modifications to the language have been made in response to this comment.
Appendix A of NRC Review		Many of the paragraphs in the executive summary are followed by a list of chapters that presumably support the statements in that paragraph. While this may be useful for the reader when the list is short (e.g., Ch. 29), it does not seem very useful when the list is very long (listing, for example, 14 different chapters). A long list does not seem to give the reader sufficient direction on where to look for more information to be very useful.	1. Executive Summary				There will be direct links to source material in the electronic format.
Appendix A of NRC Review		This statement seems to claim that we can observe human causation while attribution is a statistical and modeling test applied to observations, therefore the statement is not accurate.	1. Executive Summary		3	5	Both attribution and observations are discussed in detail in chapter 2; the connections between the observations and attribution are discussed in the cited literature.
Appendix A of NRC Review		It is unclear if the report is assessing research or actual implementation of adaptation, mitigation and decision support. The report seems uneven in their treatment Ð i.e. lack of objective metrics to measure implementation across all three, and sometimes shifting focus from implementation to research/theory.					Thank you for the comment. In revising the report, the authors have worked to improve the balance of these topics.
Appendix A of NRC Review		Should this be 40%?	1. Executive Summary		4	37	We appreciate the comment, but the text is correct as written.
Appendix A of NRC Review		Should highlight both interaction with other stresses and on the other hand areas with greater resiliency (examples are not given though it is mentioned at the end of next paragraph).	1. Executive Summary		5	3	The authors believe that many of these interactions are not increasing resilience; but recognize that some impacts are resulting in benefits, hence the final sentence in the paragraph.
Appendix A of NRC Review		If other actions that might be taken in the future are insufficient, then B1 is not feasible; the "actions that might be taken" must be refined to make this a meaningful statement.	1. Executive Summary		6	27	Good point, this language has been clarified.
Appendix A of NRC Review		This statement seems more balanced than those in the agriculture chapter that does not mention that agriculture will be resilient?	1. Executive Summary		9	28	The agriculture chapter does include statements that are consistent with those in the Executive Summary.

Appendix A of NRC Review		Why does this figure not say anything about the uncertainty band on projections whereas the next figure on sea level does?	1. Executive Summary	Figure 1.2	20		Scenarios are not the same thing as projections; in the case of the climate scenarios there is a set of assumptions that is used to generate each line in the graph. In the case of the sea level rise scenarios, this is the author's judgment of the expected range of future scenarios based on a wide assessment of the literature.
Appendix A of NRC Review		Overall ExcSummary is very nicely written - both comprehensive and easy to read. At the right level for general public.	1. Executive Summary				Thanks for these comments.
Appendix A of NRC Review		Evidence for climate change isn't just the climate data, it's also the observed changes in species & ecosystems that also point to major global shifts in climate. This is an important point to make for the general public to grasp the magnitude of change, and where the strong scientific consensus comes from.	1. Executive Summary		3	17	Agree that the evidence in species and ecosystems should be noted here, language has been amended.
Appendix A of NRC Review		extreme summer of 2011 in Texas was extreme drought as well as heat - it was the combination that was devastating in terms of impacts	1. Executive Summary		3	36	This is true. The problem in the context of the NCA is that the heat has been shown to be attributable to human-induced climate changes, whereas most changes in precipitation are not as clearly attributable. No change is recommended.
Appendix A of NRC Review		People may not connect "distorted rhythms of nature" with direct human impacts of CC. Perhaps be more explicit - e.g. how increased asynchrony among species can, e.g., cause poor crop polination? Also, declines in agricultural productivity are a direct human impact.	1. Executive Summary		5	28	This language has been amended.
Appendix A of NRC Review		Point 5 is poorly worded - it sounds like 'food' and 'water' are impacts - need to add adjectives & clarify.	1. Executive Summary		8	34	Good point, this language has been clarified.
Appendix A of NRC Review		There's no mention of species- level changes. Suggest adding to existing sentence: "...are already disrupting WHERE SPECIES LIVE AND TIMING OF KEY LIFE EVENTS, ULTIMATELY IMPACTING ecosystem structures ..."	1. Executive Summary		10	1	The text is modified.
Appendix A of NRC Review		To SW impacts, add forest losses from increased pest outbreaks (e.g. pinyon pine deaths from heat and drought stress followed by beetle outbreak)	1. Executive Summary	Table 1.1	11		The table has been replaced with an infographic of regional impacts. The figure is intended to reflect some of the highest order findings from the regional chapters, not be a comprehensive list.
Appendix A of NRC		Section on health is limited to direct effects of diseases and health conditions within the domain of environmental health (heat stroke, respiratory disease, allergies, etc) and does not mention health threats caused by infectious agents which in some instances may pose more serious threats to human	1. Executive Summary		8	34	Examples have been added in response to this comment.

Review		healthin the U.S. (pandemic influenza, SARS, dengue fever, West Nile virus, etc.).					
Appendix A of NRC Review		Admirable in intent but hard to follow for the average reader. More examples and fewer lists?	1. Executive Summary		13	19	This section does not contain any lists, so not clear what the intent of the comment is.
Appendix A of NRC Review		The Scientific basis for climate change is good summary of what we know borrowing language for previous NRC reports such as America's Climate Choices and newer climate modeling and observations that will be published as part of the next IPCC report.	2. Our Changing Climate				Thank you for the comment. There is no effect of the comment on the discussion in the chapter.
Appendix A of NRC Review		The presentation of a wide range of indicators and projections is powerful--and likely to be controversial as a result.	2. Our Changing Climate				Thank you for the comment. There is no effect of the comment on the discussion in the chapter.
Appendix A of NRC Review		A lay reader sees this as two long-term trends, moving in synchrony since about 1960. It might be helpful to supplement the annual temperature anomalies with five-year averages. It is also surprising that the existing commitment (ll. 20-21) is less than two decades' worth of emissions.	2. Our Changing Climate	Figure 2.2	31		Thank you for the suggestion, but space is limited. The author team has deliberated and agreed on the most important information to include.
Appendix A of NRC Review		This figure shows that the 2 C "limit" commonly discussed is projected to be exceeded even under the optimistic B1 scenario within the lifespan of people now alive. This should be discussed briefly in the text.	2. Our Changing Climate	Figure 2.7	37		The text has been revised to make this point in the caption for the figure on average global temperature projections.
Appendix A of NRC Review		This striking figure is an object lesson in "shifting baseline." For the people old enough to recall the period from 1958 to now in a single place or region of the country, the large increases in the Northeast and Midwest may be surprising. The figure may be accurate but some people's experience may not obviously align with this figure. Perhaps add a short discussion of the variance between long-term datasets and people's memories of a single place (at minimum in the traceable account on p. 81). It is also germane to discuss the size of the storm events in this dataset--a small, intense storm will not affect much of the multi-state region but may contribute to the tail of the distribution. The uncertainties in the projections are particularly important, since (small) intense storm events are hard to model.	2. Our Changing Climate	Figure 2.16	50		It is beyond the scope of this report and the expertise of the authors to speculate on people's perceptions of change. Regarding uncertainties, we have including a box discussion of uncertainties in regional projections.
Appendix A of NRC Review		On what emissions scenario are these projections based?	2. Our Changing Climate	Figure 2.24	62		The figure has been removed.
Appendix A of NRC Review		Caption does not explain gray shading (past), or green (RCP 2.6?). It makes sense that the pink shading narrows, since the ice cover cannot go below zero, but it is unclear why the shaded area for the high-emission scenario should be narrower than for the low-emissions (blue) early in the projected period.	2. Our Changing Climate	Figure 2.29	68		Caption has been modified to state that gray shading and dashed black line are for historical simulations. Caption states that RCP 2.6 simulations are represented by green color. Range for blue is not narrower; it is partially obscured by pink; note the additional blue shading below the pink shading.
Appendix A of		The report overall does an excellent job in communicating and interpreting what is known from current trends and model projections about future climate change over the U.S.. It is U.S. and	2. Our Changing				The approach in the assessment follows the directives of the Global

NRC Review		impact/adaptation centric. This may be all there is room for but it certainly gives short shrift to the research on basic climate system processes that have historically been much of the USGCRP. In other words, it is mostly about addressing the last clause of SEC 106: "analyzes the effects of global change on the natural environment...."	Climate				Change Research Act that Congress signed in 1990. It is written as a public document and is not intended to be a review of basic climate system science.
Appendix A of NRC Review		It also is very short on international context; e.g., what will be the consequences of climate impacts suffered by other countries on the U.S. well being? Little is said about mitigation except in terms of some carbon cycle discussion. If there were more, it would have to look at the international context to be meaningful; how can we aspire to global equity in energy use without catastrophic climate change Ð will the U.S. have to reduce its per capita energy use to that of China and India before they start being serious about reducing their exponential growth of fossil fuel use, large investments in coal fired power plants, etc.? As an analogy, the report shows us how to fasten our seatbelts but gives no indications as to how to slow down a rapidly accelerating vehicle.	2. Our Changing Climate				This comment really relates more to other chapters. We do discuss climate change itself as being a global issue but the main focus of Chapter 2 is to then focus the science of climate change onto the U.S. New text on the international context was added to About this Report (formerly the Executive Summary), and the Mitigation chapter has also been revised.
Appendix A of NRC Review		The dicing of the U.S. by clustering of states for the most part makes sense climate wise. However, the "Great Plains" unit stretching from Texas to Wyoming and Montana seems a bit puzzling, unless it was intended as some commentary on the scientific illiteracy of their state governments or the large amount of fossil fuel extraction (or ranching) they engage in.	2. Our Changing Climate				We agree that the Great Plains region is overly large but we kept the definition the same as in the 2009 assessment. In Chapter 2, we do try to break down the discussion for the Great Plains by referring to the northern relative to the southern states.
Appendix A of NRC Review		Is difficult to interpret. "rare cold events" seems to mean an increase in the number of rare cold events. Can this information be displayed in another way?	2. Our Changing Climate	Figure 2.19	54		We considered a variety of ways to express this concept. It is felt that due to resolution constraints, projected precipitation return period changes are more reliable than return value changes. Taking the ratio of the future return period to reference period expresses the change in terms a frequency change.
Appendix A of NRC Review		It might be helpful to use the key message numbers used at the start of the chapter for each of the messages within the chapter; this would make it easier for readers to locate the content supporting the points made in the beginning.	2. Our Changing Climate				We agree with the reviewer and the Key Message numbers have been added to the discussion within the chapter.
Appendix A of NRC Review		Second paragraph, last sentence: Add the specific CAQ where attribution is discussed.	2. Our Changing Climate		28	34	The section has been revised to clarify that we are referring to the Appendix on Climate Science, not the Appendix of CAQs.
Appendix A of NRC Review		Box: Models used in the assessment: The information here is very important, but will be hard for lay readers to understand. Even if it doubles the length of the box, explaining this more fully and simply would be helpful.	2. Our Changing Climate		29		The text has been revised to provide more information on the models use in the assessment, and to refer the reader to the Climate Science Appendix and other references where more information on the models can

							be found.
Appendix A of NRC Review		Ten indicators of a warming world: insert "of atmosphere" Ð "Air temperature near surface of atmosphere (troposhere)"	2. Our Changing Climate		30		"Air temperature" already refers to the atmosphere. No change to the figure is necessary.
Appendix A of NRC Review		Future climate change: add Centigrade after Fahrenheit here, as has been done elsewhere.	2. Our Changing Climate		31		The decision was made early on that only units customarily used in the U.S. would be used in this assessment, so that it would be readily understood by readers in the U.S.
Appendix A of NRC Review		The acronyms used in the figure legends should be spelled out (with the exception of NOAA, which is a commonly understood acronym).	2. Our Changing Climate		33		The acronyms are explained the first time they are used in the assessment.
Appendix A of NRC Review		For clarity, perhaps replace the word "pathways" with "emissions."	2. Our Changing Climate	Figure 2.5	34		The caption has been revised to incorporate this suggestion.
Appendix A of NRC Review		Recent U.S. temperature trends: First paragraph of text refers to "Appendix, Key Message 6," instead of CAQ. Key message in the appendix is also referenced in the caption for Figure 2.7.	2. Our Changing Climate		35		The text has been revised to clarify.
Appendix A of NRC Review		Lay reader wonders how changes in frost-free days is applicable to areas that don't have frost (e.g., Southern California)...: Lay reader found this figure difficult to understand.	2. Our Changing Climate	Figure 2.1	41		We have redrawn this figure. In particular, in its new form, those areas that do not experience freezes every year are now brought out in particular colors.
Appendix A of NRC Review		Final paragraph of the extreme weather section: The sentence "Attribution of flood events is a relatively new area of research" is unlikely to be understood by lay readers. Preferable: "Research into the causes of floods is relatively new."	2. Our Changing Climate		55	13	Text revised.
Appendix A of NRC Review		Same paragraph: The last sentence states that heavy rain in the Southeast may have less impact than in the northern Great Plains; lay reader would like to know why.	2. Our Changing Climate		55	19	We have removed this sentence.
Appendix A of NRC Review		difficult to interpret: What does "PDSI<-4.0" mean? What does the black line represent? How much does the Palmer index over-estimate drought? Why is the correspondence between the red & blue lines (i.e., actual & modeled) so poor between 1900 and 2000?	2. Our Changing Climate	Figure 2.21	57		Palmer Drought Severity Index. As discussed in the text. Note that this figure using PDSI has been moved the appendix.
Appendix A of NRC Review		Changes in Storms: The first sentence in the section on hurricanes ("There has been a substantial increase in virtually every measure...") is so direct, powerful, and clear that the authors should consider including it in the key message.	2. Our Changing Climate		59		No change in Key Message. Our concern here is that the statement was not intended as a stand-alone sentence, but as a lead-in.
Appendi		Later in the same paragraph, the text becomes more difficult to understand; the text starting with	2. Our		59		This is an area of very active research.

x A of NRC Review		"How hurricanes respond also depends on how the local..." and ending with "...increase more uniformly around the world due to increased amounts of heat-trapping gases" is not entirely clear.	Changing Climate				We have added references where more information and clarification is available.
Appendix A of NRC Review		Winter storms: Much of this section reads like a series of discrete facts that are difficult for the reader to integrate. E.g., Heavy snowstorms have increased in the Northeast, but the Northeast has seen a normal number of very snowy winters.	2. Our Changing Climate		60		These facts, along with the citations, are necessary to put the discussion in context. No effect on the text.
Appendix A of NRC Review		What do the acronyms in the legend stand for? The caption discusses both hurricane frequency and strength, but it seems the figure contains only data on strength, ... If there is information here on frequency, this should be explained; and if no, references to frequency should be dropped.	2. Our Changing Climate	Figure 2.23	61		The caption (and title above figure) have been modified based on the comment to explain the acronyms and describe better what the figure shows.
Appendix A of NRC Review		Which emissions scenario was used as a basis for this prediction?	2. Our Changing Climate	Figure 2.24	62		This figure has been removed.
Appendix A of NRC Review		Sea level rise: "Proxy data" is a term that is unlikely to be understood by lay readers; a definition is needed. The same is true for "semi-empirical models" Ð lay reader wonders if something that's only partly empirical can be trusted.	2. Our Changing Climate		63	10	Both of these terms are now more clearly defined in the text.
Appendix A of NRC Review		Spell out sea level rise in the figure's legend instead of using the acronym.	2. Our Changing Climate	Figure 2.25	64		Changed as recommended
Appendix A of NRC Review		The meaning of the final sentence is unclear.	2. Our Changing Climate	Figure 2.29	68		Final sentence of caption has been modified to provide a clearer explanation.
Appendix A of NRC Review		Message 8 - This is an example of overwrought language. Yes, there are more cat 4/5 hurricanes but there have been fewer land-falling 4/5 hurricanes. Why isn't this last fact mentioned? Because it doesn't fit the narrative? Why not discuss the hurricanes of the 1930's which would have had much larger impacts than recent hurricanes?	2. Our Changing Climate				We have added text relative to this key message that addresses the potential for track changes. When we are assessing changes that have been observed in the Atlantic, it is certainly of great relevance to identify the large increases that have occurred, and are still occurring, since the 1980s. This is not an agenda-driven narrative, as the reviewer suggests, but rather a statement of observed changes that are relevant to society. The search for long-term trends that may be driven by GHGs is not the only thing that a regional assessment needs to focus on. We can discuss the conditions of the 1930s and all the caveats related to data quality that come with this, but that does not diminish the importance

							of the fact that the Atlantic is presently experiencing large changes. Still, we recognize the potential for misinterpretation and have shored up the existing cautionary text that emphasizes the uncertainty in attribution.
Appendix A of NRC Review		Yes, there are lots of processes that have changed, but the models are still struggling with the radiative feedbacks (clouds, aerosols, black soot, melt ponds in the Arctic, etc.) Shouldn't we at least identify these issues? Again, we tend to bring global-scale processes (and models) down to regional scales where these models become extremely problematic.	2. Our Changing Climate		28		A discussion of the current state of global climate models, including limitations and recent improvements, is contained in Supplemental Message 6 of the Appendix, where parameterization challenges are discussed. Additional discussion of climate models is provided under Commonly Asked Questions R and S. Finally, with regard to regional-scale uncertainties, we have added a new Box on Regional Uncertainty at the end of KM 5 in the Our Changing Climate chapter.
Appendix A of NRC Review		Shouldn't we show more than just temperature and CO2? Aren't the radiative feedbacks the larger issue than just CO2?	2. Our Changing Climate		31		Carbon dioxide is shown as an illustration of the forcing on climate, but carbon dioxide is not the only one, and the feedback processes are indeed quite important. Other parts of the chapter text and the Climate Science Appendix discuss these forcings and the effects of feedbacks.
Appendix A of NRC Review		These lines talk about sulfate particles from power plants. 'Yes there is one paper, but it is hard to reconcile this local issue with the larger scale processes controlling temperatures over the eastern U.S..	2. Our Changing Climate		35	25	The sentence now includes natural variations as a potential explanation for the lack of warming in the Southeast.
Appendix A of NRC Review		An example of how the report misses an opportunity to be informative. It gives a huge range of possible rises in sea level, using words like "reasonable" and "useful." Without any estimates of uncertainty, its doubtful whether any policy maker could use this information. Anyone in this situation has lots of "what ifs" and possible scenarios; how does this section help?	2. Our Changing Climate		63	25	The large range of scenarios reflects the actual uncertainty in projections of future sea level rise. The science simply remains too uncertain to make likelihood statements about sea level rise scenarios.
Appendix A of NRC Review		Are these curves the average or median of some set of models? There is no information on model differences or skill of these projections in the report?	2. Our Changing Climate	Figure 2.3	33		We thank the reviewer for the helpful suggestion, which has been incorporated into the figure. The figure is a multi-model average. The uncertainty range was inadvertently left off of this figure and has been added in the revised figure.The figure

							has been removed from Our Changing Climate but remains in the Appendix of FAQs.
Appendix A of NRC Review		It would be useful to explain why Antarctica has shown an increase.	2. Our Changing Climate		67	22	We have added two sentences about the role of wind-forcing and possible linkages to stratospheric ozone depletion. References have been added to Holland and Kwok (2012) and Turner et al. (2009).
Appendix A of NRC Review		Figure seems to have a lot more colors than indicated in the legend.	3. Water Resources	Figure 3.3	115		We have addressed this comment in the caption for the figure on principal U.S. groundwater aquifers.
Appendix A of NRC Review		Each of the main headers presents an assertion that could indeed be quite strongly agreed upon by the research community, but as written now in the running text of the chapter bears no sense/level of certainty (or uncertainty). One would have to dig thru the Traceable Accounts charts to get this sense. It would be helpful to develop some telegraphic means to indicate how certain a key finding is (e.g., thru the use of an icon, a color-code, a simple statement at the end of the assertion) within the chapter text itself.	3. Water Resources				We appreciate this suggestion but still feel the existing text is clear and accurate. The chapter needs to be consistent in structure with the other chapters in the NCA report.
Appendix A of NRC Review		After hunting through some of the Traceable Accts, it is still difficult to pinpoint exactly what models or model ensembles were used for the findings and graphics presented in the chapter text. As for "Assessment of confidence based on evidence" in the Accts, it is unclear what time frames are spoken about. Thus, the authors might wish to fill in the blank as in this example: "Confidence is therefore judged to be high that precipitation and runoff decreases will continue in southern states over the next XXX years or YYY decades."	3. Water Resources				The text has been revised to clarify what emissions scenarios are being used. The Executive Summary and Chapter 2: Our Changing Climate has further information on models used in the NCA, including in the Water chapter. Regarding assessments of confidence, after consideration of this point we still think the text is clear and accurate. We do not think it is possible to assign timelines to future levels of confidence for the Key Messages in this chapter.
Appendix A of NRC Review		Up to page 117, there are many individual facts and findings, and very little in the way of a roadmap for the user to make sense of these. There are few maps or graphics that aid in synthesizing this information. Thus, while factually on sound ground, the presentation does little to aid the reader. These sections of the text need to be better synthesized as they are presented—otherwise they consist mainly of factoids thrust upon the reader. The situation I would imagine would present a particular challenge for a non-scientist. In addition, the text often presents along w/ this litany of results, mention of particular locations or regions of the country; and, since there is seldom if ever full geographic coverage across the nation this still further fragments the arguments. On the positive side, this is essentially a geography of our knowledge base, which if presented creatively could be made more intuitive to a reader. Right now maps are seldom presented. Would be nice to see some sort of publication or technical appendix or web site presenting these "geographies" (w/ direct connection to the paragraphs in the text) could be made a part of the Traceable Accounts. Figure 3.2 is a good example of the problem.	3. Water Resources				Thank you for your comment. We have added additional figures to synthesize information. The report will be published as an interactive pdf document. There will be access to additional information online.
Appendi		Some of the Spotlights fail to link to the issue at hand, or at least leave it to the reader to make the	3. Water				We have revised the text in the

x A of NRC Review		connection. On page 123, there appears a general description of some floods, with no discernible connection to the climate change question. While an informed expert might know what the text is getting at, a less seasoned reader will probably not. Another good example is on Page 128 (Spotlight on Water Management), with no connection to how the changes documented there would impact water management.	Resources				flooding and water management sections of the chapter to address this comment.
Appendix A of NRC Review		Increased residency time actually cuts two ways. While recalcitrant pollutants may stick around for longer periods of time, a longer duration in fact can aid in the processing of bioactive compounds like nitrogen (see Green et al. 2004). [REF: Green, P. et al. (2004). Pre-industrial and contemporary fluxes of nitrogen through rivers: A global assessment based on typology. Biogeochemistry 68: 71-105.]	3. Water Resources		107	37	After consideration of this point, we still feel the existing text is clear and accurate.
Appendix A of NRC Review		Bullets 9, 10: Many of the management challenges associated with Bullets 9,10 are self-inflicted by non-climate related human activities and this goes unmentioned in Bullets 7, and 8. For example, it is well-known that society seemingly unwittingly increases its exposure to hazardous weather because humans tend to settle in and make infrastructure investments in dangerous places [REF: Pielke Jr., R. A. & D. Sarewitz. 2005. Bringing society back into the climate debate. Population and Environment 26(3): 255-268.]	3. Water Resources		108		We have revised the applicable key message to note that changes in withdrawal and consumption also affect supplies. Also in the flooding section we have noted that flooding is affected by human-caused alterations, such as impervious surfaces. In the adaptation section we note that land use patterns can exacerbate impacts to infrastructure during high precipitation and runoff events and that an adaptation strategy is to target development in areas that are not highly vulnerable.
Appendix A of NRC Review		Might wish to make "Permafrost" BOLD	3. Water Resources		109	14	The text has been revised to incorporate this suggestion.
Appendix A of NRC Review		"All of these trends are projected to become even more pronounced as the climate continues to warm." Add a clause such as: "...., and as feedbacks to the climate system evolve through changes to the land surface boundary layer".	3. Water Resources		109	17	We appreciate this comment, but feel that this level of jargon is not appropriate for this report without materially enhancing the discussion. Thus we have chosen not to include the suggested clause.
Appendix A of NRC Review		It might be more correct to say: "...both solar energy and atmospheric demands for moisture (e.g., through winds and moisture deficits in the atmosphere).."	3. Water Resources		110	11	The text has been revised in response to this suggestion.
Appendix A of NRC Review		discussion on ET is a bit repetitive and could be condensed by about 25% w/o loss of content	3. Water Resources		110		We appreciate the suggestion but given the complexity of ET we have not condensed the section.
Appendix A of NRC Review		No mention of the use of satellite remote sensing to infer trends. Also, there is no parallel statement to the one made at the start of the ET section mentioning the role and importance of this component of the water cycle in sustaining crop growing and natural ecosystems, as the intervening hydrologic mediator between transpiration and runoff, and as a hydrologic buffer to some degree against extreme weather, erosion, etc	3. Water Resources		111	16	The text has been revised to indicate that Liu et al. 2011; and Su et al. 2010 are both based on a recent satellite-observed soil moisture dataset. We have also added a closely related and

							highly relevant publication based on the same satellite dataset (i.e. Dorigo et al., 2012) that examines global and continental-scale trends in soil moisture. The two new figures on annual and seasonal surface soil moisture trends are derived from the Dorigo et al. 2012 reference.
Appendix A of NRC Review		Caption for figure: Need more information about the ensembles. A clear reference to another part of the NCA would be in order, as would a literature citation. No notion of error/uncertainty is given	3. Water Resources		112		The figure caption has been revised to provide more explanation of the projections and scenarios. More information has been added clarifying the scenarios used in the chapter. The Executive Summary and Chapter 2: Our Changing Climate has further information on models used in the NCA.
Appendix A of NRC Review		Multiple mentions of "projections" or "projected", yet with no information on the reliability of these. Is there 100% agreement or merely consensus among the numerical outputs or expert opinion interpreting the outputs. Is a projection the same as forecast? A prediction? Is some nomenclature being used that has been developed in some earlier part of the Assessment being used here? If so, it should be thus pointed out. While this may be able to be dug out of the Traceable Accounts, some of these notions need to be highlighted here in the text, where it is being presented most prominently.	3. Water Resources		112		More information has been added clarifying the scenarios used in the chapter. The Executive Summary and Chapter 2: Our Changing Climate has further information on models used in the NCA, including in the Water chapter.
Appendix A of NRC Review		A good part of this writing has nothing to do with drought. Instead, use this first paragraph to define what the operational definition of drought is for the NCA. That writing which does refer to drought is about annual drought, not summer drought as the sub-heading indicates.	3. Water Resources		113	15	We have revised the message and the text to distinguish between seasonal and multi-year droughts and also include the underlying meteorologic and hydrologic drivers.
Appendix A of NRC Review		While the first clause is well-referenced, the last clause is weakened by the detailed caveat and is unsubstantiated; perhaps it is just a matter of rewording, but as it stands currently, it is unconvincing.	3. Water Resources		114	4	The text has been revised to clarify.
Appendix A of NRC Review		This is but one set of estimates and may substantially understate the value for depletion, at least with respect to the global #: Earlier work by Vŝršsmarty et al. (2005) put the use of non-sustainable groundwater at from 400-800 km3/yr, with Rost et al. (2008) obtaining similarly high numbers, in fact near the upper end of this range. REFS: *Rost. S., et al. (2008). Agricultural green and blue water consumption and its influence on the global water system. Water Resources Research VOL. 44, W09405, 2008. *Vŝršsmarty, C.J., C. Leveque, and C. Revenga (Convening Lead Authors) (2005). Chapter 7: Fresh Water. In: Millennium Ecosystem Assessment, Volume 1: Conditions and Trends Working Group Report Island Press.]	3. Water Resources		114	32	We have removed the estimated groundwater depletion rate.
Appendix A of NRC Review		Set-off this spotlight on groundwater as a box to maintain consistency with other such spotlights.	3. Water Resources		114	29	This section of the chapter has been edited and a new flood box added.
Appendi		uses English units. Earlier sections used metric. What is the policy for the Assessment re: standardizing	3. Water		118	22	The decision was made early on in the

x A of NRC Review		units?	Resources				development of the National Climate Assessment that it would use units customarily used in the U.S., so that the NCA could be readily understood in the U.S.
Appendix A of NRC Review		Change "ecosystem impacts" to "thermal impacts on ecosystems and biodiversity"	3. Water Resources		122	5	The text has been revised to incorporate this suggestion.
Appendix A of NRC Review		This is a very general description of some floods. Not particularly insightful and it makes NO connection to the climate change question. A sentence or two needs to relate this back to what is discussed in the text as the links between such extreme events and climate change.	3. Water Resources		123		We have revised the flood box and one of the key messages on floods. We note that no strong directional changes in national average flood magnitudes have been uncovered. We also note that floods may intensify in many regions of the U.S.
Appendix A of NRC Review		With respect to water availability, this clause is a bit of a non-sequiter: "and these challenges will rise as aging hydropower infrastructure needs to be replaced (Brekke 2011)." The following wording could solve the problem: "and these challenges will rise precisely within the time frame that aging hydropower infrastructure will need to be replaced (Brekke 2011)."	3. Water Resources		124	11	Thank you for your comment. We have deleted that language as a result of another comment.
Appendix A of NRC Review		on Floods: No mention of the role of land use on flooding. Land use and land cover change is critical even under current climate. However, there should be some discussion of the role of LUCC in both exacerbating climate-induced flooding (e.g., via impervious surfaces associated with urbanization) and in some cases attenuating (e.g., via reforestation). Furthermore, LUCC will interfere with the detection of climate-induced flooding.	3. Water Resources		126		These factors are now mentioned in the sections describing floods.
Appendix A of NRC Review		A statement appears: "Water management and planning would benefit from better coordination between the national, state, and local levels, with participation of all relevant stakeholders in well-informed, fair, and equitable decision-making processes." The following statement could, very logically, be placed immediately before the one above to amplify its intent: "A recent NRC report (2011) uncovered systematic mismatches between the nomenclature and translation of knowledge between atmospheric scientists and hydrologists as well as between these scientists and the applications community." (This statement could also help to amplify the comments in the paragraph on page 130 defined by lines 12-19). [REF: NRC. 2011. Global Change and Extreme Hydrology: Testing Conventional Wisdom.].	3. Water Resources		127	8	The text has been revised to incorporate this suggestion.
Appendix A of NRC Review		Unclear what the single flat red line is near the horizontal axis of the bottom graphic. Also, why does the top panel have only two results and the bottom panel several? What do the several lines actually represent? We also see English units again.	3. Water Resources	Figure 3.8	128		The graphic has been updated.
Appendix A of NRC Review		Spotlight on Water Management. There is no text relating these physical changes to water management per se; left to the reader to fill in the blanks.	3. Water Resources		128		The projected climate changes are linked to increased and multiple water uses, as described in the text.
Appendix A of NRC		The following statement appears be correct: "Infrastructure planning can be improved by incorporating climate change as a factor in new design standards and in asset management and rehabilitation of critical and aging facilities, emphasizing flexibility, redundancy, and resiliency (Brekke et al. 2009a;	3. Water Resources		129	19	The text has been revised to incorporate the suggestion.

Review		Means et al. 2010b; Wilbanks et al. 2012)." But it all depends on the time horizon of the analysis. If for example the economic lifetime of the infrastructure is 30 years, that may be an insufficient time for the signal-to-noise ratio associated with various climate change scenarios (or the variability that characterizes the ensemble predictions) to exceed the envelope of historic variability. This was one of the findings of the NRC COHS report cited above. A mention of this point seems prudent in the Assessment report text. Thus, one may conclude that there would be little value in incorporating climate change information, making it difficult to justify the "blanket" statement as given in lines 19-22 that information on climate change would indeed improve planning.					
Appendix A of NRC Review		Among the non-structural strategies are improved flood forecasts, telecommunications, and early warning systems (UNISDR 2011). [REF: UNISDR. 2011. Revealing risk, redefining development. Global Assessment Report on Disaster Risk Reduction. United Nations International Strategy for Disaster Reduction. Geneva, 178]	3. Water Resources		129	23	The text has been revised to incorporate this suggestion.
Appendix A of NRC Review		This chapter is well written and the findings are well documented. The chapter is thorough in its treatment of impacts on water resources. Uncertainties are identified in a reasonable fashion. Major trends are also reasonably projected where a factual or modeling basis exists. The key messages and graphics are clear and appropriate.	3. Water Resources				We greatly appreciate your positive comment.
Appendix A of NRC Review		It does miss an opportunity to frame the key message relative to the impact of climate change on water resources. The key message is that, without climate change, existing adaptations appear reasonably capable of accommodating the increased needs resulting from the projected 60 to 85 % increase in the U.S. population. But, climate change dramatically affects this result as, with climate change, a 25 to 35 % short-fall is expected. Thus, dramatic changes in water resource use and management are needed to accommodate the joint affects of population growth (and the associated increase in economic activity) and climate change.	3. Water Resources				We have expanded the discussion in the water resources section to highlight the joint effects of population growth and climate change.
Appendix A of NRC Review		The report also offers little in terms of the types of changes that will be needed. The need for change is highlighted in Key Message 9, but not the nature of the changes. Key Message 10 introduces the principal of increased resilience and enhanced adaptive capacity without truly describing what this means. A further discussion of the types of changes would more fully frame the effects of climate change on water resources. This is needed for this section to properly frame the discussion on response options.	3. Water Resources				We appreciate the suggestion but space is limited. We have amended the adaptation and institutional responses section to provide examples of adaptation strategies.
Appendix A of NRC Review		The data for the U.S. in figure 3.6 are from 2005 (or likely from a few years prior). Are these shares by sector stable over time? is 2005 an accurate proxy for 2013?	3. Water Resources		120		The most recent USGS data are from 2005 and the authors feel this is an adequate proxy for 2013.
Appendix A of NRC Review		Limited attention to energy infrastructure such as roads, pipelines, power transmission.	4. Energy Supply and Use				The focus of this chapter is the Energy Sector and so the projected impacts are described from the perspective of this sector. The third paragraph of supporting text for Key Message #1 identifies potential disruptions to infrastructure. The impacts to Urban Infrastructure are specifically addressed in Chapter 11: Urban Systems, Infrastructure and Vulnerability.
Appendix A of		Adaptation language on top of p168 is very broad.	4. Energy Supply		168		This sentence is in an introductory paragraph. Table 4.2 provides greater

NRC Review			and Use				detail on Possible Climate Resilience and Adaptation Actions in the Energy Sector. Chapter 28: Adaptation is focused on the issue of Adaptation.
Appendix A of NRC Review		Extreme Weather section: SREX as a reference? Refers to only precipitation vs other "intensities" of extreme events. Examples P168 (lines 32-33) might also include winter weather.	4. Energy Supply and Use				We have added the SREX reference at an appropriate spot. We have made a few changes to the text to clarify our understanding of extremes.
Appendix A of NRC Review		Figure refers to Energy when only shows oil and natural gas wells.	4. Energy Supply and Use	Figure 4.1	169		Thank you for your comment. The caption has been changed to clarify that these are oil and gas production facilities rather than energy facilities
Appendix A of NRC Review		T&D networks missing.	4. Energy Supply and Use		169	9	"Transmission and distribution" will be added to this sentence.
Appendix A of NRC Review		Check if "cooling degree days' is defined in glossary or prior use.	4. Energy Supply and Use				"Cooling Degree Day" is defined in the figure caption.
Appendix A of NRC Review		Table 4.1 (and 4.3) and elsewhere uses "negative" and "positive' impacts which is vague and interpretable. Suggest an agnostic/science based metric.	4. Energy Supply and Use	Table 4.1	173		We removed the color shading from these tables, and their associated endnotes, to avoid confusion.
Appendix A of NRC Review		Resiliency and Adaptation ; Section uses language of "no regrets" vs more technical terms. Some discussion of Ôrobustness " of adaptation might be appropriate. E.g. is 1:100 yr sufficient or 1:10,000?	4. Energy Supply and Use		177	7	As discussed throughout this chapter, energy supply and use decisions are primarily made on a local basis based on numerous factors. Therefore, it is not possible to define a general level of appropriate robustness. The targeted audience for this chapter is broad and encompasses Energy Sector Experts and the general public. Therefore, terms such as "no-regrets" that have meaning to the general public have been employed.
Appendix A of NRC Review		Should address hydro power as well.	4. Energy Supply and Use		183		Thank you for your suggestion. We have added hydropower.
Appendix A of NRC Review		Consider policy/regulation and market responses, not just regulated markets.	4. Energy Supply and Use		183	16	We have edited the sentence to clarify that because energy systems in the U.S. are not centrally planned, they tend to reflect energy decisions shaped by law, regulation, other

							policies and economic, technological and other factors in markets.
Appendix A of NRC Review		Add references?	4. Energy Supply and Use		183	23	The potential risk management approaches identified were created by the chapter authors based on science and engineering knowledge and experience. A reference to the U.S. Department of Energy Technical Input Paper (Wilbanks et al. 2012) that contains an extensive reference list was added.
Appendix A of NRC Review		Table 4.3 Caption -- temperature changes etc. affect all regions (caption says "many sectors and regions"). Why are agriculture and infrastructure mentioned in the caption since the table is only about energy? The indicator projections by region are not very helpful, and it's not clear why they need to be repeated in the table.	4. Energy Supply and Use	Figure 4.3	181		Agriculture yields refer to the production of biofuels. Infrastructure refers to impacts on fuel distribution transport and pipelines and electricity distribution. Adaptation decisions and actions by the energy industry will be made at the local level and so regional (rather than national) level indicators are needed.
Appendix A of NRC Review		The report says very little about U.S. energy consumption relative to other countries and as a share of global consumption. More information on the contribution of the US to global emissions could be included. The executive summary notes that the U.S. contributes 20% of global emissions, but does not provide information on per capita emissions or on emissions of the U.S. compared to other countries. The report misses an opportunity to mention that the U.S. is rapidly becoming a major supplier of fossil fuel to meet its own needs and that it is expected to become a net exporter of fossil fuels by the mid 2020s. Some discussion (perhaps in the energy chapter?) of where the U.S. relative to the rest of the world regarding both its energy consumption and production is warranted given the central role that energy use plays as a driver of climate change.	4. Energy Supply and Use				The charter and focus of the National Climate Assessment (NCA) Report is primarily on the United States. As identified in this chapter and other chapters, the U.S. is projected to be impacted by energy availability and on other matters due to physical climate impacts in other countries. However, a detailed discussion of the international aspects is beyond the scope the NCA Report. Regarding the carbon emissions, please refer to Chapter 27: Mitigation.
Appendix A of NRC Review		The chapter identifies potential risks for energy systems, and potential adaptation measures. The chapter, however, could be improved by putting these measures into the context of measures already taken to harden infrastructure to weather, and changes other than climate (e.g. energy demand and infrastructure improvement) that could occur over the next century. The chapter could be improved by reducing redundancy with other chapters (e.g. transportation). The chapter could also point to institutional barriers and change that would be beneficial. For example, how water will be allocated to energy is an important question not covered in this chapter.	4. Energy Supply and Use				The linkages between Energy and Water are discussed in greater detail in Chapter 10: Water, Energy and Land Use. Adaptation decisions will be made based on numerous factors and will be made at the local level. A discussion of the potential barriers to adaptation is beyond the scope of this chapter due to page length limitations. A comparison of future and historical adaptation actions in the Energy Sector has not been performed, based on our review of existing literature.

Appendix A of NRC Review		The weather becoming more extreme statement is not supported by the IPCC SREX statement that there is no such simple conclusion (see IPCC, 2012. page 124); differences in assessment conclusions should be carefully explained otherwise the reader will not know which assessment to believe. REF: IPCC, 2012:: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation [Field, C.B., et al. (eds.)]. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 1-19.	4. Energy Supply and Use		167	15	We have changed the text to be more specific. First, we note that certain types of extreme events have changed. Second, we note that some of these extreme types are increasing, but at least one type that is important to energy considerations, extreme cold, has decreased.
Appendix A of NRC Review		This statement is only looking at changes that result from temperature change and not other changes/drivers of energy demand that will change over the 21st century. This should be made clear, and temperature should be put into the context of other drivers of energy demand change.	4. Energy Supply and Use		167	18	The charter for this chapter is an assessment of the potential physical impacts of climate change to U.S. Energy Systems. The Key Messages on the first page of the chapter are intended to be succinct summaries of the most significant physical impacts of change and do not explicitly contain the words "due to climate change" to minimize redundancy. The other factors that affect energy demand are identified in the section titled Climate Change and Seasonal Energy Demands.
Appendix A of NRC Review		Changes in water demand may be a dominant factor in water scarcity, however, it is unclear in this statement if it is referring only to changes in climate or to all potential changes over the next century. There is an opportunity in this document to consider changes in availability, in relation to current systems for water allocation.	4. Energy Supply and Use		167	21	The charter for this chapter is an assessment of the potential physical impacts of climate change to U.S. Energy Systems. The Key Messages on the first page of the chapter are intended to be succinct summaries of the most significant physical impacts of change and do not explicitly contain the words "due to climate change" to minimize redundancy. Water resource and allocation issues are addressed in Chapter 3: Water Resources.
Appendix A of NRC Review		It would be helpful for the reader to put these drivers of changes in reliability of energy systems in the context of the past trend in reliability.	4. Energy Supply and Use		167	33	This is an excellent suggestion. However, we are not aware of a study that has performed this analysis. Therefore, there isn't credible source material upon which we can rely.
Appendix A of NRC Review		It is likely this finding is primarily a consequence of increased exposure. This should be made clear, otherwise this paragraph could be misleading.	4. Energy Supply and Use		168	30	The purpose of the paragraph is to provide evidence that Energy and Infrastructure systems are already being damaged by exposure to extreme events.
Appendix A of		Not clear what a climate (as opposed to weather) event is?	4. Energy Supply		168	34	Thank you for identifying this issue. The sentence has been deleted.

NRC Review			and Use				
Appendix A of NRC Review		Markets are a beneficial and extremely important adaptation mechanism, and they lead to adaptation and resilience by adjusting prices. This section, however, gives the impression that allowing for markets to react to upsets is a bad thing Ð a dependency. The report could consider if the system of markets and reserves (in both the US and Europe) enhanced reliability of the energy system in the examples given.	4. Energy Supply and Use		168	35	The intent of the paragraph is to show evidence that there are negative impacts to Energy markets (both locally and nationally) from extreme weather events. The impacts are negative, but the market responses are not.
Appendix A of NRC Review		It would be helpful to understand how the difference in heating/cooling compares to the range of demand change over the next century due to both technology/building changes, and demand for services. The cases given seem too specific and do not give information about their uncertainty. For example, what does the literature broadly say about the change in building efficiency and heating-cooling demand over the next century compared to the change in heating /cooling days.	4. Energy Supply and Use		172	3	The suggested comparison has merit for providing perspective on relative and net impacts, but the authors are not aware of a credible study that has been performed on this topic. We have also replaced this figure with an analysis of CMIP3 model data. This analysis shows areas of model agreement.
Appendix A of NRC Review		Precipitation model results are known to have significant uncertainty. While this figure may be misplaced in this chapter, it would be helpful to know where models do not agree on the sign of changes in precipitation since this shortcoming of precipitation projections was highlighted in the IPCC AR4 (page 16).	4. Energy Supply and Use	Figure 4.4	175		We have replaced this figure with an analysis of CMIP3 model data. This analysis shows areas of model agreement.
Appendix A of NRC Review		Many (all?) of these actions have taken place in parts of the energy sector. This chapter could highlight where resilience is good, and lessons learned.	4. Energy Supply and Use	Table 4.2	178		We agree that the potential adaptation actions listed in Table 4.3 have been employed by the Energy Sector and have proven effective. The selection and benefits of specific adaptation actions is made on a local basis based on numerous factors. It is not possible to provide greater detail on specific examples of adaptation actions in this chapter due to page length constraints.
Appendix A of NRC Review		Not sure how to interpret such short time-scale extremes in water with hydropower; would it be better to look at seasonal extremes? Are the air/water temperatures actually air (not water)?	4. Energy Supply and Use	Table 4.3	181		The hydropower column was removed from the table.
Appendix A of NRC Review		Transportation infrastructure is long-lived and designed for a specified climate. The chapter recognizes this and describes risks to this infrastructure and the valuable service that is provided. An opportunity that the chapter misses, however, is the context of the priority of changing infrastructure compared to other infrastructure priorities. Given the costly and long-lived nature of this infrastructure, it would be useful to take advantages of periodic infrastructure investments to make adaptations. A useful topic to cover to facilitate this would be a roadmap of the institutions and engineering practices that would need to be involved (e.g. codes and standards) to make such changes and the timelines and priorities for such changes.	5. Transportation				We appreciate your comments. We agree that this is a useful topic for future research, but it is beyond the scope of the climate assessment. We have added text to mention that as new and rehabilitated transportation systems are developed, climate change impacts should be routinely incorporated into the planning for

							these systems.
Appendix A of NRC Review		Another useful topic to cover is information on successes in reducing vulnerability (e.g. from the Gulf Coast), those systems that are robust and why, and those that are not and the barriers preventing them from being more resilient.	5. Transportation				We agree with the sentiment of the comment, but this is beyond the scope of this report.
Appendix A of NRC Review		This statement is ambiguous as to whether it applies to the net cost of the transport sector, to every system or can apply to some systems. The traceable account for this conclusion states that there is limited literature but that authors have high confidence. It is still not clear what the statement means. For example, does it mean that the cost of fewer shutdowns from winter storms will be swamped by the costs of flooding? The literature may not be sufficient to make such a conclusion.	5. Transportation		195	23	Thanks for the comment. We have modified Key Message 4.
Appendix A of NRC Review		Vehicle vulnerability to climate is not covered in the chapter and does not seem credible. Vehicles are designed for a huge range of climates. Good to recognize these as part of the system but not for impacts.	5. Transportation		195	35	We have added the estimated number of parked vehicles that sustained water damage after Sandy from the National Insurance Crime Bureau, as an example of some of the damages that can occur from extreme weather events.
Appendix A of NRC Review		Not much in the chapter on institutions and information. More consideration could provide insights.	5. Transportation		195	37	We appreciate your comment. However, we are limited in the amount of space we have to discuss climate change impacts on U.S. transportation systems. The author team has deliberated and agreed on the most important information to include.
Appendix A of NRC Review		Hurricanes increasing in frequency is incorrectly pr□cised from chapter 2.	5. Transportation		202	20	We have modified the text to address this comment.
Appendix A of NRC Review		Caption. Thirteen out of how many of the largest airports?	5. Transportation	Figure 5.2	201		The figure maps thirteen of the nation's 47 largest airports. We have incorporated this information in the caption.
Appendix A of NRC Review		Is there another source other than the newspaper to document the 14 foot storm surge from Sandy? How about FEMA?	5. Transportation		203	14	We have added the following source from NOAA, which supports the text in this section.
Appendix A of NRC Review		The number of damaged cars wasn't countless. This number is available from the Insurance crime bureau, which estimates that 230,000 cars were damaged based on insurance claims: https://www.nicb.org/public-affairs/sandy-vehicles-load-airport-runway	5. Transportation		204	7	Thank you. We have added this number.
Appendix A of NRC Review		Tropical Storm Irene also had devastating effects on upstate New York and other states in the Northeast (perhaps make reference to Northeast chapter)	5. Transportation		210	23	Thank you. This information is covered in Chapter 16: Northeast. We have added a direct link to the Northeast Chapter in the boxes in our chapter

							assessment relating to Hurricane Sandy and Tropical Strom Irene.
Appendix A of NRC Review		What does "increasing changes in snowstorms" mean?	5. Transportation		211	11	Increasing changes in snowstorms means an increase in lake-effect snows. We have reworded the text to clarify the meaning.
Appendix A of NRC Review		The transportation report is very comprehensive but instead of providing a long list of 'doom and gloom' scenarios, would it be possible to recast some of these potential impacts in terms of basic economics (e.g., how much more it will cost to buy cereal-related projects for different ranges of scenarios in today's dollars?).	5. Transportation				Unfortunately, a national cost estimate is not available. This is a key future research need.
Appendix A of NRC Review		How will the ways that climate affects food processing, storage etc. change? What are these new ways? Cimate already affects processing, storage etc.; will climate change bring new and different ways that climate affects these systems?	6. Agriculture		243	13	Thanks for your comment. Given chapter space limitations, an in-depth discussion on impacts to food processing and storage is outside the scope of this chapter assessment.
Appendix A of NRC Review		The agricultural sector is one sector where there has been a significant amount of work done estimating the economic significance of climate change. Yet that literature is not included in this chapter in any meaningful way. While a few economic studies are cited (e.g., p. 228), their RESULTS are not discussed. Rather, they are cited for statements about the ways that farmers can adapt or expected declines in yields.	6. Agriculture				Given the size of the topic and chapter space limitations, we are not able to provide this level of specificity. We defer those interested in a deeper treatment of this area to the economic studies cited in this report. We did add a reference as part of the traceable accounts.
Appendix A of NRC Review		This chapter includes a long list of possible or documented impacts of climate on agriculture. However, it is hard to distinguish what might be considered "first order effects" from "second order effects". In other words, which impacts are likely to be economically meaningful, and to what extent do estimates of the economic implications of these impacts exist. As mentioned in the previous comment, there are estimates of the economic impact of climate change on U.S. agriculture, dating back to the early work discussed by Adams et al. (cited in report) but also including more recent work (such as the Schlenker et al. paper also cited here). Cross-sectional economic analyses incorporate the many ways that climate can affect profitability (including the various channels discussed here) and give an indication of the magnitude of the economic impact. A discussion of the conclusions of these and related studies (see, for example, Fisher et al., American Economic Review, December 2012) would give the reader a better understanding of the current state of knowledge about the economic significance of the long list of possible impacts reported here. As written, this resembles a simple laundry list of possible impacts, with little indication of the importance of the effects either individually or in the aggregate.	6. Agriculture				We appreciate your comment, however given the size of the topic and chapter space limitations, we are not able to provide this level of specificity. We defer those interested in a deeper treatment of this area to the economic studies cited in this report.
Appendix A of NRC Review		The suggestion here is that, with sufficient adaptation, the agricultural sector can "keep pace" with future climate change, implying that the real cost of climate change for agriculture is simply the cost of innovation. This is a different message than what is given on lines 16-18, where it says that impacts WILL be increasingly negative on most crops and livestock.	6. Agriculture		227	28	We have modified this statement to match Key Message 1, indicating that increased innovation will be needed to ensure that the rate of adaptation of agriculture and the associated socioeconomic system can keep pace with climate change over the next 25 years.
Appendix A of		The global transmission of impacts stems from the global integration of agricultural markets. There is no mention of the importance of global markets, which is what is really driving this linkage. This is	6. Agricultu		227	31	We have revised this Key Message to incorporate your suggestion.

NRC Review		mentioned in the paragraphs that follow (p. 228) but does not appear as part of the key message.	re				
Appendix A of NRC Review		There does not seem to be a clear basis for the statement that "such projections often fail to consider the impacts from weeds, ..." The reference for this statement is Malcolm et al. 2012, but there is not a complete reference for this citation. As noted above, cross-sectional economic analyses (e.g., of the type conducted by Mendelsohn et al. 1994) embody all ECONOMIC impacts attributable to cross-sectional climate differences, including differences in weeds, insects and diseases.	6. Agriculture		228	29	We added full details on the reference.
Appendix A of NRC Review		This figure does not appear to be referenced anywhere in the text. This is a general issue throughout the report (i.e., figures are included in a number of places without any discussion of them or reference to them in the text).	6. Agriculture	Figure 6.1	229		We have added figure references to the text.
Appendix A of NRC Review		The caption should make the point that the distribution depends not only on different effects of climate change on different commodities but also in different regions.	6. Agriculture	Figure 6.2	230		We have modified the text to incorporate your suggestion.
Appendix A of NRC Review		The caption here should state that weather, not climate, was a factor in poor harvests. It was not the overall pattern (climate) that led to poor harvest but rather the specific weather (which is influenced but not fully determined by climate).	6. Agriculture	Figure 6.3	231		The caption was modified to indicate that through seasonal weather impacts on harvests and other impacts, climate change will continue to be a factor in global markets.
Appendix A of NRC Review		The portion of key message 3 addressing displacement of vulnerable populations is problematic, i.e. you could argue that moving vulnerable populations from the most at risk areas is positive. Decreasing diversity is not a positive outcome, however, in terms of risk reduction moving to less vulnerable locations is an appropriate adaptation response. The message would be stronger if it ends after the word "communities". Another alternative might be to separate this message into two, one about socioeconomic factors increasing climate change impacts by limiting adaptation options, and the second around loss of diversity on the coast, which is a community value issue that should be addressed as part of adaptation planning.	25. Coastal Zone Development and Ecosystems		867	21	We considered the rewrite of this message carefully, and have revised it slightly in response to a second comment as well. We are not aware of published literature that would support the addition of a change to cultural diversity – while possibly implied in the general trend toward gentrification of the coast and from the displacement of the socioeconomically disadvantaged, poverty and socioeconomic status are interrelated in complex ways and thus do not allow drawing this conclusion without further study. Thus, cultural diversity is not included here. We do not concur that displacement of those less well off from their homes and land is a good thing. Maybe a macro-economic perspective would view it that way, but a human perspective does not. The consequence of socioeconomic vulnerability is as we describe here in the message and detail in the text.We have added a sentence that recognizes that

							dislocation/retreat is becoming more pressing as a result of sea-level rise, coastal hazards, and the unaffordable (and maybe unwise) attempt to hold back the sea.
Appendix A of NRC Review		Delete "and" before ocean acidity.	25. Coastal Zone Development and Ecosystems		869	32	The text has been revised to incorporate this suggestion.
Appendix A of NRC Review		This graphic is confusing. Why was 1992 used as the base elevation for panels a and b? Panel c uses "mean high water level during the tide gauge record" as the base elevation. Suggest re-titling Panel C as "100-year return flood elevations above MHW", and separating panels a and b from panels c and d.	25. Coastal Zone Development and Ecosystems	Figure 25.3	871		The caption has been clarified. 1992 was the base year chosen by the NCA SLR projections document that we were asked to use, the midpoint between the endpoints of the tide gauge epoch (1983-2001) from which a base mean sea level was established. Adding this information here would make the caption unwieldy, so we did not include that explanation. We include the reference to the scenarios document, however, to make that clearer. In response to this and other comments we have tried to improve the graphic and the explanations of the four panels, without introducing undue jargon.
Appendix A of NRC Review		Adaptation Examples - Mid-atlantic box is missing text at the end.	25. Coastal Zone Development and Ecosystems		875	1	The figure has been corrected.
Appendix A of NRC Review		Has coastal been defined?	25. Coastal Zone Development and Ecosystems		877	8	We include a definition of coastal in the caption of Figure 25.1.

Appendix A of NRC Review		This is a compelling figure that illustrates the connections from the coast to the rest of the country. However, suggest re-labeling to Louisiana Coast to Inland Economic Connection. Or add to the Caption text explaining figure is one example, i.e. Louisiana.	25. Coastal Zone Development and Ecosystems	Figure 25.7	881		This figure is being updated and revised by the Technical Support Unit, eliminating the need for the suggested relabeling as it shows such linkages from four major US ports along each major coasts.
Appendix A of NRC Review		See earlier comment re: Key Message 3.	25. Coastal Zone Development and Ecosystems		882	20	After consideration of this point, we decided to leave the message virtually unchanged. We believe that "retreat" is a communication red flag for many people in the U.S. and that unmanaged displacement is actually more appropriate to describe what we expect to see happen. Growing risk is acknowledged now.We have added a sentence that recognizes that dislocation/retreat is becoming more pressing as a result of sea-level rise, coastal hazards, and the unaffordable (and maybe unwise) attempt to hold back the sea.
Appendix A of NRC Review		Needs a legend and scale, i.e. red indicates land loss?	25. Coastal Zone Development and Ecosystems	Figure 25.9	885		The figure has been revised to incorporate these suggestions.
Appendix A of NRC Review		Adaptation Planning. Here vs Adaptation Chapter?	25. Coastal Zone Development and Ecosystems		887	1	We appreciate this suggestion. The author team has deliberated and agreed that the Adaptation chapter was, by necessity, very broad and could not encompass important coastal adaptation information. A section on the state of coastal adaptation was included in the Coastal chapter for two key reasons: (1) We responded to the charge to focus on what is new since the 2009 Second Assessment report – and much more is known about coastal adaptation than was known then; and (2) the vulnerability of coastal areas cannot be fully understood by looking at

							climate drivers and socioeconomic and ecological exposure alone, but also requires a look at adaptive capacity and barriers to adaptation. Through ongoing interaction with the Adaptation chapter authors during the drafting stage, we have minimized the overlap, but believe – given how the report will be read – that adaptation should be treated in more than the 30,000 foot perspective that the adaptation chapter had to take given its much broader charge to consider all sectors and regions in very limited space. The two chapters are complementary and consistent in all ways. A more specific title was the only change we made.
Appendix A of NRC Review		"A robust finding is that the cost of preventative hazard mitigation is 4 to 10 times lower than the cost of inaction" Should this be a key finding?	25. Coastal Zone Development and Ecosystems		887	33	We appreciate this suggestion. The author team has deliberated and agreed to limit ourselves to key messages that focus on key vulnerabilities (infrastructure, economic, human/social and ecological) that hold across all coastal regions of the US and on one overarching finding regarding adaptation across the US. The particular statement here, while probably reliable across U.S. regions, only focuses on hazard mitigation, and does not encompass the broader issue of the cost-effectiveness of all types of adaptation. We could not find sufficient published literature for coastal U.S. regions to make an overarching statement about cost-effectiveness of adaptation. However, this warrants more extensive research; once available, we would support an overarching finding on the economics of adaptation - whatever it will turn out to be - at that time.
Appendix A of NRC Review		The "Social Vulnerability Index" does not seem especially compelling. These indices are extremely sensitive to the underlying assumptions and weights. If the team feels that the SoVI is powerful, why does it appear only in this chapter?	25. Coastal Zone Develop				The team considered this comment carefully and agreed to continue to use the SoVI for this chapter for the following reasons: (1) The SoVI, as the

			ment and Ecosystems				commenter rightly points out, is a relative measure and context sensitive. The main nationwide study cited (Martinich et al) offers the broadest and most consistent context relevant for the United States- namely all coastal areas across the entire nation (the study could not be done for the Caribbean territories). Thus, for the US at least it is a consistent comparative framework. (2) While the underlying assumptions and weights do affect the detailed outcomes, they are applied to the entire coast and thus do not introduce uneven biases within this study. We cite several smaller-scale studies that also used the SoVI, and other SoVI studies for the entire United States (more than coastal), and findings are consistent across even if specific numbers differ. The PATTERN of social vulnerability is replicated across all studies. Thus we feel we present reliable results. (3) While the chapter teams were given a range of consistent scenarios to use in this assessment, SoVI was not a required scenario, but a guidance document on vulnerability assessments was provided (which includes the SoVI). Even so, a nationwide county-level SoVI analysis exists. The coastal chapter has no power over other chapter teams to force them to use this assessment. (4) The coastal chapter team followed the charge to focus on new, nationally applicable scientific insights since 2009, and this focus on social vulnerability is just that. No other type of vulnerability assessment has been applied nationwide to coastal areas to provide a similarly consistent perspective. Thus, we feel justified in using the SoVI in our chapter.
Appendix A of NRC		States that "217,000 individuals are currently exposed." Since census data are statistical, putting out the number 217,000 (and not 218,000) gives a false impression of precision.	25. Coastal Zone		883	5	The text has been revised to incorporate this suggestion and edited to provide the correct number

Review			Development and Ecosystems				(270,000).
Appendix A of NRC Review		It is stated that changes were made to the National Flood Insurance Program that ensured that the "program is fiscally sound." Actually, that is not the case. These "reforms" helped but the program could not pass muster in front of any state insurance commission - there is no way it can pay the claims that it could reasonably expect in the next decades. Most people think it needs a more radical transformation to move towards a system like Germany or the UK where private insurers can write the policies (and assume the risks.) The present program, although tweaked, will continue to assume greater risks and inadvertently encourage infrastructure to be built without regard to risk. This seems to be inherent in government-funded approaches that 1) can print money and 2) respond to political pressure, not economic pressure.	25. Coastal Zone Development and Ecosystems		888	14	We appreciate this suggestion, but space is limited and we cannot give justice to the full problem with the NFIP. We agree with the commenter, especially given the most recent assessment of the NFIP since the 2012 act by the CRS. We have slightly modified the sentence and added a reference to this CRS review which provides exactly the arguments the reviewer made.
Appendix A of NRC Review		The heading is followed by text that presumes the value of decision-making as a means of making choices. This is well-known to be incomplete as a description of choices made by individuals and institutions (e.g., Kingdon, John W. 1995. Agendas, alternatives, and public policies. New York: HarperCollins). Making a decision entails creating a record that supplies a basis for reasoned selection of options. In contrast, choices can be made A) by habit or continuation of existing practices (as is common in a large fraction of budget choices, for instance), or B) via negotiation and compromise that has little or no basis in knowledge of the connection between choice and outcomes. In this light, making choices through explicit decision making (and with decision support) is important for reasons of accountability, because a decision may be more traceable when outcomes emerge. For that very reason, actors who make choices may avoid decision support as a way to avoid or weaken accountability. This is a phenomenon that needs to be recognized in the chapter; it is likely, moreover, that behavioral research on the relationships among rules, incentives, and power can help to illuminate when decision support is likely to be used. That would guide further investment in decision support in a way that is not yet done but is needed. (The points made here extend the discussion on 929, and that may be a reasonable place to include consideration of this critique.)	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		927	35	Added a new key message on decision context, decision short cuts, and why structured decision making can enhance transparency, accountability, and effectiveness.
Appendix A of NRC Review		On "more difficult," cf. Layzer, Judith A. 2012. The Purpose and Politics of Ecosystem-Based Management. M.P. Weinstein and R.E. Turner (eds.), Sustainability Science: The Emerging Paradigm and the Urban Environment, DOI 10.1007/978-1-4614-3188-6_9, Springer Science+Business Media. Pp. 177-197. This article reports on a comparative evaluation that concludes that ecosystem-based management leads to outcomes that are arguably lower in quality than decisions reached without the elaborate investment in decision support that lies at the heart of EBM. Layzer is skeptical on the point raised at 929/30-31 (facilitators). Authors may not agree with Layzer but her research (in this article and a 2008 book, Natural Experiments) should not be ignored; it may suffice to include a brief discussion at 940/33, where a "need" for science translators is asserted.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		928	7	Suggested citation added, text changed to clarify that incorporation of an iterative approach makes it possible to update decisions as information improves.
Appendi		"Learning by doing" includes trial and error learning. Trial and error utilizes decision support in a	26.		928	15	We made a modification of the

x A of NRC Review		logically different way than planning based upon deterministic models of the system being managed, in the sense that decision support does not aim at a prediction of outcomes. In particular, learning-based choice strategies require different, sometimes larger investments in monitoring than situations (e.g., designing a bridge) where predictive analysis is available. This should be acknowledged, perhaps in the related discussion of handling uncertainty and complexity.	Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				paragraph to clarify the adaptive management process. Adaptive management does attempt to predict outcomes and pick the decision that has a higher likelihood of leading to the desired outcome, but it also recognizes that in uncertain situations (because we don't know much about the system or because what we previously assumed (e.g., stationarity) is no longer appropriate) it is critical to implement a process that allows for learning and modification as needed.
Appendix A of NRC Review		Good introductory mention of boundary spanning. Should add to Traceable Accounts the helpful typology in Clark, William C., Thomas P. Tomich, Meine van Noordwijk, David Guston, Delia Catacutan,Nancy M. Dickson, and Elizabeth McNie 2011. Boundary work for sustainable development: Natural resource management at the Consultative Group on International Agricultural Research (CGIAR). PNAS, doi 10.1073.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		930	1	We have expanded the discussion of boundary spanning and boundary processes in the chapter.
Appendix A of NRC Review		The "cone of uncertainty" seems to imply that scenario planning or RDM can predict the range of outcomes. This is incorrect: RDM is a way to specify a (large) range of scenarios so as to study the implications of known variations in known variables. That is valuable but it is not the same as analyzing uncertainty.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		933	7	The cone of uncertainty is widely used in the literature to suggest the need to plan for a wide range of plausible futures -- the caption indicates that far from predicting, the cone depicts multiple potential futures in Denver Water's scenario planning exercises. The cone is not intended to imply anything about predicting specific futures. More broadly, scenario-based methods, including robust decision-making, often include an iterative process designed to encourage decision makers to expand the range of futures they consider in their planning. Thus, while it is technically correct to say that such methods only consider "known" futures, in practice

							their effect can be to bring previously unconsidered futures into active consideration.
Appendix A of NRC Review		This subsection raises a significant point: when is decision support worth using? The text is inconclusive, however. Authors suggest that the value of information and analysis can be negative at the margin--a notable assertion that is important to the NCA as a whole. If so, how would one know whether decision support should be used or developed? If knowledge on this point is not readily available, what research is needed, and is there a precautionary policy that should be adopted in the meantime? The text on 934f implies that risk analysis and management is generally a good conceptual framework--is that the precautionary policy? Note also that value of information is not listed on 941 as a topic needing further research investment.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		933	16	The significantly revised discussion emphasizes that, despite lack of "ideal" information, information and decision processes (such as adaptive management or other "ongoing" learning processes) enable planning and actions to be initiated.
Appendix A of NRC Review		Are the approaches included meant to be a representative sample? The list of approaches has a systematic feel to it (analytic methods, data management, etc.) but no system is mentioned. Authors should articulate some rationale; a claim of representativeness may be sufficient.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		936	28	Added a sentence to provide a rationale for the selection of decision support tools presented in this section.
Appendix A of NRC Review		"Lack of tools" is not enough of the story. To be useful for learning, tools need to be maintained over time, and that is very difficult without routine use by a community of users with resources to support maintenance. [REF: Curtice, Corrie, Daniel C. Dunn, Jason J. Roberts, Sarah D. Carr, and Patrick N. Halpin 2012. Why Ecosystem-Based Management May Fail without Changes to Tool Development and Financing BioScience 62:508-515]. The implication of this paper is that it may be unwise to invest in more tools until a focused appraisal of use, including analysis of extension and consultancy models for public agency users, is carried out.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change		939	33	Reference added and discussion includes "appraisal" issue.

			Context				
Appendix A of NRC Review		"Ongoing evaluation" faces the problem of defining a counterfactual--what would have happened absent an intervention. In a non-stationary climate, it is particularly important to be aware of counterfactuals, since the background assumption of stationarity may not be valid over the time scales relevant to an evaluation (or to perceptions of change and risk). This is worth considering at this point.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		941	5	Evaluating the effectiveness of decisions that are currently made and whether something different should be done to increase the likelihood of meeting the decision objectives is a different kind of evaluation and is more of the type that we refer to in this section. The final report will include a glossary to clarify the definition adopted in this chapter.
Appendix A of NRC Review		Unclear why authors do not offer a confidence rating on the scientific basis for their normative judgment. Cf. note on Layzer above, 930/1-15.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		942		The topics in these chapters do not lend themselves to confidence ratings in the same manner that Regional and Sectoral chapters do. This and several other chapters (e.g., adaptation, mitigation) do not provide confidence ratings for this reason.
Appendix A of NRC Review		Remaining uncertainties rating might look at (frail) basis in evaluation literature on use and effectiveness of these tools. Note partial relevance of Curtice et al (comment on 939/33); the implication there is that it may be unwise to invest in more tools until a focused appraisal of use, including analysis of extension and consultancy models for public agency users, is carried out..	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		944		The chapter indicates that additional evaluation of specific tools is needed.
Appendi		Remaining uncertainties rating might look at nearly absent basis in evaluation literature on use and	26.		945		The chapter indicates that additional

x A of NRC Review		effectiveness of science communications. An anecdotal example is Goldston, David 2008. Getting it across. Nature 45:16.	Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				evaluation of specific tools is needed.
Appendix A of NRC Review		This chapter doesn't assess the state of decision support. Instead, among research needs at 941.21-11, it calls for "comprehensive analysis of the state of decision support for adaptation and mitigation." Is this an abdication of the task? The chapter identifies decision frameworks and "tools" that are available, but doesn't assess their quality or usefulness, or the match between tools and decisions. Arguably, for example, there is better information available to support mitigation choices than adaptation choices, but the chapter doesn't go there.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				The chapter describes the state of decision support in general, in particular pointing users to additional information about classes of tools. Because of limits in the underlying literature related to evaluation of specific tools and space constraints, we are limited to providing examples and not a more comprehensive evaluation. We have revised the chapter to provide as much evaluation as we deem possible in the limited space available. We do not believe blanket statements about the relative availability of information for mitigation and adaptation decisions can be supported by the literature.
Appendix A of NRC Review		The chapter describes what an ideal decision support system would look like, but doesn't assess the extent to which such systems are in place, generally or for particular classes of decision makers or decisions.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				The chapter has been retitled to better reflect the purpose of this chapter, the chapter has been reorganized, and a number of examples have been added to illustrate the processes and tools discussed in the chapter.
Appendi		This is a well-written chapter that provides recommendations to improve our decision support	26.				Key message #1 has been maintained

x A of NRC Review		infrastructure. The key messages are well supported in the text. Key Message 1 (p. 925) is particularly critical to improving climate change policy development and decision processes.	Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				in the revision process. No other action requested.
Appendix A of NRC Review		"value questions that arise" needs to be re-stated or clarified.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		926	24	The text has been modified to clarify use of "value" in this context.
Appendix A of NRC Review		Suggest rewording "identification of climate risks and opportunities" to identification of risks and opportunities associated with climate change, OR combine with previous sentence.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context	Figure 26.5	934		The text has been modified as suggested.
Appendix A of NRC		Suggest moving this figure so it comes after p. 935, lines 10-20 which explain the terms in the Risk Assessment box in the figure. Also suggest equalizing (in size) the Risk Assessment and Risk Perception boxes, which feed into the Risk Management box, which should also be centered to better	26. Decision Support:		934	13	The figure has been modified to include a feedback loop from risk management strategies to risk

Review		demonstrate the equality of assessment and perception. As currently drawn the feedback loop from Risk Management does not affect Risk perception. Authors should confirm this intent with text.	Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				perception and risk assessment.
Appendix A of NRC Review		Comparative Tradeoff Methods.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		936	32	The comment appears to be incomplete, thus no action has been taken.
Appendix A of NRC Review		The use of the term "objectives" is confusing. Recommend defining objectives for purposes of this section.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		937	32	Text added to reference decision criteria and provide some other examples in subsequent sentences.
Appendix A of NRC Review		Agree that use of "ensembles" is a valuable objective. Given the public's understanding of modeling ensembles in weather contexts, particularly hurricane forecasting, , the addition of a Box or text discussing the current utilization of ensembles in terms that will resonate with many readers should be considered.	26. Decision Support: Supporting Policy,		939	40	We have referenced discussion of model ensembles and multiple models in the Climate Science chapter and appendix. Space not sufficient to develop a Box or section here.

			Planning, and Resource Management Decisions in a Climate Change Context				
Appendix A of NRC Review		Restate to better align with the other bullets, i.e. Investments in understanding the cost and benefit of non-market ecosystem goods and services analyses ... are needed.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		941	23	Modified text as suggested.
Appendix A of NRC Review		The chapter is clearly written, informative and nicely organizes information focusing on the several kinds of decision support models that have been and can be applied to climate-related decision-making. They meet the challenge of summarizing and synthetizing a broad literature that spans decision science, STS, risk analysis, etc into a short and concise chapter. The authors did a good job of describing different decision frameworks and offering readers information on the many ways science and decision-making intersect in mitigating and responding to climate change. When thinking about the goals for the chapter, one can imagine there are two main Ôuses'. First, as a roadmap for decision-makers to quickly access current decision frameworks and get started thinking about how their own decision needs can be informed by existing models. Second, as a scientific synthesis of the literature focusing on science-society interface, aiming at identifying gaps and future research needs.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				These purposes have been brought out more in the revision.
Appendix A of NRC Review		The chapter is that it offers a somewhat unidimensional description of the existing models that might fall short from meeting both goals. While the authors recognize the many dimensions of informing decision-making (lines 24-29, p. 926), the chapter is mostly normative in its description of different decision frameworks, paying relatively little attention to the empirical literature focusing on the opportunities and challenges of applying these frameworks. It begs the question: if these models are available and useful, why aren't decision makers adopting them more readily? Figure 2.6 defines Ôeffective outcome' as knowledge (and its desirable characteristics) rather than use (decision	26. Decision Support: Supporting Policy, Planning, and				The chapter has been revised to address, in part, the comments of this reviewer. As recommended, additional examples have been included in this revision.

		outcome). The focus in on the knowledge production function, instead of decision-making/usability. Empirical literature shows that not all knowledge that is credible, relevant and legitimate gets used. In contrast, when the chapter actually focuses on empirical examples of use (e.g. Denver water and data management), it comes to life. That could be attractive to decision-makers looking for ways of incorporating scientific information to their decision processes. Unfortunately there is not enough of it. For example, there is an endorsement of participatory/interactive science production and use processes (whose effectiveness is well-documented empirically) but scantly any mentioning of the challenges and limitations of these processes shown in the literature. It also mentioned the need to better understand means of increasing use of climate information but not much on how to scale up usage to a broader number of users outside interaction-intensive processes (which have been shown difficult/costly to scale up). If the goal is to inform decision-making actors about current frameworks, the chapter needs more examples and a practical roadmap of where to start and examples where users can see themselves. If the goal is to synthetize the knowledge and identify gaps it needs to pay more attention to the empirical literature focusing on actual climate information use, its opportunities and challenges and what we still need to understand to design better DST and processes to deploy them.	Resource Management Decisions in a Climate Change Context				
Appendix A of NRC Review		Lines 39-40 p. 926 references?	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		926	39	The text referred to by the reviewer has been significantly revised and is now included in the section describing decision support. References, such as NRC, 2009, have been included to support statements within the text.
Appendix A of NRC Review		Typo on figure 26.2 (Relevance).	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context	Figure 26.2	930		Modified text as suggested.
Appendix A of		This is a well-written chapter whose contributors include some of the country's best-known experts in decision science. This is clearly a strength, but it may also be a weakness. Much of the chapter consists	26. Decision				We have added a discussion of the factors that challenge decision-makers

NRC Review		of generic discussions of what the authors refer to as "idealized" models of decision-making processes. There is no discussion of what makes climate change such a challenging decision problem. The reasons given by the authors are not particularly persuasive; many problems call for decisions where there is considerable uncertainty, where scientific information is lacking or difficult to access, and where stakeholder interests are diverse and often conflicting. Almost no emphasis is given to what is relatively distinctive about climate change decision making, which is that the adaptive management capabilities of our institutions are seriously challenged by complex problems that unfold on long time scales. How can we ensure that there are mechanisms to sustain sound decisions and effective policies over time while having the flexibility to alter those that do not seem to be working? (See, for example, an article by Richard Lazarus in the Cornell Law Review on the "superwicked" problems of climate change). The chapter does not take into account the context in which decisions regarding climate change are being made in the U. S. Mitigation and adaptation decision making are highly politicized, and this is further complicated by the fact that responses to climate change are being framed as a threat to economic recovery. In placing so much emphasis on what they acknowledge is an "idealized" perspective on climate decision support, the authors spend very little time discussing how climate-related decisions are made and decision support tools are used in real-world situations. The authors review different approaches, such as tradeoff methods, scenarios, and integrated assessment models, without discussing research on how those tools have been employed, and to what effect. There has been research on integrated assessments, such as the RISAs (see, for example, Roger Pulwarty and co-authors, "The Regional Integrated Sciences and Assessment Program: Crafting Effective Assessments for the Long Haul"). What does that research and other studies tell us about the use of such assessments and how they influence decision making? What about other tools?	Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				when making decisions in the context of climate change and variability. We have also included a number of examples that illustrate the decision processes and tools in action.
Appendix A of NRC Review		It is unclear why the authors chose to discuss the "knowledge enterprise" system that was developed to provide information to decision makers during the Deepwater Horizon oil spill (a crisis situation), nor is there detailed information on what decisions it informed. The same is the case for other data management systems and other decision tools. Problems associated with such methods are not discussed; for example, in the case of data management tools, what if data are missing or contradictory, or so abundant that they actually hamper decision making? Various tools are introduced, but little is said about how they have been used to support actual decisions in U. S. communities. For example, a brief mention is made of a land-use planning tool that has been employed in Florida, but there is no discussion of its impact on land-use planning decisions—only that it provides information "in a context that is relevant to decision makers." Who are the decision makers? Who are the stakeholders? What climate-related decisions are being considered? The Denver Water case is a little more detailed, but readers get little information beyond being told that the utility is "using scenario planning." Who specifically is using it within the organization, what impacts is its use having on decisions, who are the stakeholders, and are they involved in the process? If the scenarios are making a difference in the decisions that are being made by Denver Water, why is that the case? How have regulators, the general public, and other stakeholders had an influence on decisions.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				A number of examples have been added to the chapter to further explore the use and results of decision support processes and tools.
Appendix A of NRC Review		The chapter contains some imprecise statements. For example, it is stated that "Social scientists and psychologists have studied people's concerns about risks...and found that people view hazards with which they have little personal knowledge as highly risky, and they especially dread them." This is a broad generalization that simplifies complex risk perception issues. I have no personal knowledge of what it is like to fly in a hot-air balloon, but that doesn't automatically mean that I see that activity as highly risky, or that I dread it. Some of the chapter authors have a comprehensive knowledge of the risk perception literature, so its curious why they chose to use these kinds of shorthand explanations for risk perception phenomena.	26. Decision Support: Supporting Policy, Planning, and Resource Manage				The discussion of risk perception and risk assessment has been expanded, and an example of planning within a risk-based framework has been added to illustrate various steps in the process.

			ment Decisions in a Climate Change Context				
Appendix A of NRC Review		The title of the chapter suggests that readers will learn about what is happening in the U. S. in terms of "supporting policy, planning, and resource management decisions." However, the chapter doesn't provide that kind of information. It mainly summarizes well-known points from the decision science literature and from a few NRC studies. The emphasis is on "idealized" models and general knowledge on decision support processes and tools.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				The chapter has been re-titled to better reflect the purpose of this chapter, the chapter has been reorganized, and a number of examples have been added to illustrate the processes and tools discussed in the chapter.
Appendix A of NRC Review		This chapter makes a number of statements that are rather vague, confusing, and in some cases unsubstantiated. The organizational structure is also difficult to follow. Unlike in other chapters, the text following the three key messages is not directed toward those specific messages, but rather jumps around frequently, making the logic/structure of the chapter hard to follow.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				The chapter has been revised to enhance clarity for a range of audiences and the organization of the chapter has been modified to reflect the two other chapters that are similar in nature -- Mitigation and Adaptation -- in which the key messages are supported in different ways throughout the entire chapter. We have also added a section in the introduction that provides the focus and organization of the chapter.
Appendix A of NRC Review		The first statement of key message #1 is an example of an unsubstantiated statement. While it might be true that it is important to create an appropriate process IN ADDITION TO having good scientific information and tools, what is the evidence that supports the statement that having such a process is AS IMPORTANT AS having good information and tools? Both are important, but I don't think there is a basis for saying one is more important than the other.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions		925	22	Revised key message to remove comparative importance.

			in a Climate Change Context				
Appendix A of NRC Review		These tools are available and used for a number of different decisions, not just decisions about climate change adaptation and mitigation. There is a need to put these tools and processes into the broader framework of decision making about a broad range of issues AFFECTED BY climate change. There is also experience with using these tools, and the state-of-the-art not just in terms of development but also in terms of use should be discussed.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		925	28	Revised key message to frame climate change as one of several potentially important considerations in decision-making.
Appendix A of NRC Review		Some of these do not seem to rise to the level of a key message, and the support for them is not provided in the text. For example, while it may be true, the need to improve reward structures is not substantiated in the text and is too specific for a "key message."	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		925	30	The key message has been reorganized and amended to focus on overarching needs related to developing decision support tools and building human capacity.
Appendix A of NRC Review		It is important to describe this "idealized" process explicitly and to highlight it (rather than burying it in a single paragraph in the introduction). However, it is equally important to refer back to the steps of this process at various points (both here and throughout the report) to show how the various pieces fit together and contribute to better decision making. There are statements about improving decision-making throughout the report (see, for example, the chapter on forestry) but they don't link to the discussion here.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate		926	5	Additional references have been added here and specific steps within the decision framework are described extensively later in the chapter.

			Change Context				
Appendix A of NRC Review		The lay public is not likely to understand the differences among decision "frameworks, "tools", and "processes". More specifics, or examples, of these are needed to help distinguish among them.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		926	40	The final report includes a glossary and additional examples have been added to the chapter.
Appendix A of NRC Review		The issue is not "climate change decision making" but rather "decision making in contexts affected by climate change".	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		926	42	The text has been modified as suggested.
Appendix A of NRC Review		Individuals don't just make decisions about preparedness. They make behavioral decisions/choices every day that affect emissions of GHGs.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		927	21	Modified text to include individual-level decisions about emissions. Changed preparedness to vulnerability.

Appendix A of NRC Review		It is fine to say that having an "effective" process is helpful, but this statement is not particularly helpful. It begs the question "what IS an effective process?" There is presumably a large literature on, for example, participatory processes, which identifies best practices. What are those? Can't some findings from the literature be built into this key message?	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		927	38	We have expanded the discussion of "effectiveness" and added a graphic to illustrate various process and decision outcomes related to effective decision-making.
Appendix A of NRC Review		Adaptive risk management is a type of management strategy (not a decision support tool), but it doesn't necessarily involve a collaborative process with researchers and (all) stakeholders, i.e., while it might involve "interaction between decision-makers and the scientific/technical community," it does not necessarily "engage all affected parties". Yet, the discussion here suggests that this is an example of the type of process being advocated in Key Message #1.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		928	5	Added text to clarify that this is both a general term and a specific approach, and that iterative adaptive risk management processes can be undertaken through collaborative structures.
Appendix A of NRC Review		The discussions about "bridging the gap" and using "models and tools" lead the reader to wonder how the discussion here links to the other two key messages. These links between the key messages (and the discussions of them) is unclear. For example, if a discussion of "tools" is appropriate under Key Message #1, then why is there another key message specifically related to tools?	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		930	1	The key messages have been refined and clarified and authors have added additional discussion of boundary processes in the chapter text.
Appendix A of		There is no explicit link to climate change in the discussion (caption) of this figure.	26. Decision	Figure 26.3	932		The figure caption has been revised. In addition, the selected illustration has

NRC Review			Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				been changed to a screen shot from a project for which climate change information is under development.
Appendix A of NRC Review		While it is important to include a discussion about the value of information, it is not clear how it relates to Key Message #1	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		933	16	The chapter has been reorganized. The discussion is now linked to a section considering "Implementation, Continued Monitoring, and Evaluation of Decisions" and whether gathering additional information merits delay in decision making.
Appendix A of NRC Review		The implication here is that cost-benefit analysis cannot incorporate uncertainty. This is not true. There is a large literature on doing cost-benefit analysis under uncertainty, going back to the early work by John Graham in the American Economic Review.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		934	12	We have clarified this point by indicating that cost-benefit analysis cannot deal with low probability high consequence events that might lead to unbounded measures of either costs and/or benefits.
Appendix A of NRC Review		Is the reference here to a "focus on short time horizons" a disguised reference to discounting? The entire issue of discounting (including private vs. public discount rates) is missing from the report. It would not normally be in a section on "risk perceptions", but it is a critical consideration in decision making.	26. Decision Support: Supporti		935	38	We have modified the text to better explain the need to use longer time horizons in decision making.

			ng Policy, Planning, and Resource Management Decisions in a Climate Change Context				
Appendix A of NRC Review		This discussion about the adequacy of incentives is very confusing. In the first part, it is not clear how, for example, "ensuring continuity of service" is an option with "sufficient incentives." Second, and more importantly, what does it mean for incentives to be sufficient or insufficient. For what?? Simply saying "to adapt to emerging conditions" is not a meaningful benchmark to measure whether incentives are sufficient or insufficient. Overall, it is unclear what the point is of this paragraph on Risk Management Strategies.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		936	8	We have deleted the sentence. The discussion of the importance of short-term incentives is incorporated in the discussion of risk perception.
Appendix A of NRC Review		This is the only place in what I've read where I have seen an explicit reference to tradeoffs. Yet, nearly all decisions involve tradeoffs, and the key is how to recognize, evaluate, and make decisions in the presence of these tradeoffs. I think this notion of tradeoffs needs to be elevated to a much higher level, at least in this chapter if not in the report as a whole.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		936	32	We have included additional discussions of tradeoffs in the chapter.
Appendix A of NRC Review		Why provide a detailed explanation of multi-criteria methods but not the other methods included in this list of possible approaches?	26. Decision Support: Supporting Policy, Planning,		936	37	Discussion of comparative trade off approaches other than multi-criteria methods are presented in other sections. We have included references to those sections.

			and Resource Management Decisions in a Climate Change Context				
Appendix A of NRC Review		What is an "end-to-end climate change indicator system"? This terminology is not likely to be familiar to most readers.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		938	8	Revised text to clarify the purpose of the indicator system and added references to existing indicator systems.
Appendix A of NRC Review		It is not clear why the Nordhaus, Stern and Weitzman references are used here. The main point (and focus) of the Stern-Nordhaus debate is not related to the statement in the text about the need for multiple participants in the process. It seems very odd to use these references here.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		938	16	The Nordhaus, Stern, Weitzman citations have been replaced with two citations--one that is focused on stakeholder-based valuation processes in water resources management; the other is a broader summary of multiple valuation techniques, including use of stakeholder engagement processes. The referring sentence conveys 2 things: (1) that a variety of scientific disciplines -- natural science and social science -- are needed to evaluate climate policies (thus the Nordhaus, Stern, Weitzman citations); and (2) that policy evaluation involves collaborative processes involving a range of stakeholders (references for this point have been added in to support this point).
Appendix A of NRC		Similarly, these are very odd references to cite regarding non-economic metrics. All of these references focus on economic valuation methods. While they might mention non-economic methods, that is certainly not what these references are about.	26. Decision Support:		938	27	The sentence has been revised to appropriately describe and cite the concept of non-monetary benefit

Review			Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				measures.
Appendix A of NRC Review		The list here (e.g., "implications of land use changes" and "transportation investments") are not examples of "decision frameworks".	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		938	30	The text has been modified to reflect that the examples are of decisions, not frameworks.
Appendix A of NRC Review		Is "Decision Support Analysis" the same as "Data Management"? The distinction (or, more generally, the link between data management and decision support) is unclear here.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		938	36	The introductory text has been modified to explain the content of the box.
Appendix A of NRC Review		Not clear how this discussion relates to "keeping pace with scientific advances."	26. Decision Support: Supporting Policy,		939	32	The section has been re-titled to better reflect the content.

			Planning, and Resource Management Decisions in a Climate Change Context				
Appendix A of NRC Review		There is a lot of repetition between the discussion here and the text in previous sections. In addition, it is not clear how the discussion on p. 941 provides specific support for Key Message #3.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		940		The section was revised and the organization of the chapter has changed so that it is similar to the Adaptation and Mitigation chapters (and key messages are not repeated throughout).
Appendix A of NRC Review		Why is there no need for assessment of confidence in this chapter? This is indicative of an over-arching problem with the chapter, namely, that it is not (as currently written) based on "evidence" regarding the effectivess of decision support tools and processes.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		942		The chapter includes evidence drawn from the research literature on decision support and the use of different techniques. Providing evidence and providing confidence ratings are very different things, and the use of one does not lead to confidence assessment for qualitative conclusions such as those contained in this and several other chapters.
Appendix A of NRC Review		This chapter does not describe how scientific and technological information is being used to support decision-making, but instead describes how it should be used. (The Denver water system example is a nice exception, showing how uncertainty can be incorporated into decision-making.) It would be helpful to see more examples in this chapter. If readers were given examples of how various organizations are applying the principles described in the chapter, the usefulness of the information would be greatly enhanced - i.e., readers could see how the principle can be applied.	26. Decision Support: Supporting Policy, Planning, and				We added examples throughout the chapter within the text of the sections and as detailed examples in boxes, to better illustrate application of the concepts described within the chapter.

			Resource Management Decisions in a Climate Change Context				
Appendix A of NRC Review		Overall, the writing in this chapter is difficult to understand unless you're already familiar with the information; much of it would be inaccessible to lay readers. The chapter would benefit from a re-write to simplify and clarify the language with lay readers in mind. Even the title isn't clear - the lay reader doesn't know what "decision support" refers to. Changing the sub-title would help - e.g., "Bridging the gap between scientific understanding and societal decision-making" (referring back to the language used in Introduction to Response Strategies). Perhaps the definition of decision support that starts the section, "Who are the decision-makers," can be moved to the beginning of the introduction. Lay readers would also appreciate a glossary at the beginning, as can be found in the adaptation chapter.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				Changed subtitle of chapter. The final report will include a glossary. Chapter revised and examples added to enhance clarity. Who are the decision-makers discussion in the introduction has been expanded to better clarify different types of decisions, stakeholders, and levels of decision-making.
Appendix A of NRC Review		Perhaps add a key message prior to the first one listed here, stating that governments, agencies, businesses and individuals are faced with the development of policies and programs to reduce the dangers of climate change impacts, and must do so without knowing precisely how great their future vulnerability to these impacts will be.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		925		Added a key message as suggested.
Appendix A of NRC Review		Key message #2: A one-sentence definition of what is meant by "frameworks" and "tools" would help lay readers.	26. Decision Support: Supporting Policy, Planning, and Resource Manage		925		The message has been amended and the final report includes a glossary.

			ment Decisions in a Climate Change Context				
Appendix A of NRC Review		Key message #3: Lay readers won't understand the points made here. It should be re-stated in simpler language.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		925		The key message has been reorganized and amended to focus on overarching needs related to developing decision support tools and building human capacity.
Appendix A of NRC Review		First sentence of the final paragraph: Either present definitions of the terms used here in a glossary, or add a reference to the page number where the terms are defined more fully.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		926	39	The final report includes a glossary.
Appendix A of NRC Review		The section "What is decision support?" could be clarified; i.e., definitions of processes, decision-support tools and services should be added here. The chapter headings where each of these topics is discussed should use the terms again, so readers can make the connection easily.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions		927	8	The final report includes a glossary. The text and headings have been modified to use matching terminology.

			in a Climate Change Context				
Appendix A of NRC Review		The meaning of "Frame decision" is unclear; replace, perhaps, with "Define the problem," (or the question, or the issue)?	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context	Figure 26.1	928		The figure text has been modified as suggested.
Appendix A of NRC Review		second bullet: risk perceptions ("s" is missing).	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		929	21	Modified text as suggested.
Appendix A of NRC Review		Last sentence on the page: Adding a sentence or phrase defining "multi-criteria analysis" would help lay readers; an example would also be great here.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate		929	38	The specific term "multi-criteria analysis" has been removed from this section. A description of the types of techniques is provided as well as a reference to a later section that provides additional information about such approaches.

			Change Context				
Appendix A of NRC Review		Perhaps change the title to "Decision Support Processes," to clarify the connection between this section to the definition of decision support on p. 927. Would like to see the discussion of boundary processes expanded. The chapter makes clear that this is important, but does not describe who the people are who will do this work, what they will do or how they will do it. This would be valuable information for readers.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		930	1	Title of section has been modified. The discussion of boundary processes has been expanded and examples of such processes and outcomes have been added.
Appendix A of NRC Review		Perhaps change the title to "Decision Support Models and Tools," again to connect the section to the earlier definition of decision support.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		931	1	The section has been made into a box and title modified to help readers understand that this section is meant to provide examples rather than background explanation.
Appendix A of NRC Review		Last sentence has a misstatement; it refers to management of climate extremes - something we wish we could do, but clearly cannot...	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		931	22	Modified text as suggested.

Appendix A of NRC Review		Figure uses the term "multi-criteria evaluation framework," which has not been defined in the text yet; lay readers won't understand this.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context	Figure 26.3	932		The figure caption has been revised.
Appendix A of NRC Review		The figure showing the links between risk assessment, perceptions and management could be dropped - it contains little useful information, and an example demonstrating how this is/has been done effectively would be far more useful to readers. If the figure is retained, something more is needed to clarify how public risk perceptions can be used in risk assessments.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context	Figure 26.5	934		We have developed an example to show the importance of incorporating risk assessment and risk perception in developing risk management strategies.
Appendix A of NRC Review		Last paragraph of the section on risk assessment: Examples would clarify what is meant by exposure, sensitivity and adaptive capacity.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		935	21	A new example illustrates factors involved in evaluating exposure, sensitivity, and adaptive capacity. The final report includes a glossary that will include these terms.
Appendix A of		The definition of risk perceptions is vague and doesn't capture the concept well, and the summary of the relevant research overlooks some of the most important work & insights in this area. Perhaps	26. Decision		935	29	We have expanded the references related to risk perception and climate

NRC Review		include the work by Elke Weber on risk perceptions and climate change. There's much to be said here about the barriers to building public support for mitigation and adaptation policies because risk perceptions are low, and there's a growing literature on how to overcome these barriers.	Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				change.
Appendix A of NRC Review		Risk management strategies section, word missing? "...the private section faces challenges in providing coverage..." -- insurance coverage? An example at the end of this section would be helpful as well.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		936	6	An example has been added to highlight the role insurance can play as a risk management tool.
Appendix A of NRC Review		Scenarios and scenario planning: Lay reader wonders what "framing" refers to in the sentence that begins, "This works well..."	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		937	3	The text has been modified to be consistent with earlier description of steps in decision-making processes.
Appendix A of NRC Review		Lay reader will wonder what is an "end-to-end climate change indicator system".	26. Decision Support: Supporti		938	6	Revised text to clarify the purpose of the indicator system and added references to existing indicator systems.

			ng Policy, Planning, and Resource Management Decisions in a Climate Change Context				
Appendix A of NRC Review		In Box 2, the sentence that begins, "Although values are defined differently..." has an example that's marked off by a dash at the start and a comma at the end. A dash is needed at the end.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		938	16	Modified text as suggested.
Appendix A of NRC Review		This chapter is in some ways exemplary. But it approaches the problem as one of developing and deploying the right tools. Two issues and literatures were notable by their absence. First is the near consensus in NRC documents for almost more than a decade that thinking about linking science to decision making is best approached as linking scientific analysis with public deliberation (NRC, 1996. 1999, 2008. 2010). This chapter discusses the process too often as "speaking truth to power." Given the controversial nature of many tradeoffs that have to be made, more attention should be give to the process of engaging the public as a critical part of decision support. Second is the lack of attention to policy networks rather than to isolated decisions makers. Emerging literature certainly suggests that the most important ways to influence decision making is by thinking about how to influence not single hypothetical decision makers but the networks through which information flows (Frank et al. 2012; Henry 2011; Henry 2009). Working with networks gives great leverage; ignoring them means that decision support tools may have little influence. REFS: *Frank, Ken, I-Chien Chen, Youngmi Lee, Scott Kalafatis, Tingqiao Chen, Yun-Jia Lo, and Maria Carmen Lemos. 2012. "Network Location and Policy-Oriented Behavior: An Analysis of Two-Mode Networks of Coauthored Documents Concerning Climate Change in the Great Lakes Region." Policy Studies Journal 40:492-515 *Henry, Adam Douglas. 2009. "The Challenge of Learning for Sustainability: A Prolegomenon to Theory." Human Ecology Review 16:131-140. *Henry, Adam D and Thomas Dietz. 2011. "Information, networks, and the complexity of trust in commons governance." International Journal of the Commons 5:188-212. *NRC. 1996. Understanding Risk: Informing Decisions in a Democratic Society. *NRC. 1999. Perspectives on Biodiversity: Valuing Its Role in an Everchanging World. *NRC. 2008. Public Participation in Environmental Assessment and Decision Making. *NRC. 2010. Advancing the Science of Climate	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				We have revised the chapter to explicitly discuss networks of decision-makers as well as stakeholder and public deliberation.

		Change.					
Appendix A of NRC Review		The chapter acknowledges the interactive nature of decision making and the need to engage the public (a better term than stakeholders, in my view) in places like 927:36-41 but the idea is not carried through consistently. For example, there is no indication in Figure 26.1 that this could not be done by a group of technocrats working in isolation.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				The figure has been modified to include collaborative processes between stakeholders (public), scientists, and decision-makers and the inclusion of stakeholders and the public have been better integrated in the revised version of the chapter.
Appendix A of NRC Review		The problem also comes up at the end of 929 when a grocery list of techniques is offered. NRC 2008 offers diagnostic questions and best practices that are probably more appropriate here than just a list of methods (some of which are supported by careful evaluations in the literature, some of which are not)	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		929	36	The text has been modified to point readers to discussions of various participations techniques in academic and practitioner literature.
Appendix A of NRC Review		The discussion of risk assessment and risk perception is fairly standard but would benefit greatly by more recent accounts that acknowledge risk processes are embedded in complex social and psychological processes (Renn 2005; Rosa et al. 2013). This discussion is less subtle than it should be, given the contentious nature of many of the decisions that have to be made in dealing with climate change. What is said is not incorrect but it does not go nearly far enough in working through the issues of using a risk frame.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				This section has been revised to illustrate an example of using this risk framework for coastal management decisions in the context of climate change. Appropriate references have been included to support the discussion.
Appendi		It seems odd that the chapter never mentions trust. A substantial body of literature demonstrates the	26.				We have added some discussion and

x A of NRC Review		crucial importance of trust in making collective decisions and that trust is very fragile (Fehr 2009; Henry and Dietz 2011; Leach and Sabatier 2005; Siegrist et al. 2007). This is especially true given the complex nature of U.S. public views on climate change and especially the differing views about science in the public (McCright and Dunlap 2010; McCright and Dunlap 2011) (This gets back to the issue that the chapter sometimes reads as if the decisions were being made only by corporate executives with more or less absolute authority when many of the most important decisions will be made by elected or appointed public officials.) REFS: *Fehr, Ernst. 2009. "On the Economics and Biology of Trust." Journal of the European Economics Association 7:235-266. *Henry, Adam D and Thomas Dietz. 2011. "Information, networks, and the complexity of trust in commons governance." International Journal of the Commons 5:188-212. *Leach, William D and Paul A Sabatier. 2005. "To Trust an Adversary: Integrating Rational and Psychological Models of Collaborative Policymaking." American Political Science Review 99:491-503. *Siegrist, Michael, Timonty C Earle, and H Gutscher. 2007. Trust in Cooperative Risk Management: Uncertainty and Skepticism in the Public Mind. London: Earthscan. *McCright, Aaron M and Riley E Dunlap. 2010. "Anti-Reflexivity: The American Conservative Movement's Success in Undermining Climate Science and Policy." Theory, Culture, and Society 27:100-133.. *McCright, Aaron M and Riley E Dunlap. 2011. "The politicization of climate change and polarization in the American public's views of global warming, 2001-2010." Sociological Quarterly 52:155-194.	Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				references related to trust, but have not been able to include an extended discussion due to space constraints in the chapter.
Appendix A of NRC Review		What is a group value (other than the average of individual values? Perhaps what is meant is group norms.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		929	7	The text has been modified to clarify use of the word "value".
Appendix A of NRC Review		One could argue those interested in a decision, even if they don't have a direct or indirect "stake", certainly have a right to engage.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change		929	17	Modified text to also include this concept.

			Context				
Appendix A of NRC Review		Discussion of scenarios and scenario planning should mention Robinson's work on "backcasting" which is one of the origins of this approach (Robinson 1988).	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		937	3	Citation added as suggested.
Appendix A of NRC Review		It is common for discussions of values and valuation to get muddled. Elsewhere in the chapter there is reference to individual values, that is those things that people consider important, which is different from the outcome of asking them to do a valuation (Dietz et al. 2005). It would be helpful to police this throughout the chapter.	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context		938	18	We have reviewed the use of these terms throughout the chapter and believe the meanings are now clear.
Appendix A of NRC Review		Some examples of studies that examine real-world decision-support efforts: *Ferguson, D. (2009). Evaluating climate assessment and translational science efforts in the US Southwest: Lessons from a CLIMAS pilot evaluation project. Presentation at the Climate Prediction Applications Science Workshop, March 24-27. *McNie, E. C. (2008). Co-Producing Useful Climate Science for Policy: Lessons from the RISA Program. Environmental Studies Program. University of Colorado, Boulder. *Pulwarty, R. S., C. Simpson, and C. R. Nierenberg. (2009). The Regional Integrated Sciences and Assessments (RISA) Program: Crafting effective assessments for the long haul. In: C. G. Knight, and J. J_ger, editors. Integrated Regional Assessment of Global Climate Change, Cambridge University Press, . *Bales, RC, DM Liverman, and BJ Morehouse. (2004). "Integrated assessment as a step toward reducing climate vulnerability in the southwestern United States." BAMS. 85:1727-1734. *Lemos, MC and BJ Morehouse. (2005). "The co-production of science and policy in integrated climate assessments." Global Environmental Change Part A 15:57-68. *Miles, EL, AK Snover, LCW Binder, ES Sarachik, PW Mote, and N Mantua. (2006). "An approach to designing a national climate service." PNAS 103:52. *Kirchhoff, Christine J. "Understanding and enhancing climate information use in water management." Climatic Change (2013): 1-15. *Lemos, M. C., C. Kirchhoff & V. Ramparasad (2012) Narrowing the Climate Information Usability Gap. Nature Climate Change, 2, 789-94. *NRC. 2008. Public Participation in	26. Decision Support: Supporting Policy, Planning, and Resource Management Decisions in a Climate Change Context				Thank you for these examples and references; we included those that supported our revised text.

		Environmental Assessment and Decision Making, National Academy Press. *Dilling, L and Lemos,MC. 2011. "Creating usable science:Opportunities and constraints for climate knowledge use and their implications for science policy." Global Environmental Change 21:680-689. *Moser, Susanne C and Julia A Ekstrom. 2010. "A framework to diagnose barriers to climate change adaptation." Proceedings of the National Academy of Sciences 107:22026-22031.					
Appendix A of NRC Review		Surely this is a chapter in which there should be at least one key message about the GHG emissions of other nations and the basis for American policy to mitigate on an international basis. At present there is only a simple statement of the rapid pace of GHG emissions, as compared to benchmark scenarios. Yet a discussion of the shortcomings of the FCCC (well known in the policy literature) would seem to fall within the scope of the NCA. It would also of course be good to outline the state of knowledge about constructive steps going forward.	27. Mitigation				We quote the NAS regarding the need for a strong US role in reducing emissions. Further discussion of the international negotiation process is beyond the current scope of the chapter, which has been focused on US domestic actions.
Appendix A of NRC Review		Caption should make clear that "sink" does not mean that CO2 is removed from the atmosphere or water column so that the radiative forcing and acidification processes have taken place, and will continue to do so. This is in contrast to the portion that goes into long-term storage in land and in deep sediments.	27. Mitigation	Figure 27.1	957		This is standard scientific notation for carbon budgets.
Appendix A of NRC Review		Should cross-reference Ch. 13 (land use) and 16 (biogeochemistry).	27. Mitigation		962	15	Citations to those chapters have been added.
Appendix A of NRC Review		Key messages contain vague language ; e.g. "within a few years". Msg 3 covers intensity history but omits absolutes. Msg 4 should include ", without other actions" as a caveat, as stated the msg assumes no action. Msg 5 is vague if "lower emissions' is net, gross or based on some other metric.	27. Mitigation				Details for these key messages are in the text or figures/tables.
Appendix A of NRC Review		Section on co-benefits is particularly weak, with old references. Suggest revising and updating references. Kri Ebi can help with that. REF: P. Epstein at Harvard also has recent work. Annals, NY Acad Sci, 1219, Ecol Econ Review Feb 2011.	27. Mitigation				The Co-Benefits box has been expanded, adding new references including one suggested by the reviewer.
Appendix A of NRC Review		Renewables should include all, not just wind solar and biomass (e.g., hydro, geo, kinetic, etc)....	27. Mitigation				We have edited to make clear that "wind, solar and biofuels" are just examples from a longer list of renewable energy sources.
Appendix A of NRC Review		Infers that Ôthese' technologies are only in the R&D phase, vs commercial. Suggest rephrasing to "market maturity". RETs were $257B of economic investment in 2011 and nearly 50% of all new power capital expenditures.	27. Mitigation		966	9	We have edited the text to incorporate this concern. The reviewer's suggested wording has been adopted.
Appendix A of NRC Review		Under research needs, the last bullet under social and behavioral sciences is important but the chapter is missing any text on the subject.	27. Mitigation				We have added a phrase/sentence to highlight that the behavioral and social science aspects of mitigation strategies are poorly understood.
Appendix A of NRC Review		The chapter is clear in its presentation of what it covers and I found no obvious errors. That's not surprising given the quality of the writing team. But I don't think it does justice to the best ways to think about problems of mitigation, particularly in a context where considerable attention should be paid to both the potential effects of climate change on mitigation and on the interplay between mitigation and adaptation efforts. That is, there should be a tighter connect between this chapter and	27. Mitigation				We have discussed the coordination between the Energy chapter and the Mitigation chapter, and decided to focus the latter on describing activities and effectiveness of current actions.

		Chapter 3-Energy Supply and Use. The authoring team is composed of top scholars on the economics, engineering and modeling of energy and greenhouse gas emissions, but they seem to be missing a good bit of recent literature that is relevant to this chapter.					The section on measures has been strengthened, including a reference to the Energy Chapter.
Appendix A of NRC Review		The list of factors here are appropriate for an IPAT/Kaya sort of decomposition. (See: http://www.nature.com/nclimate/journal/v2/n8/box/nclimate1506_BX1.html). But that approach masks the fact that there are decisions underpinning all these factors and that over the last decade or so we have learned a great deal about drivers. A substantial literature examines drivers and their dynamics (for reviews see: Levy and Morel 2012; Rosa and Dietz 2012). While this report may not want to get into details on current understanding, the IPAT/Kaya formulation is too simplistic, does not reflect the state of the science and implies a mechanistic response to reducing emissions. Recent work shows that substituting renewables for fossil fuels yields a less than proportional reduction in fossil fuel use. That is an important finding for understanding policy impacts (Jorgenson 2012; York 2012).	27. Mitigation		959	25	The Kaya decomposition is simply an accounting of factors that contribute to greenhouse gas emissions. It is not by itself a statement of mechanisms, nor do we portray it as such. We cannot go into great detail on specific policy measures to treat all the possible driving factors that lead to observed emissions.
Appendix A of NRC Review		The rest of the paragraph reveals the limits of the framing—it seems to imply that only prices and "autonomous" technological changes matter. This stark statement is incorrect because it greatly oversimplifies. The rest of the chapter restricts consideration to this narrow scoping save for a few minor nods to voluntary programs. The analysis ignores shifts in preferences among the public, demographic shifts more complex than simple population growth, etc.. For example, ongoing shifts in dietary preferences can have a huge impact on emissions (Carlsson-Kanyama and Gonz‡lez 2009; Popp et al. 2010; Stehfest et al. 2009; York and Gossard 2004). Changes in number of households seems to have more impact on the environment and probably on emissions than changes in the size of the population per se (Cramer 1997; Cramer 1998; Knight and Rosa 2012; Liu et al. 2003). There are many more examples of well researched understandings of drivers that are masked by this simple formulation. The framing matters because the effects of climate change on emissions and the interplay between adaptation and mitigation requires a more nuanced understanding than IPAT/ Kaya formulation and the unitary focus on prices and technological change allows. A decade ago there was little research going beyond this simple approach, now there is. The report should reflect the state of the science. In addition, see: Rosa, Eugene A and Thomas Dietz. 2012. "Human Drivers of National Greenhouse Gas Emissions." Nature Climate Change 2:581-586.	27. Mitigation				Sentences have been added to address this gap. But the chapter cannot devote space to a full review of this literature.
Appendix A of NRC Review		The limitations of this approach are striking in the lack of consideration of the "energy efficiency gap" (Hirst and Brown 1990; Jaffe and Stavins 1994). The gap is far from trivial. It has been estimated that, in the U.S. household sector alone, closing the gap using on-the-shelf technology and minor behavioral changes could reduce total U.S. GHG emissions by over 7% (Dietz et al. 2009). Nor are differences in program effectiveness minor, as seems to be implied in the traceable account (p. 975). In fact, different implementation strategies used with identical technologies and identical financial incentives can produce results that vary in success by an order of magnitude (Stern et al. 2010). REFS: *Dietz, T., G.Gardner, J.Gilligan, P.Stern, and M.Vandenbergh. 2009. "Household Actions Can Provide a Behavioral Wedge to Rapidly Reduce U.S. Carbon Emissions." Proceedings of the National Academy of Sciences 106:18452-18456. *Dietz, T., P.Stern, and E.Weber. 2013. "Reducing Carbon-Based Energy Consumption through Changes in Household Behavior." Daedalus 142:78-89. *Jones, Christopher and Daniel M Kammen. 2011. "Quantifying Carbon Footprint Reduction Opportunities for U.S. Households and Communities." Environmnental Science and Technology 45:4088-4095. *Stern, P., G. Gardner, M. Vandenbergh, T.Dietz, and J.Gilligan. 2010. "Design Principles for Carbon Emissions Reduction Programs." Environmental Science and Technology 44:4847-4848. *Thollander, Patrick and Jenny Palm. 2013. Improving Energy Efficiency in Industrial Energy Systems: An Interdisciplinary Perspective on Barriers, Energy Audits, Energy Management, Policies, and Programs. London: Springer *Vandenbergh, M., P.Stern, G.Gardner, T.Dietz, and J.Gilligan. 2010. "Implementing the Behavioral Wedge: Designing and Adopting Effective Carbon Emissions Reduction Programs." Environmental Law Review 40:10547-	27. Mitigation				Sentences have been added in the last section to address this gap. But the chapter cannot devote space to a full review of this literature.

		10554.					
Appendix A of NRC Review		The relationship between emissions and concentrations is widely misunderstood, even by many with training in science . Perhaps another paragraph, a diagram or perhaps a box might make a contribution to better public understanding of this issue.	27. Mitigation		958		We're up against space limitations in the chapter, and feel that we've made this point sufficiently clearly already.
Appendix A of NRC Review		"Forestry" should be "Forest" in the figure.	27. Mitigation	Figure 27.3	961		The caption has been clarified
Appendix A of NRC Review		Generally a good and balanced view of mitigation topics, however, many topics were not covered in this chapter and their absence leads to incomplete and potentially misleading information for the reader. Topics that are important to consider are:	27. Mitigation				The chapter does a short comparison of the range of RCP's with the SRES scenarios analyzed in the impacts-related components of the NCA. The climate science chapter makes the point that future climates are strongly dependent on which emissions trajectory the world ends up on. It is beyond the scope of the NCA to suggest particular policy options that would be required to meet any policy target. We don't have the space to do a complete review of all emissions trajectories in the literature. But the section on policy measures has been strengthened, without making specific recommendations.
Appendix A of NRC Review		Different emission scenarios and different pathways. The SRES scenarios chosen for this study are 'no additional climate policy' scenarios, whereas this chapter seems to seek to match the timing of the B2 scenario with mitigation policy. The RCPs exhibit different pathways that are not monotonically associated with their stabilization level. Further exploration of pathways would test and might better illustrate what seems to be a thesis for this chapter -- that we have only a few years for mitigation. IPCC AR5 will assess hundreds of scenarios based on recent literature, and the EMF study referenced in the NCA report (Clarke et al, 2009) includes tens of scenarios that show different pathways to stabilization at different levels. In these scenarios, the relation between near-term emissions trajectories (e.g. 2005-2010) and the outcome in 2100 are largely unrelated (as can be seen in NCA figure 1.1).	27. Mitigation				The chapter does a short comparison of the range of RCP's with the SRES scenarios analyzed in the impacts-related components of the NCA. The climate science chapter makes the point that future climates are strongly dependent on which emissions trajectory the world ends up on. It is beyond the scope of the NCA to suggest particular policy options that would be required to meet any policy target. We don't have the space to do a complete review of all emissions trajectories in the literature. But the section on policy measures has been strengthened, without making specific recommendations.
Appendix A of NRC		Economic efficiency and distributional effects of policies being considered in the chapter. For instance: *NRC, 2010. Limiting the Magnitude of Climate Change. National Academy Press (p.174-182) *Casillas, C E and D M Kammen. 2012. "Quantifying the social equity of carbon mitigation strategies." Climate	27. Mitigation				The chapter does a short comparison of the range of RCP's with the SRES scenarios analyzed in the impacts-

Review		Policy 12:690-703. *Gough, Ian. "Carbon mitigation policies, distributional dilemmas and social policies." Journal of social policy 42, no. 02 (2013): 191-213.					related components of the NCA. The climate science chapter makes the point that future climates are strongly dependent on which emissions trajectory the world ends up on. It is beyond the scope of the NCA to suggest particular policy options that would be required to meet any policy target. We don't have the space to do a complete review of all emissions trajectories in the literature. But the section on policy measures has been strengthened, without making specific recommendations.
Appendix A of NRC Review		The effectiveness of a set of policies that are not comprehensive (both within the U.S. and globally) to reach various levels of mitigation.	27. Mitigation				The chapter does a short comparison of the range of RCP's with the SRES scenarios analyzed in the impacts-related components of the NCA. The climate science chapter makes the point that future climates are strongly dependent on which emissions trajectory the world ends up on. It is beyond the scope of the NCA to suggest particular policy options that would be required to meet any policy target. We don't have the space to do a complete review of all emissions trajectories in the literature. But the section on policy measures has been strengthened, without making specific recommendations.
Appendix A of NRC Review		The shift to natural gas in the U.S. has made a large contribution to changing the trajectory of US GHG emissions. Some discussion, connection with the energy chapter, and discussion of what is causing limits to this shift both in the US and internationally would be timely.	27. Mitigation				Coverage of the role of natural gas in falling US emissions has been added.
Appendix A of NRC Review		Most other chapters were organized around the key messages. In other words, each key message was presented, followed by the text specifically supporting that key message. That is not the structure of this chapter. Is there a reason that this chapter departs from the other structure?	27. Mitigation				We felt the current organization was most appropriate for this chapter.
Appendix A of NRC Review		Given the beginning of this sentence, should it read "greenhouse gas emissions IN THE U.S. are expected to continue to rise."?	27. Mitigation		955	33	This has been corrected to be consistent with the most recent EIA projections.
Appendix A of NRC		This key message refers to aging forests as the reason the carbon sink from forests is expected to decrease. But this is not the same message as one gets from the discussion on p. 962.	27. Mitigation		955	34	We have edited the key message to be more clearly consistent with the text. We have added the same words from

Review							the text to Key Message #4, and in its description in the traceable accounts.
Appendix A of NRC Review		In what sense does the chapter provide an "analysis" of activities contributing to emissions? What type of "analysis"?	27. Mitigation		956	16	We have replaced "analysis" with "survey" to more accurately portray the contents of the chapter.
Appendix A of NRC Review		The heading here is "Industrial Emissions" and yet the discussion is broader than that. For example, the second paragraph refers to other sources. But then the discussion of "driving forces" seems to be back to focusing on industrial emissions. Where the discussion refers to industrial emissions and where it refers to total emissions should be clarified.	27. Mitigation		959	12	The section has been re-written to clarify these points, and citing a more recent analysis on historic US emissions.
Appendix A of NRC Review		Why are these projections included here? And don't trends/projections depend on policy decisions? A clearer indication of the assumptions underlying these projections (e.g., BAU) is needed here.	27. Mitigation	Figure 27.2	960		The figure on drivers of U.S. fossil emissions has been replaced with a more recent analysis, and the new figure does not include a projection, removing this issue.
Appendix A of NRC Review		Why does Table 27.2 appear in the text before Table 27.1?	27. Mitigation		962	40	The tables have been renumbered.
Appendix A of NRC Review		The categorization here (R&D and commercialization/development) doesnt seem like a useful categorization of the actions in use, and Table 27.2 does not make use of this categorization. What about regulatory approaches? A glaring omission here are automobile fuel economy standards (CAFf), which are not voluntary standards. Although CAFE is included in Table 27.2, it is not included in the text, which leaves the reader with the impression that there are no regulatory approaches being used.	27. Mitigation		962	40	CAFE is covered; it's the first item in the table on sample federal mitigation measures.
Appendix A of NRC Review		What does it mean to "manage the economic costs"?	27. Mitigation		965	9	Changed "manage" to "limit" for clarity.
Appendix A of NRC Review		There is an important distinction between technologies that are technologically feasible and those that are economically competitive at current prices. This distinction needs to be clearly made. More generally, there is a key distinction between the technological feasibility of mitigating emissions and the incentives in place to do so.	27. Mitigation		965	40	After consideration of this point, we still feel the existing text is clear and accurate.
Appendix A of NRC Review		It is useful for this chapter to have a research needs section. A comparable section was not included in the other chapters, but perhaps it should be.	27. Mitigation		967		Thank you.
Appendix A of NRC Review		This last research need seems correct, but not well supported by any of the discussion in this chapter. More discussion is needed in the text to lead up to this research need. Also, while there is reference to "regulatory and subsidy programs", it is notable that there is no reference to a tax-based policy (such as a carbon tax or cap-and-trade system). One understands the need to avoid an appearance of suggesting a particular policy approach, but referencing regulatory and subsidy approaches without referencing tax-based policies (the instrument of choice for most economists) by itself seems to implicitly signal a preference for these approaches over tax-based policies. This is inappropriate. Perhaps simply refering to the costs and effectiveness of both voluntary mitigation efforts and "alternative government policies aimed at increasing mitigation."	27. Mitigation		967	16	Additional discussion of policy measures have been added earlier in the chapter

Appendix A of NRC Review		This chapter is well-written - clear, easy-to-read, with a great deal of valuable information. But the authors should reduce the use of acronyms wherever possible - they force readers to keep looking back in the text to recall the acronym's meaning.	27. Mitigation				Acronyms have been removed where possible.
Appendix A of NRC Review		In the first paragraph of the emissions section, the sentence that begins "These gases cause radiative 'forcing'... will be difficult for many lay readers to understand.	27. Mitigation		956		The following phrase explains the term in close to layman's language.
Appendix A of NRC Review		The fourth paragraph contains a central point about the stabilization of CO2 emissions - a figure illustrating this point would be useful for emphasis and clarity.	27. Mitigation		958		We're up against space limitations in the chapter, and feel that we've made this point sufficiently clearly already.
Appendix A of NRC Review		Industrial emissions: A definition of flaring would be useful, and the last paragraph on the page could be clarified and simplified.	27. Mitigation		959		The section has been re-written to be clearer.
Appendix A of NRC Review		What emissions scenario is being used here?	27. Mitigation	Figure 27.2	960		The figure on drivers of U.S. fossil emissions has been replaced with a more recent analysis. The new figure does not include a projection, so this issue no longer arises.
Appendix A of NRC Review		In the first paragraph on land use, reverse the order of the sentences so that stocks and flux are defined before they're discussed.	27. Mitigation		961		A helpful suggestion, and the sentences have been reversed.
Appendix A of NRC Review		Box on co-benefits: The meaning of the sentence beginning , "Methane reductions have also..." isn't clear.	27. Mitigation		964		We have clarified the sentence.
Appendix A of NRC Review		The chapter lacks an analysis of how knowledge enters into adaptation; this is essential to an assessment of the knowledge that exists or does not. While one might infer a latent theory of how knowledge enters into adaptation from the case studies, that would indicate starting with the cases--and a reasoned statement of how they were chosen and what they illustrate. As it is, the chapter begins with a long discussion of existing activities devoted in part or whole to climate adaptation, with several listings that appear to be illustrative of the scope of activities. How this fits into an assessment of knowledge isn't made clear, though. There does not appear to be an analytical principle underlying the selection of activities summarized. The assessment document might do well to draw on existing conceptual frameworks that describe the kinds of knowledge needed to assess and reduce vulnerabilities to climate change and therefore the progress of efforts to advance adaptation. Examples include NRC (2009, 2010, 2013) and IPCC (2012). The assessment could either adopt one of the frameworks in the literature or develop a new one building on the literature. As it is, the re-compilaton and expansion of the lists of activities in map form does not add anything. These lists of activities are followed by a discussion of the adaption "process" (998-1000) that indicates an absence of knowledge or process for accumulating reliable knowledge as climate becomes increasingly non-stationary. This may indicate that the considerable efforts aimed at adaptation will be faced with continuing surprises. If that is the state of knowledge, it is salient to note that congressionally approved aid for Sandy ($60	28. Adaptation				While we agree with many of the components of this comment, the full breadth of the comment is outside the scope of our chapter. We have added the idea of iterative learning, learning from pilots, and urge the readers to read the relevant and much longer NRC reports referenced. We added the reference on the new NRC report "Climate and Social Stress" to the chapter.

		billion) is larger than the public debt of all 50 states (about $50 billion). The cost of surprise, in human, ecological, and economic terms provides a way to articulate the value of reliable knowledge, applied in a coherent fashion. This does not seem to be in the chapter as drafted, however. REFS: *IPCC 2012. Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the IPCC . Field, C.B., et al, eds. Cambridge, UK, and New York, NY: Cambridge University Press. *NRC, 2009. Informing Decisions in a Changing Climate. *NRC, 2010. Adapting to the Impacts of Climate Change. *NRC, 2013. Climate and Social Stress: Implications for Security Analysis.					
Appendix A of NRC Review		The entry for New York, describing flood planning with FEMA, is poignant in the wake of Sandy. Have there been changes since the storm struck?	28. Adaptation	Table 28.3	993		Thank you for your comment. The authors have added some short material about Hurricance Sandy and the national response. Unfortunately, due to space limitations, more information could not be added.
Appendix A of NRC Review		This listing of barriers stands in interesting contrast to the discussion of decision support in Ch. 26. Virtually none of these barriers can be hurdled by knowledge alone.	28. Adaptation	Table 28.7	1005		Thank you for your comment. The authors agree with the commenter. However, no change was made to the text.
Appendix A of NRC Review		The underlying premise of these paragraphs is that getting organizations to work together will overcome the barriers laid out in 1005. That is not plausible.	28. Adaptation		1006	1	Thank you for your comment. We have edited the text to integrate the points.
Appendix A of NRC Review		What is the framework within which these lines of research appear to be compelling? Are they ripe from the standpoint of science? Is the need so urgent, given observed changes that may be related to a non-stationary climate that the research should be funded even without good ideas of what to do? These conceptual frameworks in the adaptation literature noted above can also be useful in justifying and setting priorities for lines of research.	28. Adaptation		1007	2	Thank you for your comment. The authors are aware of near-term research needs that have been identified in many of the seminal reports, ranging from the 10-year Global Change Plan, to America's Climate Choices by the NRC, to the IPCC reports,etc. To reflect this, the authors have added some references where appropriate.
Appendix A of NRC Review		The compilation of lists in the chapter, without an articulation of how they were chosen, makes it hard for the reader to grasp how authors could dismiss the questions of uncertainty and confidence. What one might infer from the list-making is that earnest people in a wide range of institutions are raising awareness of climate change by doing things that respond to anticipated stresses from a changing climate. These things are not coherent in the aggregate, and they will not forestall surprises like Sandy (which struck what is arguably the most alert city in the nation). So grouping them together as adaptation asserts a wholeness that is absent. It is that finding, about the lack of coherence in the use of climate science, that may be most important in a national assessment, particularly as the nation awakens to the reality of a non-stationary climate.	28. Adaptation		1014		The authors do not think, nor do they claim, that the compendium is a coherent whole. We have identified there are lots of beginnings and a need for much more coordination. We cannot assess the success of adaptation responses (we really don't know what is enough; so we had to choose illustrative examples of actions happening around the country. We make no assessment of whether or not these are the right, the best, or the most successful actions.) The authors have provided some clarifying text to

							describe the intent of the compendium.
Appendix A of NRC Review		Surely there are uncertainties about multiple stresses that lead to issues of confidence? This would seem to be logically connected to social choices about how urgent the multiplicity of stressors is as a cause of problems and surprises.	28. Adaptation		1018		We thank the commenter for this comment. No action is taken on this comment because as we discussed, there is no comprehensive adaptation evaluation metric to measure or evaluate the success of adaptation activities. Multiple stressors certainly exist. As we discuss, the challenge in this active research area is how to evaluate the success of the adaptation activity itself.
Appendix A of NRC Review		This chapter mainly assesses the state of adaptation planning activities around the country, but does not assess vulnerability or adaptive capacity. Should it? Or is this the job of the regional and sectoral chapters?	28. Adaptation				Thank you for your comment. This was the job of the regional chapters, so no changes were made to the adaptation chapter.
Appendix A of NRC Review		Earlier chapters do not take a consistent approach to assessing vulnerability or distinguish all the aspects of vulnerability. The term also seems to be used inconsistently. For example, in Chapter 16 (Northeast), Key Message #1 says that flooding "will increase the vulnerability of the region's residents, especially populations that are already most disadvantaged" (549.16-17). "Vulnerability" here apparently means harm or damage. Elsewhere, it seems to mean exposure: "Historical settlement patterns and on-going investment in coastal areas and along major rivers combine to increase the vulnerabilities of people in the Northeast to sea level rise and coastal storms" (557.21-23). Chapter 11 (Urban) treats vulnerability in more detail and with more coherence.					Thank you for the comment. In revising the report, the authors have worked to make use of "vulnerability" more consistent.
Appendix A of NRC Review		The chapter notes that evaluation of adaptation mainly uses "process-based rather than outcome-based indicators" (1000.4-5), but the research section does not identify a need to develop outcome indicators. Such indicators presumably would be measures of vulnerability, adaptive capacity, coping capacity, etc.	28. Adaptation				Thank you for your comment. In the section on monitoring and evaluation, we talk about new research efforts in the outcome based/indicator world, so we did not list that in the very short research section. However, we point the readers to references that detail this more thoroughly.
Appendix A of NRC Review		The chapter focuses on providing an insight into what is happening - and to some extent, not happening - in relation to adaptation to climate change (CCA) is the U.S.. In that context, it does provide an entry point to activity on adaptation in the U.S., but it fails to deal effectively with the barriers to further progress and the most promising opportunities. Some examples: The chapter quickly (pg 984 ln 20) takes up the common refrain that adaptation is difficult because we do not have adequate climate projections. Is this really a major barrier in a technologically sophisticated and well-educated country with access to the best of environmental information, modeling expertise and decision making techniques? If it is, why then have many European countries, and Australia and Canada, apparently made more progress in tackling adaptation? Yes, lack of precise projections is often cited as a barrier, but here I would have expected this idea to be analysed in more detail. Given adaptation's entanglement with many other stressors and societal goals, where is the analysis of whether the uncertainties in climate projections are any greater impediment to action than other socio-economic projections?	28. Adaptation				The reviewer raises a good point. The literature is not very instructive on this point. What is happening in Europe is not always instructive. In many cases, the Europeans have focused on a single projection of climate change. It is not clear that is a better way to proceed than trying to consider a range of potential changes in climate. Our statement reflects what is widely reported as barriers and our own experience. We agree with the reviewer that in spite of uncertainties,

							adaptation measures can be taken. No change was made to the chapter.
Appendix A of NRC Review		The chapter repeats the point that most agencies/actors are engaged only in planning and not implementation. This is true and a numerical inevitability of any new and developing activity. But the discussions of the barriers to more implementation are shallow. We have a comprehensive table of dot points; some U.S. specific, others very generic and often more applicable to developing countries. But it is not a huge help on where to focus efforts.	28. Adaptation				Thank you for your comment. The chapter presents a broad overview of measures by different actors, barriers and other topics. Given the length allowed for the chapter, we view this overview as being helpful, but not as in-depth as the reviewer wishes. Such an in-depth analysis may well require an entire study devoted to adaptation. Unfortunately, that is outside the scope of this chapter, so no change was made.
Appendix A of NRC Review		The section on overcoming the barriers simply lists the need for more cooperation. NIDIS is a good example of the problems with progressing adaptation in the U.S., but not necessarily a Ôbest practice' example. The services it provides is excellent and needed - with or without climate change, but its engagement with climate change has, by my reading, been fraught with problems. It's web page introduction links its existence to NOAA's climate related goals that include climate change, but its direct engagement with climate change issues appear to be driven mainly by that of the First Nation users and subject to political debate (see House Committee on Science, Space & Technology hearing on July 25th 2012). NIDIS could be used as an excellent case-study of Federal institutional issues but it will require greater depth of analysis than here.	28. Adaptation				We thank the commenter for this opinion. The author team feels that the NIDIS is an example of a good practice and cooperation. The issues cited by the commenter appear to be beyond the scope of assessment. Therefore, no change was made.
Appendix A of NRC Review		Other issues that are contentious within the global adaptation debate but are only mentioned in passing in the chapter include "is mainstreaming adaptation the way ahead and what does this mean in practice?" and the process and interpretation of benefit cost analysis in adaptation decision making. Maybe this is asking more of the authors than what can be achieved within the context of the NCA. But GCRA Section 106 seems to be requesting this sort of advice. Adaptation very specifically raises the issues of "global change" v "climate change" and, possibly more importantly, just what constitutes science. There is a need for a better treatment of the social, behavioural and economic disciplines, but there still seems to be an over-powering caution amongst the climate change community in assessing and interpreting these fields.	28. Adaptation				We thank the commenter for this comment and agree that this is asking more of the authors than can be achieved. However, we try to point readers to references that flesh this out more fully. We explicity call out social science now in the research needs.
Appendix A of NRC Review		The authors indicate in the chapter introduction that they will highlight "efforts at the federal, regional, state, tribal, and local levels, as well as initiatives in the corporate and non-governmental sectors to build adaptive capacity and resilience towards climate change." What this means is that adaptive activities that are under way are not being given much emphasis. This is an important point; many of the activities discussed in the chapter involve planning to act, or establishing frameworks for action in the future, as opposed to adaptive activities that are under way. It would have been nice if the authors had been more clear on this point, or if they could have organized chapter discussions along those lines. Which actors are getting ready to plan, which are planning, which have adopted plans, and which are implementing plans? Where is most of the attention currently focused? What is the status of adaptation measures overall? Much of the chapter consists of laundry lists of measures that are being undertaken around the country (see Table 28.6), again without any effort to develop a typology of those activities. Can't these efforts be classified and presented in a more systematic way?	28. Adaptation				We thank the reviewer for the suggestion. Recognizing that adaptation activities are rapidly evolving, the authors did not integrate this comment into the revised chapter since activities could advance over the next 6 months. However, most efforts are still only in the planning phases, as identified in the text.
Appendix A of		Regarding climate change and extreme events, the authors seem to have missed some opportunities to make connections. For example, the Disaster Mitigation Act of 2000 required states, local jurisdictions,	28. Adaptati				Thank you for your comment. The authors have added reference to the

NRC Review		tribal governments, and U. S. territories to develop plans for mitigating hazards to which they are exposed. Pursuant to the law, tens of thousands (literally) of hazard mitigation plans have been developed and submitted to the Federal Emergency Management Agency. A very small amount of research has been undertaken—mainly at the University of North Carolina and Texas A&M—to assess the content and quality of some of those plans, mainly plans in coastal areas. It would seem useful to explore the extent to which climate hazards are being incorporated into those plans (they have to be updated regularly) and the extent to which plans for mitigating floods, coastal hazards, wildfires, and other climate-related hazards, if implemented, might also help reduce vulnerability to climate-related hazards. The Army Corps of Engineers, which has major responsibilities for flood control nationwide, is attempting to take climate change into account. Community flood loss-reduction measures are currently rated for purposes of setting flood insurance premiums under the National Flood Insurance Program—what's called the Community Rating System. What communities are incorporating climate change into their flood loss reduction plans? Do such measures increase adaptive capacity for climate-related hazards? Is the CRS a useful tool for encouraging climate change adaptation in flood-prone areas? What is going on with federal and state coastal zone management programs? What adaptive actions have been stimulated by California's AB 32 and other state legislation?	on				long history of thinking about dealing with climate variability (Lamb, 1982), and included two comments directly referencing the Hurriance Sandy response and recovery effort. We also point out many examples in the local and regional decriptions of building on disaster preparedness activities. We also hope that readers will go to the many authoritative refs on regional work that can go into more detail than we can in our few pages.
Appendix A of NRC Review		The chapter indicates that "areas of needed research include...adaptation to extreme events," but it is unclear how much the authors are aware of existing research in that area. Much of what has been learned from 60 years of research on adaptation to extreme events is transferrable to both research and practice on climate change adaptation (see, for example, the NRC report Facing Hazards and Disasters: Understanding Human Dimensions). The authors could have placed more emphasis on these natural connections. For example, the extreme events literature contains typologies of forms of adaptation and provides important insights on barriers to the adoption and implementation of loss-reduction measures for extreme events such as hurricanes and floods, as well as factors that facilitate adaptation, such as state-level enabling legislation and the presence of loss-reduction coalitions and advocates. The U.S. has done more of this kind of research than any other country, beginning with the seminal work of geographer Gilbert White, and this literature should be tapped for its many insights.	28. Adaptation		1007		We have included more references in the text and to additional resources that support this point. Because of space limitations, we couldn't go into this in any detail.
Appendix A of NRC Review		It is surprising that the chapter's discussions on barriers to implementation of adaptation action make no mention of the fact that there are organized movements in the U.S. that oppose climate change adaptation. This is a politically sensitive topic, but it is intellectually problematic to argue that "lack of funding, policy and legal impediments, and difficulty in anticipating climate-related changes at local scales" constitute important barriers without also noting that in the U. S. there are groups that actively oppose such measures, because they are framed as part of the U. N.'s "Agenda 21," or advocated by ICLEI, or because adaptive measures interfere with property rights, or because they could constitute illegal "takings." Including this kind of information in the NCA may be viewed as a non-starter, but the fact remains that a number of politically active local groups have opposed climate change adaptation measures on these grounds, and there are movements that oppose sustainable growth and development planning, comprehensive land-use planning, and other measures that could include climate change adaptation. This opposition is an empirical fact, and it should be acknowledged in the NCA. Like other chapters in the report, this one is curiously devoid of references to the political and economic interests that are active in the climate change arena. The avoidance of these empirical facts is understandable, but it results in an incomplete picture of the current climate-change action landscape	28. Adaptation				Thank you for your comment. The chapter mentions that a barrier is conflicting values and risk perceptions. This is a broad and complex topic, which given the word constraints, needs to be dealt without going into depth. As such, no additional text was able to be added.
Appendix A of NRC Review		Update building and landscaping codes to "protect against disease vectors?" This seems like a stretch.	28. Adaptation		984	17	We thank the commenter for this question about clarity. An example of what this statement is trying to convey is the idea that landscaping codes can

							affect changes in in water usage and minimize standing and stagnant water, minimizing conditions that breed disease vectors. Because of the relevance of this subject, no change was made.
Appendix A of NRC Review		It's reasonable to talk about risks, but shouldn't we be balanced? What about the opportunities? Risk is something that all businesses face, and it's hard to make a compelling case for risks given our high level of uncertainty. However, we might think about the opportunity space.	28. Adaptation		995		We agree with the commenter that indeed there are oportunities as well. Table 28.5 gives examples of companies that are taking adaptation actions, which will include taking advantage of new supply opportunities, new formulations of products and other services that could add business opportunities. No additional changes were made.
Appendix A of NRC Review		The discussion of the adaptation process is geared towards agencies and large businesses that either have the mandate or the capital and staff to play in the climate adaptation arena. We should think about how do we engage a broader spectrum of organizations and businesses. The present approach does not downscales to these smaller entities.	28. Adaptation		1000		We agree with the commentor, but given the space limitations and the fact that the report is to the Congress by the Administration, we needed to focus our limited prose at higher levels. However, we note that the provision of usable information is needed at all scales.
Appendix A of NRC Review		The NIDIS discussion is very good, but in a way it is a counterexample to the approaches laid out. It worked because it had a clear and understandable focus on an issue that affects a wide spectrum of organizations. Climate adaptation is broad and diffuse, operates over a range of time and space scales, and it is convolved with a range of other processes. Think about flood control. It is tied into water rights, amounts of impervious surfaces, the National Flood Insurance Program as well as the natural environment. On the other hand, drought is really focused on the amount of water available. The problem is how to distribute a limited resource. Floods and their impacts are much more interlinked between the social and natural worlds. Perhaps the lesson learned from NIDIS is that it worked because it was bounded in its scope.	28. Adaptation				Thank you for your comment. The authors agree. There are different approaches, and perhaps NIDIS is successful because it's focused on information sharing and worked with the stakeholders to identify what was useful information for policymakers. No change to the text has been made.
Appendix A of NRC Review		This chapter is very well-written, well-organized, and easily accessible to lay readers. The glossary at the start of the chapter was quite helpful; it would be good to see other chapters follow this example. The tables summarizing the various types of adaptation actions taking place give the reader a clear sense of the scope and variety of the national response.	28. Adaptation				We appreciate this comment. The overall Assessment will have a master glossary for the entire report.
Appendix A of NRC Review		This chapter seems to build strongly upon the America's Climate Choices and USGCRP strategic plan documents. There is strong emphasis on adaptation science and decision support, while mitigation seems to be given less emphasis.	29. Research Agenda for Climate Change Science				The chapter has been reorganized in response to multiple comments about the need to focus the research agenda on the highest priority messages. Mitigation research needs, as well as the intersection of adaptation and mitigation topics, are now higher priorities in new version.
Appendi		It would be useful to identify existing agency research programs that are pursuing these objectives in	29.				It is outside the scope of this chapter,

x A of NRC Review		whole or part. The reader unfamiliar with federal research may perceive these priorities as new, even though significant work is already underway.	Research Agenda for Climate Change Science				given the page limitations, to identify which agencies are engaged in each of the research topics. For information on this topic, it is recommended that the commenter review the annual Our Changing Planet reports from USGCRP.
Appendix A of NRC Review		Particularly in light of the priority set on traditional knowledge (ll. 20-23), there should be studies of community-based natural resource management arrangements and the conditions under which they are effective.	29. Research Agenda for Climate Change Science		1038	15	This topic is an important one, but in light of the need to limit the number of priority topics to avoid a "laundry list" of research needs, we have not been able to incorporate this suggestion. The revised chapter calls for research on a variety of best practices for adaptation.
Appendix A of NRC Review		In light of the intense focus on job creation in public policy discussions, it would seem useful to include studies of labor markets. One has the (not well informed) impression that much of the growth in employment in environmentally related job specialties over the past half century originates in widening regulation of environmentally consequential activities. If, as some expect, growth in that and other aspects of the public sector is constrained in the future, the capacities described here will need to arise from private sector and civil society demand. That possibility could be illuminated through studies of the labor market.	29. Research Agenda for Climate Change Science		1041	18	This topic is an important one, but in light of the need to limit the number of priority topics to avoid a "laundry list" of research needs, we have not been able to incorporate this suggestion.
Appendix A of NRC Review		The goals as structured, do not address the criticality of integrating adaptation and mitigation. Further goal 7 does not warrant self standing. It is a sub element of either 5 or should fit elsewhere.	29. Research Agenda for Climate Change Science				The original Goal 7 has been incorporated more broadly into the chapter. We have made the importance of adaptation-mitigation research more explicit in RG4.
Appendix A of NRC Review		Is there a rationale for the ordering of the research areas identified? If they are not in a priority order, then that should be said. And they will have more impact if they are not listed in the same general order that they have been in previous reports.	29. Research Agenda for Climate Change Science				The chapter has been reorganized in response to multiple comments about the need to focus the research agenda on the highest priority messages. Research needs have been thematically grouped.
Appendix A of NRC Review		In a time of stable or declining budgets, it would be very helpful to get priorities from a process like the National Assessment. Having just completed this huge and very well done exercise, no one is in a better place to make recommendations about what research is most needed to make the ongoing assessment process better. A list of 37 equal priorities is only of modest help.	29. Research Agenda for Climate Change Science				The chapter has been reorganized in response to multiple comments about the need to focus the research agenda on the highest priority messages. We have fewer goals in revised version. The chapter now has five research goals and five priorities for cross cutting capabilities, as well as a set of prioritization criteria at the end.
Appendix A of		Because of the heavy involvement of federal agencies, it would be useful for the research recommendations to indicate how they could be handled by existing programs and where new	29. Research				It is outside the scope of this chapter, given the page limitations, to identify

NRC Review		initiatives would be needed. For example, given RISAs, RCAs, CSCs, etc., who might effectively take up what part of the research agenda?	Agenda for Climate Change Science				which agencies are engaged in each of the research topics and who could effectively take up what part of the agenda. For information on this topic, see the annual Our Changing Planet reports from USGCRP.
Appendix A of NRC Review		If the goal is to provide better projections, then the better understanding of uncertainties needs to consider uncertainties in emissions scenarios that come from projections of population change, economic growth, technological change, preferences, etc. It seems appropriate to understand how much of uncertainty in future projections comes from the climate system (and our models of it) and how much comes from uncertainty about emissions trajectories. The contributions to uncertainty will of course vary depending on what is being predicted over what time scale and at what spatial resolution.	29. Research Agenda for Climate Change Science		1036	21	We have added emission scenarios as a source of uncertainty in both RG1 and the scenarios crosscut.
Appendix A of NRC Review		This bullet deals with a critically important and complex line of research and needs a few sentences of elaboration. Also, the term "experiments" is not clear. To some disciplines experiments involve randomization and control groups, to other disciplines an experiment is large scale coordinated data collection. The former kind of experiment will play little role in expanding our understanding of the effects that are the point here.	29. Research Agenda for Climate Change Science		1037	7	This is no longer in the revised chapter because of review requests to reduce number of priorities.
Appendix A of NRC Review		Tipping points and thresholds are important not just in climate systems but in coupled human and natural systems and need to be studied with high priority.	29. Research Agenda for Climate Change Science		1037	9	Thresholds and abrupt change impacts on ecosystems and human systems are now mentioned in a new research goal on impacts, RG2.
Appendix A of NRC Review		The phrasing here is hard to follow: The importance for various kinds of decision making of various types and sources of uncertainty?	29. Research Agenda for Climate Change Science		1037	12	This is no longer in the chapter.
Appendix A of NRC Review		The difference between bullets 1 and 3 is not clear. Bullet 2 on federal clearinghouses (not sure what is meant, examples?) seems of much more narrow scope that the other priorities in this list. Bullet 4 mixes what is largely a problem in physical climate sciences (how well do various approaches to downscaling work?) with a social/ policy sciences question (what's the best way to deploy such information and what information is really needed?). They are related but different people would actually do the work for each, perhaps informing each other. On the last bullet: while it would be neat to know more about these strategies, to what extent are they actually useful, given the current technological organization of our communities? They may be very relevant, but the case should be made, as it's not obvious.	29. Research Agenda for Climate Change Science		1037		Bullets have been rewritten and combined now to respond to these comments.
Appendix A of NRC		This makes it seem as if energy technology and economics are all that matter, when a variety of other social factors are important drivers of GHG emissions and human responses to climate change. See comments on the mitigation chapter.	29. Research Agenda		1038	26	This section has been revised to emphasize social and institutional factors (RG4).

Review			for Climate Change Science				
Appendix A of NRC Review		What is meant by "socio-economic analyses?"	29. Research Agenda for Climate Change Science		1039	1	This is a very common term in social sciences.
Appendix A of NRC Review		This seems very narrow compared to the rest of the items on the list.	29. Research Agenda for Climate Change Science		1039	4	This is no longer in the chapter as we have revised the mitigation research goal.
Appendix A of NRC Review		Why only with regard to mitigation? Why not drivers overall and decisions about adaptation?	29. Research Agenda for Climate Change Science		1039	7	Revision of chapter brings in these factors for both mitigation and adaptation. The bullet has been rewritten.
Appendix A of NRC Review		Research Goal 4. It is admirable that the need for social data is mentioned at least in passing. But this needs elaboration. The social data needed is the only data on this list that is an orphan—with no federal agency in the GCRP with responsibility for it. What is needed should be specified in more detail. Specifying what is needed is essential given the lack of engagement with this kind of data by the GCRP agencies. Bullet 1 has the same problem—a mention without enough detail for anything operational to happen.	29. Research Agenda for Climate Change Science		1039		We have added more mentions of social data but have not addressed the agency gap per se; this is outside the scope of this document.
Appendix A of NRC Review		While "socio-economic issues" (what this means is not entirely clear) influence use of information, so do cognitive factors on how people process information which makes the way in which information is generated and provided of great importance. As this para is phrased I don't see that considered.	29. Research Agenda for Climate Change Science		1040	17	A sentence has been added in the intro to RG5 5 that mentions cognitive factors and individuals.
Appendix A of NRC Review		Bullet 1: It's not clear whether this is about research on how to communicate effectively on the things in the list that follows (e.g. transferable vulnerability assessment techniques) or it's about research on the processes listed themselves (e.g. improved understanding of consumption patterns and environmental consequences).	29. Research Agenda for Climate Change Science		1040		It is now clearer that this is about research into communication and other elements of decision making.

Appendix A of NRC Review		Current education seldom provides an understanding of coupled human and natural systems. What is the rationale for the particular list given here at the end of the bullet point. For example, why only "economic" sustainability?	29. Research Agenda for Climate Change Science		1041	31	This is no longer in the chapter.
Appendix A of NRC Review		Better to say "biological, physical and social"	29. Research Agenda for Climate Change Science		1041	33	The text has been amended to address this suggestion.
Appendix A of NRC Review		What about historically black colleges/universities? I would suspect that any vulnerability analysis would show that the African-American community also has high vulnerability and is underrepresented in the appropriate sciences.	29. Research Agenda for Climate Change Science		1042	2	We have rewritten this section to refer more generally to the needs of tribal and other groups
Appendix A of NRC Review		Research Goal 7. Certainly much more can be done with scenarios. But it's not clear how much of what is called for involves "downscaled" scenarios for levels of decision making involved in adaptation and resilience building. If that is intended, then some discussion of the sharp rise in scenario uncertainty at the local to regional level is warranted. We are finding that downscaled climate models may not have sufficient skill to be useful for some key parameters in some regions, and the same may well be found for downscaled scenarios. Or perhaps what is meant is that given the importance of scenario uncertainty in generating uncertainty in projecting climate change and impacts, better global scenarios are needed because when one follows the chain of analysis down to the local to regional level, this would aid in adaptation planning.	29. Research Agenda for Climate Change Science		1042		The scenario discussion has been substantially modified and included in other sections of the chapter. The language referenced here no longer appears.
Appendix A of NRC Review		Title does not reflect content in this chapter. The content focuses on research for the assessment process, but there is reason to be skeptical that research to support assessment is the same as research that actually can be transitioned into tools for decision-makers, products and policies that allow societies to make adaptation decisions, and investments that will lead to new energy and water systems.	29. Research Agenda for Climate Change Science				Title of chapter has changed to focus on assessment.
Appendix A of NRC Review		While the chapter talks about more research on impacts and risk assessment, it does not take the step of the research needed to identify and quantify vulnerabilities and options for societal action. The latter would begin to engage communities, engineers, and scientists.	29. Research Agenda for Climate Change Science				This has been added in impact section, RG2.
Appendix A of		Research goal 1: The high priority research goal 1 needs do not mention ocean/coastal marine resource impacts and vulnerabilities. Going through the list:	29. Research		1036		We have added oceans in most of the places suggested. Thank you.

NRC Review			Agenda for Climate Change Science				
Appendix A of NRC Review		Missing coastal environments and healthy ocean	29. Research Agenda for Climate Change Science		1036	25	We have added oceans in most of the places suggested including the new Impacts goal.
Appendix A of NRC Review		Ocean circulation also important for not only global transfer of heat but also water cycle and carbon cycle	29. Research Agenda for Climate Change Science		1036	29	We have added oceans in most of the places suggested. Thank you.
Appendix A of NRC Review		Does not mention any of the ocean stressors: pollution, fishing practices, unsustainable resource extraction	29. Research Agenda for Climate Change Science		1037	1	We have added oceans in most of the places suggested. Thank you.
Appendix A of NRC Review		It is not just sea level change that produces risk but also the compounding effect of increased probabilities of storm surge from extreme events.	29. Research Agenda for Climate Change Science		1037	26	This language has been revised.
Appendix A of NRC Review		Missing the largest part of the water cycle - the ocean - and the impact it might have on water availability (monsoons, etc)	29. Research Agenda for Climate Change Science		1037	17	We have added oceans in most of the places suggested. Thank you.
Appendix A of NRC Review		Research Goal 2: The terms risk, vulnerability, adaptation, resilience are all used here and require some good definitions. Many of these bullets are not what one would necessarily call a research agenda, but rather are capacity building. It is surprising that indigenous knowledge is mentioned but not other experiential based knowledge.	29. Research Agenda for Climate Change				The new Research Goal 2 focuses on issues of vulnerability and impacts research. We look at capacity building as a cross cutting capability now.

			Science				
Appendix A of NRC Review		Research Goal 3: It's not clear how many of these bullets are going to lead to the exploration of options and actions. In order to better link the fate of carbon emissions with effectiveness and timescales of mitigation measures we need to have some proposed mitigation measures. The second bullet refers to land-based decision-making but is completely missing the increasing use of the ocean and coastal resources. The 4th and 5th bullets call out for "understanding" but how is this understanding going to lead to action. Again, in the 5th bullet there should be mention of ocean energy development and water availability impacts.	29. Research Agenda for Climate Change Science				A new mitigation section was added that includes a reference to oceans.
Appendix A of NRC Review		Research Goal 4: Missing critical ocean state variables, extreme events, and the lack of an integrated coastal ocean observing system. There is no discussion of needed essential variables.	29. Research Agenda for Climate Change Science				Ocean observations mentioned under observations CCRC2 now.
Appendix A of NRC Review		Research Goal 5: Is this list carried out via "desk studies" or does it require real experiments?	29. Research Agenda for Climate Change Science				Hopefully it is now clear that the research need is for original research to develop decision support tools.
Appendix A of NRC Review		Research Goal 6: Why are Native American colleges and universities called out but not other minority institutions?	29. Research Agenda for Climate Change Science				We have rewritten the section to be more general and not to highlight one group.
Appendix A of NRC Review		Research Goal 7: It seems as though this goal should include something about responsibilities at various levels (Local, state governments; industry; public; communities).	29. Research Agenda for Climate Change Science				We have not assigned responsibility for the research goals in this chapter.
Appendix A of NRC Review		Research Goal 1: The only mention of health in this section is "healthy wetlands" (line 27)	29. Research Agenda for Climate Change Science				Public Health is now mentioned 14 times in chapter (14) and specifically in impacts research goal.
Appendix A of NRC		Research Goal 4: Indicators should include trends and changes in all environmentally sensitive infectious diseases in addition to those that are vector-borne.	29. Research Agenda				The text has been amended to expand references to health in various places.

Review			for Climate Change Science				
Appendix A of NRC Review		Overall, this chapter seems to take a different approach to social science than Advancing the Science of Climate Change or the GCRP Strategic Plan. Rather than being highlighted and identified as a priority in which there has been little investment and relatively little commitment by agencies, social science is there most often by inference in some of the topics mentioned. Perhaps this is because the authoring team included only two social scientists, both geographers who are world class experts on adaptation. So to them the need for social science efforts to address some of the topics listed is obvious, but this may not be true of the GCRP/ NCA agencies who have very limited social science capacity and thus struggle to include it despite apparently good intentions. One could argue that the NCA has to again make the point that we cannot carry out the research needed without a serious commitment to and investment in the kinds of social science research needed to support the overall agenda.	29. Research Agenda for Climate Change Science				The introduction and the cross cutting priority on integration (CCRC1) now make a stronger case for social science as well as in many other parts of the revision.
Appendix A of NRC Review		The absence of specific identification of the kinds of social science data needed is strking.	29. Research Agenda for Climate Change Science		1039		We have made changes to mention social data on drivers, impacts and responses in observations and data section CCRC 2.
Appendix A of NRC Review		If the NCA is not capable of looking across the issues discussed and identifying research priorities, I wonder who would ever be in a position to do so. Granted the immense amount of work undertaken may not have left time to hammer out a consensus on research priorities. But for all the good work we have seen with the NCA and the GCRP strategic plan, we still have no set of research priorities, only lists. These lists are not as integrative as the ones available in the ACC reports. To be sure, the NCA is not the activity to adjudicate the relative priorities to be given to basic science, mitigation and adaptation. But within the realm of adaptation/ vulnerability/ resilience it is well poised to say what is needed to do a better job in 5 years and 10 years.	29. Research Agenda for Climate Change Science				The whole chapter has been revised to emphasize a smaller number of priorities and avoid the "laundry list" approach, and there is a new section on prioritization.
Appendix A of NRC Review		Since "a much larger effort" is proposed, it would be helpful to know which audiences are targeted now, and the rough cost estimated for the web and communications effort. NASA's effort to gain users for its satellite data may be a useful benchmark.	30. The NCA Long-term Process: Vision and Future Development		1050	6	Agree in part. Added a new concluding sentence on original line 6 on page 1050 to address the intended audience that states: "Initial targeted audiences include assessment practitioners across various sectors and governmental levels." A visionary chapter such as this one is not an appropriate place to provide cost estimates. It is more appropriate that this occur as part of the agency processes needed to support the GCIS.
Appendix A of NRC Review		Overall, language is cautious and unclear about the goals, breadth and depth of a sustained process. E.g. p 1048; lines 9-13.	30. The NCA Long-term Process:				The tone of the chapter was intentionally meant to be visionary and not prescriptive. Specific NCADAC recommendations regarding the sustained assessment process will be

			Vision and Future Development				contained in the Special Report on Sustained Assessment due out this fall. No changes were made to the chapter in response to this comment.
Appendix A of NRC Review		Should include "other energy-economic-climate models" not just IAMs. "projects' are referred to as "infrastructure"; this seems odd. Line 32 refers to "utility and timeliness of future synthesis reports" vs perhaps "informing robust decision making".	30. The NCA Long-term Process: Vision and Future Development		1049	13	Agree. IAMs were presented as an example; however, to broaden the example, IAMs was expanded to "various types of integrated and vulnerability assessment models" on original line 13 on page 1049. On original line 12 on page 1049 "infrastructure" was changed to "support." The last part of the sentence on original lines 31 and 32 on page 1049 was changed to "...developments in decision and climate science and changing conditions to inform robust decision making and improve the overall utility and timeliness of future quadrennial assessment reports."
Appendix A of NRC Review		Refers to "two-way" communication Ôamong partners" vs "effective communications".	30. The NCA Long-term Process: Vision and Future Development		1050		Agree in part. Added "effective" but also retained "two-way" on original line 31 on page 1050 as effective communication can still be one way.
Appendix A of NRC Review		The chapter does not make clear why we should have sustained assessments. How have assessments been used? What have been the tangible outcomes? What has changed in terms of taking action that incorporates climate change information in the multitude of decisions that are made? What new information products have come out of the assessment that is being sustained?	30. The NCA Long-term Process: Vision and Future Development				Disagree in part. The Introductory section of the chapter provides a brief rationale for a sustained assessment process. It was purposely meant to be visionary with more specific details and rationale to be provided in the NCADAC Special Report on Sustained Assessments; however, to address the comment in part added the following sentence after the sentence ending on original line 22 on page 1047: "(Based on recommendations stemming from the National Research Council, USGCRP in its most recent strategic plan (USGCRP 2012) identified the

							rationale and benefits of implementing a sustained assessment process.)"
Appendix A of NRC Review		In this chapter the sustained assessments are to "evaluate the nation's vulnerabilities to climate variability and change and its capacity to respond". If this is the vision then one would expect the research agenda to be very different than what was proposed in the previous chapter. Also such an evaluation would require very different assessment than what has been done. However in lines 31-36t it would appear that the sustained assessment would be more of the same, rather academic, assessment strategy that currently is being used.	30. The NCA Long-term Process: Vision and Future Development				Agree in part. Specific changes to the research agenda articulated in chapter 29 can be found there that address this comment in part. Original lines 31 through 36 (presumably on page 1047) are seemingly taken out of context in regards to their complete articulation of the sustained assessment process. Throughout the chapter the emphasis has been on depicting the sustained assessment process as focusing, not exclusively but in an enhanced manner, on decision-relevant science, on creating new assessment-related activities, such as indicators and information management through the Global Change Information System, engagement opportunities (e.g., through NCAnet), and new types of assessment-related reports beyond the quadrennial assessment reports that both can improve the overall assessment process (foundational reports) and enable comprehensive assessments on important topical areas of concern to the nation. Additional details on the preceding will be included in the NCADAC's Special Report on Sustained Assessments. No changes were made to this chapter in response to this comment.
Appendix A of NRC Review		Sustained assessment of health impacts and adaptation must adopt a more comprehensive coverage of disease threats in addition to direct impacts (heat stress, allergy, mental health, etc.). This would require a multidisciplinary effort within the health sector (environmental health and infectious diseases) and cross-sectoral efforts between the health sector and ecosystems science, biodiversity, hydrology, forestry, etc, as well as capacity building.	30. The NCA Long-term Process: Vision and Future Development				Although the specific relevance of this comment to the Sustained Assessment chapter is not clear, the general spirit of the comment was addressed by adding the following sentence at the end of the original line 24 on page 1050: "Moreover, these types of assessments can encompass a more holistic, multi-disciplinary, and integrated approach that considers various types of data analyses that may not have been previously attempted."

Appendix A of NRC Review		This may be one of the most-read sections of the report because informal science educators are asked these questions all the time, and many are nervous about responding to skeptics - particularly when they're in front of an audience. The questions and answers are clear and simple, and they explain the science in terms that most people would understand.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z				We thank the commenter for their kind words.
Appendix A of NRC Review		It would be helpful to have definitions available for some terms - either by links, footnotes, or a glossary. Photographs would also be a useful addition for the people who struggle with charts and graphs (sea ice shrinkage, glaciers melting, etc.).	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z				Additional photographcs will be added in the final report. The final version will also have glossary terms.
Appendix A of NRC Review		One of the most common misconceptions in the U.S. is that the scientific community is in widespread disagreement about the reality and causes of climate change (36%, as of Sept. 2012). The appendix has an excellent section clarifying the scientific consensus (CAQ J). But it would be good to see the text of the question be re-stated in terms of this issue, i.e., "Isn't there a lot of disagreement among scientists about whether climate change is happening and whether humans are causing it?"	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z				We have purposefully tried to avoid using negative language when posing these CAQs. Therefore we have kept the question as stated.
Appendix A of NRC Review		Terms that need definitions for lay readers: forcings, radiative, proxy data, feedback, infrared spectrum.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z				The final version of the report will have glossary terms.
Appendix A of NRC		CAQ A: The text explaining the difference between weather and climate is excellent. It would be useful to expand the final paragraph, which is goes to the heart of the question.	Appendix: NCA Climate		1057		We have added some additional text as suggested.

Review			Science - Addressing Commonly Asked Questions from A to Z				
Appendix A of NRC Review		CAQ D: The final paragraph refers to the "warmest winter everywhere except in the Southeast." Should this say "...everywhere in the U.S. except..."?	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1065		Topic sentence of paragraph was revised to incorporate this suggestion.
Appendix A of NRC Review		CAQ E: The authors might consider adding a sentence stating how long emissions stay in the atmosphere; it brings home the point that rapid action is needed.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1067		The text has been revised to incorporate this suggestion.
Appendix A of NRC Review		Figure 8: This is a great figure, but another showing just the U.S. would be a good addition. With a U.S. map, readers would be able to identify their home state, and everything that helps localize the issue for readers can increase their readiness to support mitigation efforts.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1068		We have a U.S. map in Chapter 2. For this section, we want to show the basic coherency of patterns on a global scale. Rather than reproduce the Chapter 2 map here, we have simply referred to it. In the online version, the U.S. map can be dynamically linked to this section.
Appendix A of NRC Review		Figures 8 & 9: The two figures appear to be in conflict: Figure 8 shows no warming in the Southeast, but Figure 9 shows the region as increasing by about 1 degree. Figure 9 also appears to have a small error in the vertical axis, i.e., a -.05 above zero, as well as below it.	Appendix: NCA Climate Science - Addressing	Figure 8	1068		For the Southeast in Fig. 9 (the blue curve), there is no temperature trend, unlike all of the other regions which do exhibit upward trends. Thus, there is no inconsistency between the two graphs.

			Commonly Asked Questions from A to Z				
Appendix A of NRC Review		CAQ F: The second paragraph states that heat-trapping gases are transparent to the sun's energy, but opaque to the heat radiating back from earth - the lay reader wonders why that would be so. A sentence or two clarifying the difference would be helpful, and can actually be found in the answer to the next question (i.e., G, third paragraph). Perhaps readers could be referred to G for further information.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1070		The discussion has been expanded to further explain the greenhouse effect.
Appendix A of NRC Review		CAQ H: This answer is particularly nice. The question is raised so often, and this answer refutes it clearly, simply and directly.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1074		Thank you for the positive comment.
Appendix A of NRC Review		CAQ I: An example or two would help lay readers understand the research being described here. The last sentence of the answer (increasing likelihood of extreme weather) could be dropped because it doesn't address the question.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1076		We disagree. The attribution of changes in extreme weather statistics due to human activities is key part of this CAQ.
Appendix A of NRC Review		Figure 14: The data are impressive; I'd suggest deleting the map that is behind the graphs to make the page less busy and easier to read.	Appendix: NCA Climate Science - Addressing Commonly Asked Question	Figure 14	1078		We have redone the background map to incorporate this suggestion. We have also change the line thickness and color to make it less intrusive on the graphs.

			s from A to Z				
Appendix A of NRC Review		CAQ J: A climate skeptic could say in response to the last paragraph, well, how can you be so sure climate change will be harmful when you don't know how sensitive the climate is to emissions, how emissions affect clouds, etc. While acknowledging what we don't know is important, it's also critical that we don't give the skeptics more ammunition. Would it be possible to include what is known in all these areas? E.g., "We know sea levels will rise, but don't know exactly how much - somewhere between one and four feet over this century." The point made in the last sentence in the response to CAQ S would bear repeating here.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1080		After consideration of this point, we still feel that the existing text is clear and accurate. However, we have modified the last sentence to make what is known even more clear.
Appendix A of NRC Review		Figure 15: This figure is very complex and contains many terms that lay readers won't understand. Anything that can be done to simplify the figure would be helpful.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z	Figure 15	1081		The figure has been replaced. The new figure compares the natural and human contributions to climate change, so very different from previous figure but easier to comprehend.
Appendix A of NRC Review		Figure 16: The figure is redundant with Figure 14. Most readers probably won't read all the questions in the appendix, however, so the redundancy may not be a real problem.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z	Figure 16	1082		We thank the reviewer for the comment. As pointed out, we expect that readers will go to specific questions, rather than reading them all. For that reason, we think this minor level of redundancy is helpful to the reader.
Appendix A of NRC Review		CAQ K: Again, an excellent response to one of the assertions often made by skeptics.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1083		We thank the reviewer for the kind words. No change was made to the text.

Appendix A of NRC Review		Are there attribution studies that actually conclude it is impossible to explain many aspects of warming without human activities ? (EU heat wave in previous sentence is an example).	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1076	16	There have been no extreme events to date that would have been impossible in the preindustrial climate system. The sentence has been revised for clarity.
Appendix A of NRC Review		The use of questions is an effective communication tool, however, the choice of questions, tone, and lack of rigor can be both polarizing and argumentative and can detract from the credibility of the NCA. The questions largely are about climate science and not about the assessment for the U.S.; given the general nature of the questions, there are ample other sources of such information (for example, the IPCC assessments). And in some cases the informal answers (e.g. using analogies) can lead to inaccurate overgeneralization of scientific evidence.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z				he purpose of the assessment is to provide useful, relevant information on climate science and impacts to the American public, many of whom may never read an IPCC report. These questions reflect a selection of those commonly asked by the American public. While there are other places where many of these are also addressed, our intent is to address common questions in one location in the assessment, so it can serve as a stand-alone resource.
Appendix A of NRC Review		The figures are not referenced in the text answers to the questions; and the captions, referencing, and traceable accounts are incomplete.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z				Throughout the report, we have attempted to make the figures clear enough that referencing them in the text is not required (but is possible if the authors decide to reference the figures). The captions and references have been improved throughout, though traceable accounts were prepared only for the chapter and not the appendices. We hope that the Chapter 2 traceable accounts will meet the reader's needs.
Appendix A of NRC Review		The comparison between human choices and climate variability is a poor analogy for climate statistics especially since it has been argued by some (and perhaps in the NCA) that emissions scenarios cannot be assigned a probability. Suggest avoiding such analogies and focusing on climate.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1057	15	We agree that emission scenarios cannot be assigned a probability, and have removed the analogies to human activities.

Appendix A of NRC Review		Asserting that we know the physics "relatively well" does not present a clear basis for the answer to the question. The lack of assessment of uncertainty of projections in the NCA and such a simple assertion leaves a very weak basis for the reader.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1057	25	We have removed the phrase "relatively well" and added a discussion of projection uncertainties. We has also added a sentence about the successful replication of observed temperature changes by climate models, but only when greenhouse gas concentration increases are included.
Appendix A of NRC Review		The figure does not fit the caption. For example, there are no day to day changes in the figure.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z	Figure 1	1058		Figure caption has been revised.
Appendix A of NRC Review		Text erroneously states that the last decade (unequivocally) is the warmest in 2000 years. Analyses have attempted to answer this question and have estimated the likelihood that this may be true.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1067	17	We have modified the text so that this is no longer an issue.
Appendix A of NRC Review		This an overgeneralization (e.g. the specific time context is not given and therefore it may or may not be true) and does not apply to all time periods; the Earth has had periods of warming and cooling.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1067	22	The sentence has been revised to incorporate this suggestion.
Appendix A of NRC		Suggest removing "exactly"; pattern matches are not exact.	Appendix: NCA Climate		1074	15	The text has been revised to incorporate this suggestion.

Review			Science - Addressing Commonly Asked Questions from A to Z				
Appendix A of NRC Review		Attribution studies have not found unequivocal results therefore "impossible" is incorrect.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1076	16	The sentence has been revised for clarity.
Appendix A of NRC Review		Attribution of extremes is of very limited confidence as assessed by the SREX. For example, SREX states (p9) "only low confidence of the attribution of any detectable changes in tropical cyclone activity to anthropogenic influences".	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1076	19	Confidence that the risk of certain heat waves and floods has been changed by human activities is high. However, we have deleted reference to intense tropical cyclones as the consensus is still incomplete.
Appendix A of NRC Review		It is incorrect to claim attribution is certain for the systems in the figure. Even for temperature, attribution is a probability statement (e.g. very likely). For other features (e.g. floods), ability to attribute to climate (and other factors) is much poorer.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z	Figure 13	1077		Each item in the figure has at least one attribution study associated with it. We are not describing the likelihood with this figure.
Appendix A of NRC Review		The certainty of the assertion "only" in the figure and caption is not consistent with attribution studies or IPCC conclusions.	Appendix: NCA Climate Science - Addressing	Figure 14	1078		Sentence has been revised for clarity.

			Commonly Asked Questions from A to Z				
Appendix A of NRC Review		"nothing short of remarkable" and 97% without reference seems argumentative.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1080	16	We have revised the text to incorporate this suggestion. The basis for 97% is now explained.
Appendix A of NRC Review		Suggest that the trend for both Antarctica and arctic sea ice be quantitatively described instead of saying simply "little trend".	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1085	7	The text has been revised to incorporate this suggestion.
Appendix A of NRC Review		This seems like a very small set of papers considering how many on climate change are published?	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z	Figure 19	1088		At that time, general concerns about climate change were just beginning to be raised across the scientific community and the public. Nonetheless there were still more papers raising concerns about a warming climate than the cooling one.
Appendix A of NRC Review		"cannot be altered" is not true; it is insensitive to greenhouse gas emission reduction.	Appendix: NCA Climate Science - Addressing Commonly Asked Question		1089	10	Sentence has been revised for clarity. It is true that immediate reductions of greenhouse gases will not immediately stabilize the temperature.

			s from A to Z				
Appendix A of NRC Review		12F is higher than shown in the chart on page 25 (or about 4C given in the scientific literature); why are uncertainties not given for all projections?	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1089	25	Uncertainties were meant to be part of this graphic and are now included.
Appendix A of NRC Review		Since no uncertainty is shown in the curves, one cannot tell how to compare sensitivity to scenario to uncertainty. Caption is confusing since only scenarios are mentioned. It is not mentioned how the curve is derived from models (median, average, ?).	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z	Figure 20	1090		Uncertainties were meant to be part of this graphic and are now included.
Appendix A of NRC Review		"many areas" is not consistent with the IPCC SREX which assessed that this may occur in some areas with medium to low confidence. Overconfidence is expressed with regards to projections of extremes throughout the NCA.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1091	10	No likelihood statement was intended. The sentence has been revised for clarity. We have revised the text to incorporate this suggestion. IPCC SREX has stated that these are likely to increase in many areas.
Appendix A of NRC Review		"has clearly increased" implies high confidence in attribution which is not true for most weather extremes. This should state precisely for which extremes there is high confidence attribution, otherwise this is providing misinformation.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1091	16	We have modified this text to focus on temperature extremes, for which there is the clearest attribution evidence. We now state that the likelihood of extreme temperature events has clearly changed. With the focus of this revised text now on temperature, we have moved it to directly follow the earlier text about temperature records.

Appendix A of NRC Review		The analogy to steroids in not appropriate. If one reads the IPCC SREX response to the FAQ (is becoming more extreme, p.124) next to this paragraph, one is left with the impression that this draft is hype.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1091	18	We appreciate the comment of the reviewer and can see how this text might be misinterpreted as hype. We have deleted the paragraph.
Appendix A of NRC Review		reference for the caption conclusions should be provided and validity assessed through traceable account (this is not commonly covered in assessments).	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z	Figure 21	1092		The source for the figure has been provided and the revised caption provides additional explanation about the figure.
Appendix A of NRC Review		"availability of calcium carbonate" does not make sense? Perhaps concentration of carbonate ion is what is meant?	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1093	24	The text has been revised to incorporate this suggestion.
Appendix A of NRC Review		"supersaturated with calcium carbonate minerals" does not make sense.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1095	7	The text has been revised to incorporate this suggestion.
Appendix A of NRC		"concentration of these minerals" does not make sense.	Appendix: NCA Climate		1095	8	The text has been revised to incorporate this suggestion.

Review			Science - Addressing Commonly Asked Questions from A to Z				
Appendix A of NRC Review		30% -- shouldn't this now be higher since CO2 has increased 40%?	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1095	11	We appreciate the comment, but the value on ocean acidification is correct.
Appendix A of NRC Review		Should also mention that there are large variations in pH in ocean sediments. The 20 million only refers to inferred average ocean surface pH.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1095	15	After consideration of this point, we still feel that the existing text is clear and accurate.
Appendix A of NRC Review		The shell shown seems to not include the actual pteropod (only the shell). Is this all the evidence that we have (it is not convincing or particularly relevant since shells have always been dissolving on some parts of the sea floor)?	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z	Figure 23	1095		This figure has been updated showing images from a new study (Bednaršek et a.., Nature Geosciences, 2012), of pteropods collected live from regions in the Southern Ocean with different levels of acidity.
Appendix A of NRC Review		This text does not answer the question of trust and the NCA largely does not discuss uncertainty of projections. Clearly we would not trust the models in the same way we trust those that, for example, control airplanes.	Appendix: NCA Climate Science - Addressing		1096	1	A significant omission from the draft NCA3 was the absence of uncertainty in the figures showing global mean temperature projections. This has been corrected. New figures for temperature projections do include

			Commonly Asked Questions from A to Z				the uncertainty range. Uncertainties are discussed at length in the CAQ S. We think the text does address whether the models are trustworthy representations of the atmosphere. The new figures with uncertainty ranges add to that discussion.
Appendix A of NRC Review		"do a good job"? No proof provided. Projections of precipitation differ in sign between some models which is hard to describe as "good job".	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1096	14	The commenter is confused on two accounts. First, there are regions where the projections should not agree on sign. These are mostly regions where any human induced change is small compared to natural variability (white in the projection maps of NCA3). Second, the regions where models wildly disagree on the sign and magnitude of future precipitation change are remarkably small in a global sense for the CMIP5 models. No change needed.
Appendix A of NRC Review		Should show estimates of uncertainties in projections.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z	Figure 25	1099		We have redone the graphic to include a range of model results. The revised version of the figure has the uncertainty included.
Appendix A of NRC Review		This section seems to go further than the executive summary says we know about tipping points. It should be explained that there is not a consensus among models about major tipping points occurring this century.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1100		The text has been revised to incorporate this suggestion.
Appendix A of NRC Review		Variability or vulnerability? This chart needs discussion if included.	Appendix: NCA Climate Science -	Figure 30	1108		Figure caption has been corrected and expanded to provide more information. There is insufficient room to fully explain the index, but the

			Addressing Commonly Asked Questions from A to Z				reader has the reference to be able to get even more explanation.
Appendix A of NRC Review		Biofuels? The land use and life cycle emissions of corn ethanol mean it cannot contribute significantly.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z		1109	11	Mention of biofuels has been clarified to depend on fossil fuels required for production and other environmental effects.
Appendix A of NRC Review		This page only describes end use and not power generation which has large scope for reducing emissions.	Appendix: NCA Climate Science - Addressing Commonly Asked Questions from A to Z	Figure 32	1109		As with figure in CAQ N, uncertainties due to forcing scenario are included in figure. Revised figures for temperature projections do include the uncertainty range. Across-model ranges have not been evaluated and would complicate the figure, detracting from the message about scenario dependence.