

Unified Synthesis Product: Global Climate Change Impacts in the United States (2nd Draft)
 January/February 2009 Reviewer Comments and Responses (Final Revision, 4/25/09)
 Comment Type: BR – Blue Ribbon Panel, G – U.S. Government, P – Public

PUBLIC COMMENTS

Type	Reviewer	Page	Side	Line	Specific Comments	Responses
P	Carns	Gen			As suggested by David Budescu, "Improving communication of uncertainty in the IPCC reports," consider including numerical percentage chances along with "likely" or "probably" whenever possible. i.e., write "...it is very likely (95% chance)..."	We have modified the discussion on likelihood in the 'About this Report' Section in response to this and other comments.
P	Covey (LLNL)	Gen			I'm very impressed with the way this report spells out its main points in plain language. The authors have raised the bar for all of us who write such reports.	Thank you.
P	Tellinghuisen	Gen			<p>It concerns me that many of those who are opposed to doing anything about global warming have recently chosen to attack the most fundamental data — the temperatures — by making statements such as "... there has been no recorded global warming for more than a decade, or one-third of the span since the global cooling scare." [George Will, column of February 15]. Focusing on just the first part of this statement, I have seen similar from many of the people (some actually scientists, many not) who have been included in the "U. S. Senate Minority Report: More Than 650 International Scientists Dissent Over Man-Made Global Warming Claims; Scientists Continue to Debunk 'Consensus' in 2008" (December 11, 2008).</p> <p>I wonder if the report under comment here should address these claims early on. To the extent that the public choose to believe Will and Inhofe and the 650 "scientists," that we are now experiencing cooling, they will also conclude that little else in this report warrants their attention. In other words, it seems to me that these notions must be addressed and put to rest, or the impact of the report may be severely weakened.</p> <p>To satisfy my curiosity as to how anyone could be making such a claim, I experimented with least-squares fitting of just recent global temperature data to a linear relationship, and I found that indeed, if one chooses the data set and the time range just right, one can make this claim. This is mainly a consequence of the anomalously low temperature for 2008, which is actually the third consecutive decline in one data set (Hadley). If these data are fitted from any time 2001 or later, they do indeed yield a statistically significant (at the one-sigma level) negative slope. On the other hand, the GISS data show a much warmer 2007, and they yield apparent cooling only if just the last four years (2005-2008) are included in the data set. (With both data sets one can make the softer claim of "no significant warming" over a somewhat longer time period, especially is two σ is adopted for statistical significance.)</p> <p>Accordingly, it may be worthwhile to note early in the report that such claims of cooling</p>	We feel that the information presented in the 'Global' Section addresses your concern. We have strengthened our point using solar energy vs. temperature to show the lack of relation.

					<p>or insignificant warming can be justified only by taking recent time periods too short to be of any value in establishing trends. And a counterillustration might be offered — like apparent cooling of $-0.025(6)^{\circ}\text{C}/\text{yr}$ between 1940 and 1950 (GISS data), or warming of $0.019(7)^{\circ}\text{C}$ for the 1929-1940 period (GISS). Or negligible change from 1998 on [Hadley, $-0.001(8)^{\circ}/\text{yr}$], becoming statistically significant warming with inclusion of just two earlier years [Hadley, $0.010(8)^{\circ}\text{C}/\text{yr}$].</p> <p>The above given numerical values are relatively easy to obtain, but if anyone wants more detail, I would be happy to provide it.</p>	
P	Carns	Gen			<p>The practice of using lengthy sentences as headings for subsections is slightly confusing, since the highlighted paragraphs look similar to highlighted quotes. An additional way to set off separate sections with typography or layout would be helpful.</p>	<p>We have considered this and a number of other format revision suggestions but prefer that the current subsection headings style.</p>
P	Fitzpatrick	Gen			<p>Chapter on Response Strategies, deleted?</p> <p>The 2nd public review draft version of the Unified Synthesis Product Global Climate Change in the United States is a useful, informative but insufficient assessment of climate change, impacts and responses. The stated goal of the report is “to make the key results of the enormous body of scientific information about climate change and its impacts on the United States accessible in a plain English document that can help inform public and private decision makers at all levels.” There are several critical changes from the 1st public review draft that have decreased the potential use of this report as a reference document for decision makers.</p> <p>The complete chapter on Response Strategies has been removed from this 2nd draft. Has this material been incorporated into other chapters? If not, why was this chapter removed?</p>	<p>The document has undergone major revisions and reorganization of material. It now includes a new section ‘An Agenda for Climate Impacts Scienc’”. Also, adaptation boxes and text that address issues previously discussed in the ‘Response Strategies’ Chapter have been added throughout the report.</p>
P	Gilbert	Gen			<p>I am impressed with the general orientation of the draft document as it seems to comprehensively reflect the most recent scientific consensus on climate change. I am concerned, however, with the relative emphasis of the document, as it seems to place insufficient stress on curbing greenhouse emissions from burning fossil fuels (the acknowledged major contributor to climate change). It is stated in the “Executive Summary” that, even though mitigation is not directly addressed in the document, it is a critical component of a comprehensive strategy to address climate change. Such an acknowledgement seems insufficient, however, to appropriately stress the urgent need to</p>	<p>This issue of mitigation has been carefully evaluated in light of this and other comments. We have decided to expand our treatment of mitigation through revisions in the ‘About this Report’, ‘Executive Summary’, and ‘Concluding Thoughts’ sections, as well as other areas in the text.</p>

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					<p>directly deal with the core cause of climate change. My recommendations for additional wording are directed toward partially restoring what seems to be a needed balance of emphasis.</p> <p>If released in its present form, the authors possibly should have concern that those reading the document might perceive, perhaps unfairly, that it has been unduly influenced by persons with huge economic stakes in maintaining, for as long as possible, the status quo regarding societal use of fossil fuels.</p>	
P	Horner	Gen			<p>Pursuant to the request for public comment in NOAA’s Federal Register Notice of January 13, 2009 please consider the following comments on the Draft “Global Climate Change Impacts in the United States” (hereafter, “USP” or “the document”).</p> <p>CEI reaffirms its comments initially submitted on August 14, 2008, including the thematic or general comments (e.g., regarding the Information Quality Act, USP bias and conflicts, exceeding the scope of USP’s authorized charter) and, as applicable, comments specific to items not substantively changed from the First Draft USP to Second Draft.</p> <p>We particularly emphasize that the USP is premised in computer models that recent observations have confirmed are insufficiently reliable so as to, e.g., be admissible at trial as “sound science” pursuant to <i>Daubert v. Merrell Dow Pharmaceuticals, Inc.</i> As such, CEI reaffirms its position that these models are insufficient as the basis for “climate” policy but also ensure that USP’s projections and relevant claims may not be disseminated by covered federal offices pursuant to statutes relevant to USP including but not limited to the Federal Information Quality Act.</p>	We disagree with this comment and are leaving the text as written.
P	Lampel	Gen			<p>I believe the goal of this report is to present the latest information on climate impacts in the U.S. in a manner that is easily accessible — and readable — to anyone. As a layperson, I greatly appreciate the plain-language approach to discussing the science and impacts of climate change.</p>	Thank you for your comment.
P	Lewis	Gen			<p>While there are many worthwhile policies, the single most important is a carbon tax swapped against some other taxes on labor (cuts) and transfer payments (increases for low to moderate incomes with little or no taxable income). The average family would have no net tax increase or decrease, only a change in price relationships.</p> <p>Such a tax should start low in order to establish the mechanics of collection, assure no one escapes (especially federal agencies and the Pentagon), implement tax and transfer</p>	The USP specifically avoids policy recommendations.

				<p>changes, study how imports should be treated, and to have a low incentive to evade the tax.</p> <p>Such a tax should be analyzed in the context of more comprehensive national income accounts, which would consider the current costs of warming and, thus, allow in the future the costs to be offset by benefits. Benefits measured qualitatively should not have to compete with costs measured quantitatively. The national accounts leave out the environment as if it had no value, and, while difficult, some effort at comprehensive modeling should be invented and continually developed.</p> <p>Similarly, as the tax is increased, the increase should be based on long term elasticities of better conservation, efficiency, land use density/transportation systems, non-fossil sources, and population levels. The tax swap should have triggers for increasing the tax under conditions of economic growth or lack of change, and cut back or not increase under conditions of contraction or adequate decarbonization.</p>	
P	Michaels and Kappenberger	Gen		<p><i>Overall Reliability of the CCSP Second Draft of the USP</i></p> <p>The Second Draft (as well as the first) is based largely on a suite of climate models, designated CMIP-A. The models have been used in ensemble form in order to generate regional estimates of precipitation and temperature changes, and then often these results were used to provide some quantitative guidance for climate impact assessment on various economic, ecological, or social sectors.</p> <p>It is therefore a <i>requirement</i> that these models are demonstrably capable of simulating reality, and it is a <i>requirement</i> that these models be rigorously tested in their ensemble form, and based up the frequency distribution of their global temperature trends. Obviously, if the models are in agreement with reality globally, then there <i>may</i> be some credence for their credibility for regional application.</p> <p>Direct performance of this analysis is not feasible within the financial and personnel limits of most individual reviewers. However, in preparation of testimony presented (by one of us, Patrick Michaels) on February 12, 2009 before the Oversight and Investigations</p>	<p>We cannot use testimony as a reference. Also, Our use of models is outlined in the 'About this Report' Section: "The Federal Advisory Committee has taken into consideration a wide range of information, including the strength and consistency of the observed evidence, the range and consistency of model projections, the reliability of particular models as tested by various methods, and most importantly, the body of work addressed in earlier synthesis and assessment reports."</p>

					<p>Subcommittee of the Energy and Commerce Committee of the U.S. House of Representatives, we performed an analogous analysis.</p> <p>Please note that we analyzed the 21 models used by the United Nations' Intergovernmental Panel on Climate Change (IPCC) for their "midrange" emissions scenario, technically known as "A1B." The atmospheric carbon dioxide <i>concentrations</i> observed in the last decade are highly consistent with this scenario, so the radiative forcing changes within this scenario can be assumed resemble reality.</p> <p>Of course that assumes that the sensitivity of temperature to carbon dioxide and other greenhouse gases, as well as to sulfate aerosols is correct. The sensitivity is ultimately determined by the internal model equations and coefficients, and their interaction terms.</p> <p>The AIB models produce a large variety of outcomes, as do the CMIP-A models. They are likely to be little different in their overall mean warming and the spread of their forecasts under different realizations, in no small part because some of the CMIP-A models are indeed A1B models.</p> <p>Following is the appended testimony, modified to refer to the CCSP Second Draft. Note that the similarity of the CMIP-A suite to the A1B makes this analysis totally applicable to the Synthesis Second Draft. We are sorry to say that the models fail to meet the normal standards of scientific acceptability as given in Daubert v Merrell Dow, and certainly therefore fail the provisions of the Information Quality Act. The CCSP Synthesis Report should therefore be withheld from publication until the suite of models does not demonstrably fail as shown below.</p>	
P	Michaels and Kappenberger	Gen			Reference: Applicable Testimony Of Patrick J. Michaels to the Subcommittee on Energy and Environment of the Committee on Energy and Commerce, U.S. House of Representatives (modified to include reference to the Second Draft of the Unified Synthesis Product)	We cannot use testimony as a reference.
P	Michaels and Kappenberger	Gen			In a review of the First Draft of the Unified Synthesis Product (USP), we tendered nearly 25,000 words of general and specific commentary. For our efforts, we have been able to locate few points in the text that seem to have been changed, although it is difficult to	We evaluated and acted upon comments from the first draft as appropriate. As noted in a previous response, we maintain our use of

				<p>track the individual changes because of the new format of the Second Draft.</p> <p>Having said that, we have found many places in the Second Draft where our specific comments have clearly been ignored.</p> <p>Therefore, our comments take a different tack this time around. Rather than a long list of specific comments that show how and where the text does not accurately reflect the latest research results or the appropriate scope of current scientific understanding (or lack thereof), we submit a general comment demonstrating that the large suite of existing climate models that underlie the findings of the CCSP USP are in the processes of failing. Our comments are based upon a simple and straightforward analysis that shows that the recent behavior of global temperature is at or below the lower bound of climate models' expectations of such behavior. As a result, the reliability of climate projections is now questionable.</p>	<p>models as outlined in the 'About this Report' Section: "The Federal Advisory Committee has taken into consideration a wide range of information, including the strength and consistency of the observed evidence, the range and consistency of model projections, the reliability of particular models as tested by various methods, and most importantly, the body of work addressed in earlier synthesis and assessment reports."</p>
P	Milmoe	Gen		<p>My name is Joe Milmoe, a graduate student at George Mason University studying science and communication. I wanted to start by thanking you for your all of your hard work on this issue and also for the opportunity for folks like myself to participate in the comment and review process.</p> <p>You have clearly done a wonderful job at compiling and synthesizing a wide array of scientific data and presented it in your report. While I am in strong agreement with many of the scientific components, I would like to provide you with comments relating to how CCSP can more effectively communicate the issues, findings and recommendations within your report.</p> <p>As you likely are aware, a major disconnect often exists between the biological and social science fields, often leaving the "general public" unaware of the wealth of critical information enclosed in reports similar to yours. No question - scientific information, research and reports are abound. The public is overwhelmed by this, in which case they are left with little more than fear and uncertainty as to how they can make a difference themselves. This lack of public understanding, involvement and stewardship is of extreme concern in light of climate change, given that you open the document by acknowledging</p>	<p>One of the strategies of encouraging two-way communication is in the formal public release, or roll-out, of the document, with supporting materials (e.g., brochures, web sites, outreach to media). We believe that this will address the issues raised in this comment.</p>

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					<p>that the leading cause of warming is human-induced emissions over the past fifty years (p7; R2). I think it is safe to assume that changes in individual human behaviors will play a critical role in the overall solution to ameliorating the effects of climate change.</p> <p>Aside from the obvious scientific goal of presenting an accurate, clear and concise report, I would urge you to take things a step further by initiating and sustaining two-way communication with your key stakeholders and individual constituents. As civil servants, I feel CCSP has the responsibility of striving to effectively translate and communicate your climate change findings to your individual constituents. Doing this will not only foster citizen support for your work as concerned scientists, but also to motivate and empower individuals throughout society to become actively involved.</p>	
	P	Milmoe	Gen		<p>-Random FYI: I found that these key terms received little mention throughout the 211 page report.</p> <ul style="list-style-type: none"> -“Communication” – 7 times -“Communicate” – 0 times -“Outreach” – 0 times -“Audience” – 0 times -“Stakeholder” – 7 times -“Partner” – 3 times <p>-While these themes and concepts do still exist throughout the document, I feel it to be important to better articulate the need and movement to connect with the public on the scientific issues.</p>	<p>We have taken great care to ensure that the text communicates the science and impacts in a straightforward manner. This does not necessarily require use of the terms mentioned.</p>
	P	Niblock	Gen		<p>Prior Draft Review Comments Resolution. There were comments on the First Review Draft and a document was published that incorporated responses to the comments. Although I searched the Internet with several search engines I was unable to find the document that resolved the comments on the First Review Draft until I specifically searched ClimateScience.gov. I suggest that you publish the web location more broadly. The prior comment resolution is a much-appreciated courtesy to the reader that should be easy to locate.</p>	<p>The U.S. Climate Change Science Program web site <climatescience.gov> is the primary location for information on this report. The final version and the review comments and responses will be posted on that site.</p>
	P	Niblock	Gen		<p>The Misuse of Counts as Measures. Lack of Time Series or Sequential Analysis There are many counts presented in chart form that give the appearance of a measurement, implying frequency. Those counts are not measurements so this is misleading. Frequency in this application is the measure of events per unit of time. An alternative measure is the</p>	<p>We disagree with the assertion that the figures misrepresent the contained information. The cited sources are available for additional information, if desired.</p>

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					<p>time between events. The “signal” mentioned at page 19 as arising from the “noise of natural climate variability” was nonexistent when some of the charts were analyzed from a time series (or statistical process control) perspective. Generally the report lacks this sort of information –typical of time series measurements – for processes that we hope to control. There is no indication of natural process limits and whether or not the variation observed is within process limits. More specific examples follow using a simple process control analysis(ref 1) and data from the charts at pages 47 and 49. In each instance where counts are used to imply frequencies, a time-series analysis should be prepared to determine if we can reasonably conclude whether anything is actually happening.</p> <p>Reference: Donald J. Wheeler. Understanding Variation: The Key to Managing Chaos. SPC Press. 1993</p>	
P	Niblock	Gen			<p>Projection. Much of the background for the document could be characterized as projection and “Oh, ain’t it awful stories.” Charts are included which show the awful effects of generalized warming, e.g. page 107 – Lightning-related Insurance Claims. The chart suffers from an implicit assumptive claim that temperatures are increasing by the use of counts as a measure of frequency. They are not the same. The abundance of scary projections, if evaluated from a rhetorical perspective, would likely result in classification of the report as propaganda. The totality of the report gave me the sense that an overwhelmingly complex process has been trivialized to a problem with a simple solution – reduce carbon dioxide emissions.</p>	<p>The comment has been considered, but we disagree with its basic premise. It is judged to contain no suggestion relevant to improvement of the scientific content of the USP report.</p>
P	Public	Gen			<p>With the report and changes looming, we need to regulate to make our country's citizens know about these changes and take the steps necessary to accommodate to them. we must also try to lead the world in this regard. if we dont get the rest of the folks in the world to work with us, we are all doomed. it wont be easy to make the changes.</p>	<p>No response required.</p>
P	Reynolds				<p>I have read this elaborate and beautifully illustrated report on climate change and of human responsibility for the increasing amounts of carbon dioxide due to fossil fuel use and its causing an unprecedented rise in global temperatures, endangering all life on Earth. As a geologist, with some knowledge of paleoclimates, I assure you that this has never happened within the Phanerozoie Era (the last 500 million years).</p> <p>I understand that you have adopted a policy that is grounded in environmental fantasy</p>	<p>The comment has been considered, but is judged to contain no suggestion relevant to improvement of the scientific content of the USP report.</p>

					<p>but I do not see how you can fly it very long and waste trillions of dollars sequestering carbon dioxide without infuriating our taxpayers because The Basic Science is Not There to Support You.</p> <p><u>Reference attached:</u> Robinson, A.B., N.E. Robinson, and W. Soon, 2007: Environmental Effects of Increased Atmospheric Carbon Dioxide. <i>Journal of American Physicians and Surgeons</i>, 12, 79-90.</p>	
P	Salvagin	Gen		<p>“Global Climate Change in the United States” should provide an excellent resource for the country as long as its basis stays totally on sound scientific findings and the data is not skewed or altered as occurred during the Bush administration.</p> <p>The language on climate change mitigation in the document is currently quite vague and does not place adequate emphasis on the importance of immediate efforts to act. Significant efforts must be made in all sectors NOW in order to reduce the scientifically projected devastation based on the most recent thermal data available.</p> <p>Granted, the most significant devastation will initially occur in the poorer nations where the bulk of the population is concentrated near sea level. Perhaps fewer cities in such locations along with the inhabitants would reduce the human impact on the Earth’s environment but allowing such catastrophes to occur without efforts of avoidance is not moral or humane.</p> <p>Please make every effort to use the most up-to-date research analyses and emphasize the importance of immediate action by government as well as individuals toward the reduction of pollutants contributing to global climate change.</p>	<p>This issue of mitigation has been carefully evaluated in light of this and other comments. We have decided to expand our treatment of mitigation through revisions in the ‘About this Report’, ‘Executive Summary’, and ‘Concluding Thoughts’ sections, as well as other areas in the text.</p>	
P	Scott	Gen		<p>The National Biodiesel Board is a non-profit organization dedicated to the coordination of science to develop a domestically-produced alternative to petroleum diesel fuel. We commend the CCSP for compiling this report summarizing the science of climate change.</p> <p>Biodiesel is one of our best alternatives for mitigating greenhouse gas (GHG) emissions resulting from the burning of fossil fuels. Comprehensive lifecycle analysis shows that biodiesel reduces GHG emissions by 78% compared to petroleum diesel. This reduction was confirmed in a study by the United States Department of Agriculture (USDA) and the US Department of Energy (DOE)¹.</p>	<p>The USP specifically avoids policy recommendations.</p>	

The biodiesel industry has grown steadily since 2005. US production achieved 700 million gallons in 2008. That volume of displaced petroleum diesel was equivalent to removing 980,000 vehicles from American roadways. This demonstrates very real progress toward reducing the largest source of human-induced GHG emissions-burning fossil fuels.

The US biodiesel industry has set a goal to displace 5% of on-road diesel consumption by 2015². It is anticipated, that our gallon-per-gallon reduction in GHG emissions will continue to improve as new technologies are continually implemented. These technologies include increased yield of traditional crops, reduced agricultural inputs such as diesel fuel and agricultural chemicals, improved processing efficiencies, and increased utilization of recycled and waste fats and greases. By 2015, these factors combined can be expected to reduce GHG emission five-fold the reductions experienced in 2008.

In addition to helping reverse the cause of climate change by reducing GHG emissions, there are ways biodiesel can help the US adapt to effects of climate change. There are many impacts of climate change highlighted in the USP that should concern the United States. Among those, is the impact of extreme weather conditions on the fuel distribution infrastructure in the gulf coast area of the Southern United States. Extreme weather, such as the hurricanes of recent seasons, cause major disruption to offshore crude oil facilities. Also impacted are the pipelines and ports where crude and refined fuel are delivered to the US coast for refining and distribution. Terminals and refining facilities in the gulf coast area are also vulnerable to high winds and floods from storm surge and torrential downpours. Disruption to this distribution network has negative, cascading effects on fuel availability, fuel price, economic vitality, and public safety.

The US biodiesel industry can help the US adapt to these energy and national security impacts by offering a decentralized fuel production system. In contrast to the gulf coast's concentration of fuel resources and infrastructure in increasingly hurricane prone areas, 176 biodiesel plants have been constructed all across the country. (A map of plant locations is available at http://www.biodiesel.org/buyingbiodiesel/producers_marketers/Producers%20Map-Existing.pdf)These plants are often built in the geographic vicinity of feedstocks used by

				<p>each plant. They are also capable of using feedstock transported by barge, rail, and truck. The versatility of these biodiesel plants to use different kinds of feedstocks from different geographic areas reduces their susceptibility to interruptions such as those experienced in the gulf coast during recent emergencies. Because biodiesel plants are distributed across America, they are far less likely to suffer operational interruptions at multiple facilities due to a single natural disaster or terrorist attack. These attributes should be highlighted in any national plan to prepare this country for life in an era of global climate change.</p> <p>As climate change alters precipitation patterns in the US, wise use of water resources can be expected to be of even greater importance in the near future. Biodiesel as an alternative to petroleum is a wise use of water resources. The USDA/DOE lifecycle inventory referenced above also concluded that biodiesel reduces wastewater production by 79% and reduces hazardous waste production by 96% compared to petroleum diesel. Reducing wastewater production is key to preserving usable quantities of fresh water. Furthermore, utilizing renewable sources of energy is vital, because energy will always be required to treat and transport fresh water for human use.</p> <p>Biodiesel significantly reduces GHG emissions causing global climate change, and increases domestic energy security in ways that compliment strategies to adjust to global warming. For these reasons, biodiesel production and use should be supported at all levels of government and society where it is practical to do so.</p>	
P	Singmaster	Gen		<p>Stopping Unneeded GHG Emissions First</p> <p>Concerning your comments on NY Times' "Room for Debate" topic "Who Should Regulate GHG Emissions" Feb. 19, I will be forwarding several e-mails pointing out that unneeded GHG emissions are pouring out from the mishandling of the massive ever-expanding messes of organic wastes and sewage. By using the pyrolysis process on those messes detailed in my following big e-mail with many added comments, about half the biochemical carbon in the messes gets converted to inert charcoal(Remaking coal) with the rest going off in an expelled gaseous mix of various organic chemicals, some water and other gases, from which the organic chemicals can be collected to use as fuel or raw materials for making drugs, cosmetics and other useful chemicals. A very big additional</p>	<p>This issue of mitigation has been carefully evaluated in light of this and other comments. We have decided to expand our treatment of mitigation through revisions in the 'About this Report', 'Executive Summary', and 'Concluding Thoughts' sections, as well as other areas in the text. It should also be noted that the USP specifically avoids policy recommendations.</p>

				<p>benefit arises from pyrolyzing the messes because all germs, toxics and drugs are destroyed to greatly reduce escape problems and costs in new dumps compared to present ones. I urge you to check over my following e-mails and start calling for development of pyrolysis of the messes to stop some unneeded GHG emissions. Would you not agree that if we can stop dead some unneeded GHG emissions that we ought to get such action going first? Your comments will be appreciated.</p> <p>Is there or is there not already too much CO2 in the biosphere? All the proposals for global warming(GW) control so far made talk of cutting back emissions meaning that some more CO2 emissions will be increasing, more slowly perhaps, the overload. So if there is already too much, just reducing CO2 emissions goes nowhere. Unfortunately, the last NOAA or NASA report for 2007 indicated that atmospheric methane levels were increasing as well as CO2's adding to the problem.</p> <p>I am following this with an e-mail that tells how to actually remove some CO2 permanently by pyrolyzing the massive ever-expanding messes of organic wastes and sewage converting biochemical carbon into inert charcoal. A few added comments on the original e-mail outline have been made by me due to news and science reports since I wrote out the outline on using pyrolysis. Pyrolysis of those messes will have big additional benefits in also greatly reducing pollution of water systems as all germs, toxics and drugs will be destroyed and in reducing costs for new dumps.</p>	
P	Spanger-Siegfried	Gen		<p>The talented team behind this report has done a commendable job of synthesizing the state of knowledge around climate change and impacts in the United States.</p> <p>There is one area that I find extremely incomplete in this version, and thus very problematic: namely, the treatment of climate change solutions in general, and the role of mitigation in averting future impacts, in particular.</p> <p>The earlier draft report applied a tremendously effective framing to the entire body of information: the frame of climate choices. In this earlier version, it was clearly articulated that future climate change and resulting impacts depend fundamentally on our choice of emissions pathway. The connection between science, impacts and policy was laid out in simple, effective terms for the target audience.</p>	<p>This issue of mitigation has been carefully evaluated in light of this and other comments.</p> <p>We have decided to expand our treatment of mitigation through revisions in the 'About this Report', 'Executive Summary', and 'Concluding Thoughts' sections, as well as other areas in the text.</p>

						<p>What has changed (for the worse in my opinion) in this document is the near-complete removal of the fundamental link between near-term climate action and future climate change. The result is a report which is appropriately laden with information on potentially crippling impacts, but oddly decoupled from the human choices through which the most sobering effects may still be avoided. This rather fatalistic rendering of the information does not serve the reader as well as your earlier version.</p> <p>I would, therefore, strongly encourage the authors to reintroduce the earlier framing of climate choices, ensure this theme of human agency is once again articulated at the outset, is touched on throughout (e.g., when higher- and lower-emissions scenario findings are presented), and is revisited forcefully in the closing section.</p>	
	P	Wolf	Gen			Throughout: (We commend the CCSP for incorporating information from recent scientific studies on climate change into sections of this report, which provides important updates to information presented in the IPCC and SAP reports. The second public draft is greatly improved by the addition of citations throughout.)	Thank you.
	P	Milmoe	7	L	31	-I find it very important to understand the interconnectedness amongst various industries and sectors such as agriculture, public health, transportation, etc. as you have listed. I feel that continuing and integrating communications research will allow you to expand your knowledge of the depth of interrelatedness while also uncovering new connections.	Interrelations between sectors are reflected in the key findings, the adaptation boxes, and in the examples embedded in the text.
	P	Fitzpatrick	8	L	4	<p>About this Report, Pages 8 The 2nd public review draft version of the Unified Synthesis Product Global Climate Change in the United States is a useful, informative but insufficient assessment of climate change, impacts and responses. About this Report (Page 8) states that “While the primary focus of the USP is on the impacts of climate change in the United States, it also deals with some of the actions society is already taking or can take to respond to the climate challenge.”</p> <p>However the narrative that discusses emissions choices has been removed largely from the report and the chapter on response strategies has been removed. How have these deleted sections been re-incorporated in the text to ensure that the report shows how decision makers can respond to the challenge?</p>	Much of the emissions choices language has been folded into the ‘Executive Summary’ and other sections of the document.

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P	Staudt	8	L	18	[to L20] Constraining the discussion of mitigation to just the two CCSP SAPs seems inappropriately restrictive. Clearly other subjects in the report draw on a broader body of knowledge than what is included in the SAPs, so why is mitigation treated differently? While addressing the technological options for mitigation is beyond the scope, certainly the impacts of different mitigation choices would be relevant. Improved information on what the science says about emissions targets for the US and the world is desperately needed in the ongoing policy dialogue about response options. Research efforts supported by the program could be better synthesized in a way to address the questions of stabilization targets and the implications for emissions pathways. Furthermore, according to the US Global Change Research Act, this topic would clearly be within the scope of this report. (My understanding from the Charter is that this report is intended to fulfill the GCRA requirements for scientific assessment, i.e. “integrate, evaluate, and interpret the findings of the Program and discuss the scientific uncertainties associated with such findings.”) This begs the question as to why the report does not more directly address the implications of different emissions mitigation strategies, a subject of research supported by the CCSP.	This issue of mitigation has been carefully evaluated in light of this and other comments. We have decided to expand our treatment of mitigation through revisions in the ‘About this Report’, ‘Executive Summary’, and ‘Concluding Thoughts’ sections, as well as other areas in the text.
P	Staudt	8	L	20	[to L22] The US CCTP website does not have any information about a report on mitigation under development. At least, it’s not readily apparent where to find the information. The “What’s New” section has not been updated since May 2008.	This issue of mitigation has been carefully evaluated in light of this and other comments. We have decided to expand our treatment of mitigation through revisions in the ‘About this Report’, ‘Executive Summary’, and ‘Concluding Thoughts’ sections, as well as other areas in the text. Also, we find a large number of links to mitigation information on the CCTP web site.
P	Gilbert	8	L	22	In chapter “About this Report” under “Does this report deal with options for responding to climate change?” at end of paragraph 2 (p. 8) add: “In general, however, the CCSP suggests that proactive mitigation, rather than reactive adaptation, is the preferred approach to dealing with problems of climate change.”	The USP specifically avoids policy recommendations.
P	Shapiro	8	L	47	[to L48] Text understates the urgency of taking immediate action to reduce emissions and develop specific strategies to that end, such as increasing energy efficiency, using	We have expanded our treatment of mitigation through revisions in the ‘About this Report’,

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					renewable energy sources, and creating economic incentives for greenhouse gas reduction. The lack of detail in the draft conveys a lack of urgency that is not in keeping with the magnitude of the problem.	'Executive Summary', and 'Concluding Thoughts' sections, as well as other areas in the text, but it should be noted that the USP specifically avoids policy recommendations.
P	Fitzpatrick	9			<p>Executive Summary, Pages 9-12</p> <p>The 2nd public review draft version of the Unified Synthesis Product Global Climate Change in the United States is a useful, informative but insufficient assessment of climate change, impacts and responses. The stated goal of the report is "to make the key results of the enormous body of scientific information about climate change and its impacts on the United States accessible in a plain English document that can help inform public and private decision makers at all levels." There are several critical changes from the 1st public review draft that have decreased the potential use of this report as a reference document for decision makers.</p> <p>The Executive Summary has decreased from 9 pages to 4 pages in length, removing compelling descriptions of Sectoral and Regional impacts, as well as a complete section on Response Strategies. This includes removal of descriptions for planners and decision makers about community strategies for adaptation to climate change. Has this information been included elsewhere in the document? If not, why was it removed?</p>	The FACA team has deliberately condensed the report in response to many comments. Much of the language on response strategies has been folded into the Executive Summary on page 10, as well as recommendations at the end of the document.
P	Staudt	9			<p>Executive Summary: The Summary is much improved. It has an accessible "plain language" style that is very effective. I find the prose approach to be more readable and more fitting for this sort of report than the assortment of boxes used in the previous draft. The Summary does a good job of explaining at a not overly detailed level what the report covers. More importantly, it summarizes the state of understanding in a way that is straightforward and without an excessive use of qualifiers, caveats, and emphasis on uncertainty. This is a welcome change from some previous government reports on climate change, especially because it much more accurately characterizes the strength of knowledge and the sense of the scientific community.</p>	Thank you for your comment.
P	Gray	9	R	1	<p>[to R3] Tenor: Man made CO₂ causes global warming.</p> <ol style="list-style-type: none"> 1. The IPCC "hockey stick", published ice-core data showing atmospheric CO₂ increasing AFTER warming throughout geological time. 2. It follows that if the earth's climate behaved as the paper under comment describes, the 	The comment has been considered, but is judged to contain no suggestion relevant to improvement of the scientific content of the USP report.

						<p>feedback effect of increased atmospheric CO₂ would inhibit cooling after a warming period.</p> <p>3. The earth has, however, never failed to cool after a period of warming, increased CO₂ levels notwithstanding.</p> <p>4. The IPCC should, it appears, have argued that CO₂ causes cooling. They have no data to support their current position, which is also the position of the paper under comment.</p> <p>5. It seems extraordinarily unlikely that the hitherto unfailling sequence of events over hundreds of thousands of years has been reversed just today, particularly in the light of the following:</p> <p>-- CO₂ besides being colourless, benign and indeed essential to life, is a trace-gas making up only some 0.04 percent of atmosphere and less than five percent of all the so-called "greenhouse" gases. (Some 186 billion tons of CO₂ are estimated to enter earth's atmosphere every year from all sources.)</p> <p>-- Dwarfed as ever by nature, man creates (other than by breathing) around 3.3% of that 0.04%. The proportion of man-made CO₂ in the atmosphere is thus, try as we may, still around 13.2 parts per million. That ratio is probably rising but clearly has some way to go before becoming significant, particularly since there is no evidence that any level of CO₂ has ever triggered warming up to now.</p> <p>-- CO₂ is indeed an efficient reflector of IR radiation, <u>but only in a small sector of the IR waveband.</u></p> <p>-- Much IR thus passes straight through what CO₂ there is and, since man-made CO₂ is very thinly spread, (see above), the majority of IR radiation simply passes it by.</p>	
P	Knutson and Vecchi (NOAA/GFDL)	9	R	2	<p>"The global warming observed over the past 50 years is due primarily to human-induced emissions of heat-trapping gases." This is stronger than the IPCC AR4 statement: "<i>Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations.</i>" The report should go with the IPCC statement unless a very good case is made for the stronger statement (it isn't). Same comment applies for p. 10, L3; P. 19, L20, and elsewhere in report.</p>	<p>Additional work since the 2007 IPCC report (since 2005) gives us greater confidence in the attribution of global warming to human sources, and the author team does not agree with the suggested revision. See the 'Global' Section for more details.</p>	
P	Alvarez	9	R	2	<p>I believe the linkage that has been made is between the observed rate of increase in temperature and human activity, not the overall increase. Change: change the start of line R2 to read "The observed rate of increase in temperature over the past 50 years"</p>	<p>We have decided to leave this as written. We do not feel that the suggested change is technically correct.</p>	

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P	Fitzpatrick	9	R	2	The Executive Summary lacks a reference to current observed temperature changes compared with known past changes. The sentence on Page 9, Line R2 “global warming observed... heat-trapping gases” needs context in terms of a longer record. Suggest the following sentence be added: “Changes in purely natural factors also influence climate, but cannot explain the warming of the past 50 years.”	We have decided to leave this as written. We do not want to diminish the basic message provided by the current sentence.
P	Niblock	9	R	2	<p>The second sentence of the executive summary states “The global warming observed over the past 50 years is due primarily to human-induced emissions of heat-trapping gases.” There are at least two scientific papers that indicate that emissions of carbon dioxide, methane, and other greenhouse gases do not necessarily cause global warming. The first(ref 1), published in 1990, reported a study by scientists at AT&T Bell Labs of a recent period of thirty years. That study noted that temperature and atmospheric carbon dioxide content are significantly correlated. The second(ref 2) states that concentrations of carbon dioxide and methane correlate well with Antarctic air temperature over a period of about 420,000 years.</p> <p>The first of those two studies, a time-series analysis, contradicts the notion that increases in greenhouse gas content cause temperature increases. The Bell Labs study concludes: “Changes in carbon dioxide content lag those in temperature by five months.” If human-induced emissions cause temperature increases, the increase in carbon dioxide content of the atmosphere would be expected to increase before the temperature increase.</p> <p>The second study of Antarctic ice cores that spans 420,000 years cites a separate study(3) of their data which found that during periods of temperature increase the carbon dioxide content lags the temperature increase by 200 to 1,000 years. Over this much longer period, the carbon dioxide increase again follows the temperature increase. That report states: “The time lag of the rise in CO2 concentrations with respect to temperature change is on the order of 400 to 1000 years during all three glacial-interglacial transitions.”</p> <p>It appears that increasing temperatures cause increased carbon dioxide content. If not, these reports indicate a singular anomaly, an effect that precedes its cause.</p>	We have decided to leave this as written. Additional work since the 2007 IPCC report (since 2005) gives us greater confidence in the attribution of global warming to human sources. See the ‘Global’ Section for more details.

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					References: Kuo et al. Nature 343, 709-741, 22 Feb 1990. "Coherence established between atmospheric carbon dioxide and global temperature" Petit, et al. Nature 399, 429-436, 3 Jun 1999. "Climate and atmospheric history of the past 420,000 years from the Vostok ice core, Antarctica" Fischer, H., et al, Science 283, 1712-1724 (1999). "Ice Core Records of Atmospheric CO ₂ Around the Last Three Glacial Terminations"	
P	Milmoie	9	R	4	-You do a good job of introducing the structural constraints of addressing climate change (P9, R4). While there are several unknown factors and effects of climate change, the presence of uncertainty appears a bit redundant. As a concerned citizen, I would much rather focus on bridging existing gaps than continuing to explore "knowing what we don't know". I feel that such a proactive approach would better empower citizens to become involved in climate change, as opposed to continually being inundated with fear and uncertainty. I do appreciate the "key" to terminology associated with uncertainty (P12; R5)	Document revisions now include a new section entitled: 'An Agenda for Climate Impacts Science'. We believe that this addresses the reviewer's comment.
P	Knutson and Vecchi (NOAA/GFDL)	9	R	10	[to R12] Temperatures in the United States, <i>with the exception of the Southeast</i> , have risen by...	The text has been changed and now discusses the issue in the context of the "U.S. average temperature."
P	Carns	9	R	13	"Increases at the lower end of this range are more likely if global heat-trapping gas emissions are cut substantially, and at the upper end if emissions continue to rise at or near current rates." Unclear sentence construction. Suggested revision: "Increases at the lower end of this range are more likely if global heat-trapping gas emissions are cut substantially. If emissions continue to rise at or near current rates, increases are more likely to be near the upper end of the range."	Thank you for your comment. The suggested change has been made.
P	Tolman	9	R	17	Change 'strength' to 'response'.	This sentence has been removed in the course of editing the 'Executive Summary'.
P	Spanger-Siegfried	9	R	19	[to R23] This paragraph suggests, presumably inadvertently, that reducing emissions of carbon dioxide is a lower priority than reducing those of methane and certain particles. I would encourage the authors to edit the text to avoid such a misreading, particularly given it's placement in the very front-end framing of the report.	We have added a sentence to address this concern.

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P	Shapiro	9	R	25	This statement should be strengthened to indicate that the large majority of deviations from consensus predictions have been in the direction that climate impacts have been larger and more rapid than anticipated. Many people will rely on this report to interpret cautions about the inherent uncertainties in climate science. They will be seriously misled if they do not know that the errors have largely been on the side of underestimating the speed and magnitude of adverse change.	We have addressed this point in the 'Concluding Thoughts' section.
P	Carns	9	R	28	"A longer ice-free period on lakes and rivers, lengthening of the growing season, and increased water vapor in the atmosphere has also been observed." Subject-verb disagreement--three phenomena are mentioned, so this should be "have" not "has."	Thank you for your comment. The suggested change has been made.
P	Tolman	9	R	29	Change 'has' to 'have'.	Thank you for your comment. The suggested change has been made.
P	Carns	9	R	33	..."surrounding coastal waters including..." Insert a comma, to read "...surrounding coastal waters, including..."	Thank you for your comment. The suggested change has been made.
P	Pendergrass	9	R	38	[to R45] The last paragraph on the page is the most important summary paragraph of the Executive Summary. It should be expanded to include the most important points from the rest of the report. Otherwise, the Executive Summary fails to summarize the report.	We feel that the broader perspective is provided in the Key Findings.
P	Staudt	9	R	38	Should refer readers to Page 11.	We have adjusted the text to make the reference clearer.
P	Tolman	9	R	42	After 'Southeast' add ', Middle-Atlantic'.	'Middle-Atlantic' is not one of our defined regions, so we are leaving this as written.
P	Alvarez	9	R	43	In my opinion storm surge during hurricanes carries a high potential for damage to the coastal built environment; also, storm surge is one damage component of hurricanes that is already being exacerbated by global warming through sea level rise. In addition, adaptation measures can be taken now through changes in building codes and design criteria for new buildings. Because of this, it is important to list storm surge as one of the examples of impacts. Change: insert "storm surge damage" after "risk of erosion"	We have revised the text to address your point.
P	Carns	10			[and p. 11] The report mentions certain things as being vital to a complete discussion of climate change, then says they won't be discussed. Page 10 (column 2 para. 2 line R21) says "a discussion of these issues would be incomplete without mentioning some of the	This issue of mitigation has been carefully evaluated in light of this and other comments. We have decided to expand our treatment of

					<p>actions society can take...", (line R33) "...mitigation is not directly addressed in this report." Page 11 (column 1 para. 4 line L47) reads "It is thus difficult to fully evaluate the impacts of climate change on the United States without considering the consequences of climate change elsewhere. However, such analysis is beyond the scope of this Report." I expect mention of the importance of a particular topic to be followed by a discussion of it; to say that it is important and then point out that it won't be discussed weakens the authority of the report.</p> <p>The sections should be rewritten to avoid building up reader expectations and then immediately disappointing them. Writing "mitigation will not be discussed in this report, but it is important for [reasons]" might be an improvement.</p>	<p>mitigation through revisions in the 'About this Report', 'Executive Summary', and 'Concluding Thoughts' sections, as well as other areas in the text.</p>
P	Pendergrass	10			<p>[and left column p. 11] This page and a half contains lots of important topics not found in the rest of the report (unanticipated impacts, uncertainty, and mitigation). It reads more like a persuasive essay for action than a summary of the report. If the purpose of the executive summary is to give someone an idea of the highlights of the report in 4 pages, these two pages are not helpful. They belong in an introduction instead of in a summary.</p>	<p>We feel that our generalized approach is appropriate for this section.</p>
P	Alvarez	10	L	5	<p>Because the emphasis over the past few years has been on mitigation, it is important to balance things out by sending the message that adaptation deserves a level of attention that is equal to that we pay mitigation. Change: change "adjust" to "adapt"</p>	<p>The suggested change has been made.</p>
P	Alvarez	10	L	6	<p>It is important that we differentiate what we can do with respect to existing facilities and infrastructure versus that which under design and not yet built. Change: insert "existing" after "replace"</p>	<p>We have modified the text to address your concern.</p>
P	Alvarez	10	L	9	<p>Given the trillions of dollars invested in buildings and infrastructure in the coastal region, it is important a message be sent relative to the need for adaptation to protect such enormous value at risk. Change: after "abrupt climate change," insert "which may require radical changes in the current approach and criteria for the design, construction and specific location of new buildings and infrastructure particularly in coastal communities"</p>	<p>We have decided that we cannot include this detail here, but the topic is more generally covered elsewhere in the document.</p>
P	Tolman	10	L	20	<p>After 'storms;' add 'large releases of CO2 and methane from melting permafrost and methane hydrates;'</p>	<p>We will add this point in the 'Global Climate' Section under abrupt climate change.</p>

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P	Gray	10	L	29	<p>[to R17] Tenor: You can be confident in the paper under comment because it is underpinned by <i>“careful analysis of outputs from global climate models run on the world’s most advanced computers”</i></p> <ol style="list-style-type: none"> 1. Lehman Bros enjoyed the same priceless advantages in their field. 2. The models do not work; applied retrospectively they predict today’s temperatures to be much higher than they are. Reliable prediction is, in any event and any discipline, a chimera, particularly where there are, as here, a multitude of factors including known and unknown unknowns. 3. The model underlying the IPCC’s own “hockey stick” graph, for example, has been shown to make a hockey stick out of the numbers in the telephone book, and hurricane path models get even the very next day wrong. 	Thank you. The comment has been considered, but is judged to contain no suggestion relevant to improvement of the scientific content of the USP report.
P	Tolman	10	L	32	After ‘computers’ add ‘and paleoclimate data showing how Earth’s climate has changed in the distant past’	We feel that the language is clearer as written.
P	Tolman	10	L	43	After ‘this century’ add ‘and beyond’.	The text has been revised.
P	Tolman	10	L	48	After ‘this century’ add ‘ – especially –’.	We have made this change as suggested.
P	Milmoe	10	R	1	<p>-As you mention the need to manage for a future prediction condition (P8, R1), the importance of adaptive management immediately comes into mind. It is not until four paragraphs later that you introduce the idea of adaptation (P8; R40), and further mention the term over the next several pages. I would emphasize a stronger introduction and definition of adaptability / adaptation to better communicate urgency and the need for continued preparedness.</p> <p>(P12, L9) is a later example of a far more concrete definition that I feel needs to be introduced earlier.</p> <p>(1) “mitigation” measures to reduce climate change by reducing emissions of heat-trapping gases and particles; and (2) “adaptation” measures to improve our ability to cope with</p>	This issue of mitigation has been carefully evaluated in light of this and other comments. We have decided to expand our treatment of mitigation through revisions in the ‘About this Report’, ‘Executive Summary’, and ‘Concluding Thoughts’ sections, as well as other areas in the text.

					or avoid harmful impacts and take advantage of beneficial ones, now and in the future.	
P	Carns	10	R	2	<p>"...there is a high degree of confidence in projections of future temperature increases that are greatest near the poles and in the middle of continents."</p> <p>This sentence is not clear--does it mean there is high confidence in the projections, which happen to predict greater increases near the poles and middles of continents? Or does it mean that, while the projections of average temperature are uncertain, there is high confidence that temperature increases at poles and continent centers will be greater than the average?</p>	We have corrected this.
P	Fitzpatrick	10	R	16	Strongly recommend that the paragraph beginning "Unanticipated impacts..." should remain in the final document. The paragraph describes in a general way the major influences of the climate system on large-scale oceanic and atmospheric processes, and the subsequent risks to ecosystems. It is important to the understanding of the scale and nature of risks.	Thank you for your comment. The paragraph has been retained.
P	Tolman	10	R	18	<p>Add a new paragraph as follows:</p> <p>"An important factor in projecting how the climate may change in the future is the sensitivity of the global average temperature to a doubling of the atmospheric carbon dioxide concentration – the so-called climate sensitivity. Scientists have thought, based on climate models, that the most likely value was about 3°C (5.4°F), with a range of uncertainty of about ±50%. A credible recent report by James Hansen and others, based on studying Earth's climate history, says that the historical record shows a sensitivity of 6°C (about 11°F). This means that we may already have released enough carbon dioxide to cause dangerous interference with the climate system.</p> <p>Another worrisome finding from Earth's climate history is that there were abrupt large increases in global temperature and ocean acidity 55 million years ago at a time geologists call the Paleocene-Eocene Thermal Maximum. It appears that at least 2000 billion tons of methane were released from the warming sea floor; subsequent oxidation of the methane to carbon dioxide and dissolving part of it in the ocean increased the acidity enough to destroy sea creatures with calcium carbonate shells, leading to a marine extinction event. This suggests that continued burning of fossil fuels might cause enough warming to induce a tipping point with a similar methane release and abrupt changes in</p>	We have decided to leave as written. This is more detail than we have space for, or want to include in the 'Executive Summary'.

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					global temperature and ocean acidity.”	
P	Gunther	10	R	19	<p>I applaud NOAA for the release of this important report. While I could make many minor comments, I will instead provide on major comment for your consideration. It is essential that in the Executive Summary, which will likely be read much more widely than the rest of the report, you point out that the rate of mitigation implementation starting TODAY will have a major influence upon effects in the future. There is an inherent time delay in implementation for a variety of reasons, and we cannot wait until some time in the future and then attempt to move our economy to a lower carbon status.</p> <p>It is not a policy I am asking you to recommend. Rather, it is simply the mathematics of slope that has such important policy implications. If we start now, we can reduce carbon emissions 3% per year. If we wait another 10, we’ll have to reduce 8% per year.</p>	<p>This issue of mitigation has been carefully evaluated in light of this and other comments. We have decided to expand our treatment of mitigation through revisions in the ‘About this Report’, ‘Executive Summary’, and ‘Concluding Thoughts’ sections, as well as other areas in the text.</p>
P	Tolman	10	R	31	Delete ‘, and so on’.	Correction made.
P	Shapiro	10	R	33	[to R34] The failure to include a detailed discussion of mitigation options seriously undermines the report's utility. These options and the relevant technical and economic parameters to be considered deserve to be included in summary form.	<p>This issue of mitigation has been carefully evaluated in light of this and other comments. We have decided to expand our treatment of mitigation through revisions in the ‘About this Report’, ‘Executive Summary’, and ‘Concluding Thoughts’ sections, as well as other areas in the text.</p>
P	Fitzpatrick	10	R	35	<p>This section should convey a far stronger description of the role of mitigation in limiting climate change and impacts. The section from Exec Summ, Page 10, Line R24-R38 does not adequately describe the role of mitigation in avoiding the most dangerous consequences of climate change. Suggest that the following sentence is added on Exec Summ, page 10, Line 35 before the sentence starting “Mitigation”:</p> <p>“By reducing emissions in the short term, the resulting climate impacts may be limited to a more manageable level, avoiding the worst projected climate impacts.”</p>	<p>This issue of mitigation has been carefully evaluated in light of this and other comments. We have decided to expand our treatment of mitigation through revisions in the ‘About this Report’, ‘Executive Summary’, and ‘Concluding Thoughts’ sections, as well as other areas in the text.</p>
P	Fitzpatrick	10	R	38	<p>This section should convey a far stronger description of the role of mitigation in limiting climate change and impacts. Suggest the following sentences be added after “...in current</p>	<p>This issue of mitigation has been carefully evaluated in light of this and other comments.</p>

					research.”: “Another 1 deg F of warming in the next few decades (on top of the 1.5 deg F rise) is already locked in due to past emissions. The amount of warming we will experience beyond the next few decades depends on choices about emissions made now and in the near future. Lower emissions of heat-trapping gases will result in less climate change and related impacts.”	We have decided to expand our treatment of mitigation through revisions in the ‘About this Report’, ‘Executive Summary’, and ‘Concluding Thoughts’ sections, as well as other areas in the text.
P	Alvarez	10	R	40	In my opinion we must place equal emphasis on both mitigation and adaptation measures, consequently we must avoid giving any impression that mitigation is more important than adaptation. To that end, if we call mitigation “major” we should also qualify adaptation as “major”. Change: insert “major” after “The second...”	This issue of mitigation has been carefully evaluated in light of this and other comments. We have decided to expand our treatment of mitigation through revisions in the ‘About this Report’, ‘Executive Summary’, and ‘Concluding Thoughts’ sections, as well as other areas in the text.
P	Alvarez	10	R	44	[and R45] The timelines for mitigation and adaptation measures to produce results are often quite different. Also the degree of certainty regarding how effective a particular measure will be varies considerably between mitigation and adaptation. There is a moderate to high degree of uncertainty regarding how effective mitigation measures will actually be and how soon they may show tangible results. In contrast to this, there is a moderate to high degree of certainty that effective adaptation measures need to be taken now, which can produce tangible results, to protect the built environment and infrastructure from some of the impacts already being felt. Because of this asynchronous nature of the timelines for mitigation and adaptation it is counterproductive to make the statement “Effective mitigation measures reduce the need for adaptation” Change: delete the sentence “Effective mitigation measures reduce the need for adaptation.	This issue of mitigation has been carefully evaluated in light of this and other comments. We have decided to expand our treatment of mitigation through revisions in the ‘About this Report’, ‘Executive Summary’, and ‘Concluding Thoughts’ sections, as well as other areas in the text.
P	Alvarez	10	R	50	The report has a major weakness in that it does not address the major drivers of climate change that are the rotational and orbital mechanics of the Earth, and the variations in solar activity, which are cosmological in nature and totally beyond human influence and control. By listing three main drivers and omitting any mention of the cosmological drivers the report paints a partial picture at best. Change: add new language after “This is true for several reasons” , add “First, because climate change is also driven by cosmological processes that are beyond human influence and control, such as the rotational and orbital mechanics of the earth, and variations in	On the time scales that we are focused on (decades to centuries), this is not relevant.

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					solar activity.”		
P	Alvarez	11	L	3	[and L8] Also on Page 11, Line L3, change “Second” to “Third” Also in Page 11, Line L8, change “Third” to “Fourth”		We disagree with the suggestion and have decided to leave this as written.
P	Tolman	11	L	3	After ‘have’ replace the rest of the sentence by ‘a large heat capacity and a long turnover time, so that the global average surface temperature will continue to increase for centuries, even after net greenhouse gas emissions are zero and the composition of the atmosphere is no longer changing.’		This sentence has been rewritten.
P	Staudt	11	L	15	[to L30] I’m surprised that the US Global Change Research Act is not mentioned here. According to the charter for this activity, the report is intended to address the duties required by this law (here’s a link to the charter: http://www.climate.noaa.gov/ccsp/pdf/usp_draft_charter.pdf).		The legal underpinnings are discussed in the ‘About this Report’ section.
P	Alvarez	11	L	27	[and L28] While there is uncertainty regarding how much adaptation will need to be implemented, and by when, to reduce the potential for damage from climate change exacerbate impacts, there is a much higher degree of uncertainty and clearly many more factors at play regarding the effectiveness of mitigation measures. Consequently it is counterproductive to make the statement that “However, it is clear that there are limits to how much adaptation can achieve”. First , because of the risk of painting a doomsday scenario that may drive society to inaction. Second, because relative to many of the potential impacts we already have the knowledge and technology to quantify and characterize the same in terms of actual forces [loads] that may affect buildings and infrastructure, which allows to the identification, design and implementation of adaptation measures now. Change: Delete the following language: “However, it is clear that there are limits to how much adaptation can achieve”.		Our team feels that the statement about limits to adaptation is appropriate.
P	McCurry	11	R	2	It would be appropriate to make a statement regarding the importance of reducing emissions of greenhouse gasses in the US. Such a statement would be supported by information presented in the report, including the summary statements on Page 9 Lines R2 to R3 and Page 9 R13 to R16.		Thank you for your comment. This general topic has now been adequately addressed elsewhere in the Executive Summary.
P	Kruk (NOAA/NCDC)	12			Recommend listing the Key Findings in order in which they appear in the rest of the report. That is, they should be listed chronologically according to page number of their		We have considered this suggestion but do not agree.

					eventual discussion within USP.	
P	Milmoe	12			<p>-Key Findings:</p> <p>-1. (P12; L1) “There is no question that global temperature has increased over the past 50 years”. This is a very clear, concise and direct statement that I think will resonate with members throughout society. Very nice!</p> <p>-2. (P12; L5) “Climate changes are underway in the United States...” -We are clearly already experiencing these physical effects of climate change. I would encourage you to reconsider wording of this caption to be more direct.</p> <p>-3. (P12; L11) Sections 2 and 3 address different topics, yet the caption summaries are quite similar. I would again encourage revisiting both of these.</p> <p>-4-7. Nice captions. Very direct and target a specific issue.</p> <p>-8-10 These present good “next steps” exploring interconnectivity, unanticipated consequences, and looking ahead into the future.</p>	Thank you for your comment. We feel that the language used for the Key Finding addressed by the second point is effective and should be Retained in the final report.
P	Spanger-Siegfried	12			To accurately reflect recent literature and provide the reader with a more complete sense of the state of scientific knowledge, can this findings section somewhere acknowledge the rapid (and scientifically surprising) pace of observed change?	We have included a sentence in the ‘Executive Summary’ narrative to address your point.
P	Gilbert	12	L	45	<p>In chapter “Executive Summary” (p. 9) under “Key Findings” (p. 12) at end of paragraph 10 (“Future climatic change and its impacts depend on choices made today”) add:</p> <p>“Since the ultimate economic and human welfare costs of trying to adapt to the consequent climate change could substantially exceed the costs of current and near future mitigation measures, the CCSP recommends that policy decisions be preferentially directed toward proactive mitigation measures rather than later, out of necessity, toward reactive adaptative measures.”</p>	The USP specifically avoids policy recommendations.
P	Alvarez	12	R	2	<p>The long term scientific record points toward cosmological natural processes, such as the rotational and orbital mechanics of the Earth and changes in solar activity, as major drivers of climate change. Because of this it is important not to give the impression that human activity is the main driver of global warming, although it is important to emphasize the human contribution to the recent and continuous increase in the rate of warming.</p> <p>Change: change the second sentence to read: “The observed rate of temperature increase</p>	Cosmological changes are important on scales of 20,000 years or more. We are talking about scales of a human life time. On those scales, these cosmological factors are exceedingly minor.

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					is due primarily to human-induced emissions of heat-trapping gases”.	
P	Fitzpatrick	12	R	3	Omitted from the Key Findings is the crucial information for readers of this document that global emissions are higher than those used in climate models. Suggest under Key Finding 1, Exec Summ, Page 12, Line 3 the following sentence is added: “Global emissions of heat-trapping gases are now increasing even more rapidly than the highest emissions scenarios scientists have used in these analyses.”	No change made as this point, while shown on page 25, is minor in the near term. Besides, emissions are proportional to GDP and therefore it seems likely that 2009 emissions will be below the scenarios.
P	Carns	12	R	6	"These include increases in temperature, sea level, and heavy downpours, rapidly retreating glaciers..." Trying to connect "increases in" to "temperature", "sea level", and "heavy downpours" breaks the pattern of the rest of the sentence and may be confusing. Suggested revision: "These include increases in temperature, rising sea levels, more frequent heavy downpours, rapidly retreating glaciers..."	Thank your for your comment. The sentence has been revised to address this point.
P	Alvarez	12	R	7	In order to be more specific regarding the high potential for damage from specific impacts we must also list “storm surge”. Change: add “storm surge” after “sea level”	Storm surge is mentioned in key finding 6. We don't have room to mention it twice.
P	Fitzpatrick	12	R	9	Omitted from the Key Findings is the crucial information for readers of this document that many climatic changes are occurring at a faster rate than projected even a few years ago. Suggest under Key Finding 2, Exec Summ, Page 12, Line 9 the following sentence is added: “Many climatic changes are occurring faster than projected even a few years ago.”	We have included a sentence in the Executive Summary narrative to address your point.
P	Alvarez	12	R	12	To call attention to the high value at risk we must specifically mention “the built environment” Change: add “the built environment” after “energy”	This is a reasonable suggestion, but we don't have space. The ‘Energy’ and ‘Transportation’ Sections, of course, include the built environment. Other sectors could have been added before built environment if we had had space.
P	Alvarez	12	R	17	[and R18] Water management, which involves flood control, water availability and quality etc., is perhaps a more comprehensive term to be used here. Change: replace “Floods and water quality problems are....” with “Water management problems are”	Water management is too abstract for our target audience while the language we use, floods and water quality, are easily understood.

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P	Carns	12	R	17	"...increases in evapotranspiration"--"evapotranspiration" is jargon. Possible revision: "increases in water loss by evaporation , including evaporation from plant surfaces (transpiration.)"	Thank you for your comment. The sentence has been edited to address this comment.
P	Tolman	12	R	19	After 'Southwest' add 'California,'.	We no longer say southwest, just the west as it applies to all of the West, which includes California.
P	Alvarez	12	R	28	To focus attention on the high value at risk the "built environment" should ne specifically listed here. Change: change the sentence to read "The built environment, energy and transportation infrastructure..."	"Built Environment" has been added in several sections of the report, although not in this list of Key Findings.
P	Fitzpatrick	12	R	38	Omitted from the Key Findings is the crucial information for readers of this document that extreme weather events are more likely to occur. Suggest under Key Finding 8, Exec Summ, Page 12, Line 38 the description be expanded to include the occurrence of extreme weather events. Add the sentence "As historical climate and weather patterns may no longer be an adequate guide to the future, planning should take into account the occurrence of simultaneous extreme weather events that can amplify impacts and challenge our response capabilities."	We feel that extremes are adequately addressed in Key Findings 2, 6, and 7.
P	Tolman	12	R	42	Change 'unforeseen' to 'unpredictable'. [Methane release from methane hydrate as the sea floor warms is not unforeseen, but its timing and magnitude are unpredictable.]	Left as is, as some are known to be unforeseen, like the ozone hole. No change necessary.
P	Fitzpatrick	12	R	42	Omitted from the Key Findings is the crucial information for readers of this document that some climatic changes (potentially leading to irreversible thresholds) are happening faster than anticipated. Suggest under Key Finding 9, Exec Summ, Page 12, Line 42 the following sentence "Such changes ... been observed." be amended to: "Such changes, including faster melting of both the Arctic sea ice and the large polar ice sheets, have already been observed."	We have included a sentence in the Executive Summary narrative to address your point.
P	Alvarez	12	R	44	To maintain the focus on adaptation of the built environment this section would be enhanced by adding language addressing that topic. Change: add language after "flood and fire risks" ADD: " also using forward-based design criteria in the construction of buildings in areas vulnerable to storm surge and coastal flooding"	The sentence quoted has been removed. Space is limited so we can not add more about the built environment.

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P	Spanger-Siegfried	12	R	45	[to R49] This key finding acknowledges the role of emissions choices in determining future climate change and impacts. But it then goes on to provide examples (with page numbers) only for adaptation. To readers, the subtext is that adaptation is most important, and has therefore been given space within the report. (This is equivalent to telling someone on a sailboat that there is a potentially devastating storm approaching, that these are the steps to securing equipment below decks, but never telling them the storm's path and how to steer clear of it.) I encourage the authors to clearly name what we mean by reducing emissions in this finding, and then to include/reintroduce such information in the body of the report.	This issue of mitigation has been carefully evaluated in light of this and other comments. We have decided to expand our treatment of mitigation through revisions in the 'About this Report', 'Executive Summary', and 'Concluding Thoughts' sections, as well as other areas in the text.
P	Fitzpatrick	12	R	49	Omitted from the Key Findings is the crucial information for readers of this document that extreme weather events are more likely to occur. The key findings do not address the increases in extreme events which are clearly discussed in the Chapter on National Climate Change on Page 27. Title: "Extreme weather and climate are having increasing impacts on society and pose limits to adaptation" Suggested text: "Many types of extreme weather events have become more frequent and intense in the U.S. during the past 40 to 50 years. Changes in extreme weather and climate are among the most serious challenges to our nation in coping with a changing climate. (p. 32-33)"	We feel that this is more appropriately addressed in Key Finding 2.
P	Fitzpatrick	12	R	49	Omitted from the Key Findings is the crucial information for readers of this document that unless reductions in emissions occur that some climatic changes may be too great to adapt to. Suggest under Key Finding 10, Exec Summ, Page 12, Line 49 the following sentence be added after "... that are unavoidable" : "However, there are limits to adaptation due to technical, societal and financial challenges. By limiting emissions to the low end range of scenarios, successful adaptation is more likely."	This issue of mitigation has been carefully evaluated in light of this and other comments. We have decided to expand our treatment of mitigation through revisions in the 'About this Report', 'Executive Summary', and 'Concluding Thoughts' sections, as well as other areas in the text.
P	Pendergrass	13	R	25	[and R26] In the last sentence of the paragraph, omit "necessarily" because it is awkward and unclear. One alternative is to replace "understanding these changes and their impacts necessarily requires an understanding of the global climate system" with "the climate system is global so to understanding impacts here requires an understanding of the whole system."	The suggested change has been made.

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P	Pendergrass	14	L	2	[and L11, R5] Lines L2 and R5 are headings containing the term “heat-trapping gases,” which are discussed in the subsequent sections. In the text after line R5 and figure on this page, the widely known term “greenhouse gases” is used instead of “heat-trapping gases.” The term “heat-trapping gases” is never defined, and is vague and unfamiliar. One of these terms should be chosen, probably the more familiar “greenhouse gases.” Whichever term is chosen should be defined in a new sentence starting on line L11, immediately after the sentence describing these gases (e.g. “These gases are called greenhouse (or, heat-trapping) gases.”). Then, the term should be applied consistently throughout the report.	The suggested change has been made.
P	Tolman	14	L	26	After ‘era,’ insert ‘about 1750,’.	We have modified the sentence along the lines of your suggestion.
P	Tolman	14	R	18	After ‘since the’ insert ‘beginning of the’.	Thank you for your comment. The text has been edited following your suggestion.
P	Pendergrass	14	R	25	One problem throughout this chapter that is particularly conspicuous in the methane discussion is the lack of acknowledgement of uncertainty when numbers are provided. The methane budget mentioned in the paragraph about methane is not well constrained (as of IPCC AR4, see WG1 Chapter 2), so the 70 percent of emissions attributed to humans in this line is probably highly uncertain. At a minimum, the reference for this value should be provided, but it would also help to qualify the figure with a mention of the uncertainty about methane.	We consider this issue settled. We have added a reference to IPCC 2007 WG1, Chapter 7 for clarity.
P	Tolman	14	R	40	After ‘as a result of’ insert ‘photolysis in the stratosphere and’.	We have decided to leave as written.
P	Pendergrass	14	R	42	[to R44] The halocarbon paragraph only discusses CFCs and concludes that their concentrations are decreasing due because of regulation following the Montreal protocol. But HFCs, the replacements for CFCs, aren’t discussed. They are also strong radiative absorbers and their concentrations are increasing (see your reference 2, Chapter 2 of the IPCC AR4 WG1 assessment report, page 144). The last sentence of this paragraph should be changed to “Continued decreases in ozone-depleting halocarbon emissions are expected to reduce their effect on climate change in the future.” In addition, this or a similar statement should be added: “However, CFCs are being replaced by gases, largely hydrofluorocarbons (HFCs), that have similar properties but don’t harm the ozone layer.	This is an excellent point that we have addressed in the text. We are citing sap 2.4 for the information.

					These gases still have a strong effect on climate change, and their concentrations are increasing.”		
	P	McCurry	14	R	43	The text is missing from this line.	We have reviewed this paragraph and do not see this problem.
	P	Roberts	14	R	44	<p>The U.S. Climate Change Report appears to be a well reasoned and comprehensive analysis of the present and predicted impacts of climate change in the United States, and Environmental Investigation Agency (“EIA”) will leave it to climate scientists and organizations to make sure that the consequences of the climate crisis are accurately portrayed. EIA is submitting these comments to point out the Climate Change Report fails to accurately depict the causes of climate change by completely omitting discussion of hydrofluorocarbons (“HFCs”) and ozone depleting substances (“ODSs”) which are super greenhouse gases (“GHGs”) with global warming potential (“GWP”) hundreds and thousands of times greater than carbon dioxide (“CO2”). For example, if the causes of global climate change are not fully understood, it is impossible to fully understand the magnitude of the problem or to fashion a proper remedy and response.</p> <p>The Montreal Protocol on Substances that Deplete the Ozone Layer (“Montreal Protocol”) has forced the phase-out of more than 95% of several classes of chemicals that deplete the ozone layer in developed countries and approximately 50-75% of ODSs in developing countries. It is estimated that the phase-out of CFCs and other ODSs will have reduced GHG emissions by 135 gigatons (“Gt.”) of CO2 equivalent (“CO2-eq.”) between 1990 and 2010. As a consequence of these phase-outs, a significant portion of ODSs that are used as refrigerants and foam-blowing agents are now being replaced with HFCs. Although HFCs are not ODSs, they are extremely powerful GHGs that exacerbate climate change. Most HFCs have a global-warming potential hundreds to thousands of times greater than CO2. The production of HFCs is increasing exponentially and is set to become a major contributor to climate change unless there is a concerted effort to use low GWP substitutes for ODSs.</p> <p>BAU HFC AND HCFC Market Demand (Estimated) in U.S.</p> <p>A second issue that must be addressed is that although there are existing stockpiles of ODSs that have been taken out of service, ODSs in discarded stockpiles, equipment and</p>	We have added a sentence to address your concern.

					<p>products (collectively referred to as “Banks”) are rapidly emitting powerful GHGs into the atmosphere. ODSs in Banks are continuously being released to the atmosphere, either through leakage or when ODSs or products containing them are disposed of at the end of their useful lives. The emissions from Banks are delaying the recovery of the ozone layer and are exacerbating global climate change. Banks are currently not regulated by either the Montreal Protocol or the Kyoto Protocol of the United Nations Framework Convention on Climate Change (“UNFCCC”). The International Panel on Climate Change (“IPCC”) and the Technology and Economic Assessment Panel (“TEAP”) estimated in 2002 that approximately 21,000,000,000 tons (“Gt.”) of CO2 equivalent (“CO2–eq.”) are contained in Banks . Unless action is taken now, 6 Gt. of CO2–eq. will be emitted from Banks by 2015, nullifying all of the reductions in GHGs achieved under the Kyoto Protocol. If only the world’s Banks of ODSs in refrigeration, stationary air conditioning and mobile air conditioning (i.e., those that are most easily and cost-effectively recovered) were destroyed, it is estimated that the release of approximately 2.8 Gt. of CO2–eq. would be prevented by 2015. As these emissions are already occurring continuously throughout the world, the gains that could be achieved by preventing these super GHGs from being emitted to the atmosphere are available immediately.</p> <p>Failure to include HFCs and ODS Banks in the U.S. Climate Change Report omits a major cause of climate change and fails to indentify actions that need to be and can be taken to dramatically reduce GHGs. The transition to high-GWP HFCs is occurring now and will only accelerate as phase-out deadlines occur (e.g., production and consumption of CFCs, halons and carbon tetrachloride are already phased out in developed countries and are scheduled to be phased out in developing countries in 2010). Emissions from banks are occurring daily and off-setting the gains being made in controlling and reducing the emissions of the basket of GHGs currently being regulated under the Kyoto Protocol of the UNFCCC.</p> <p>On behalf of EIA, We urge you to supplement the report to include these major contributors to the global climate crisis.</p>	
P	McCurry	15	L	11	The text is missing from this line.	We have reviewed this paragraph for readability and do not see this problem.
P	Tolman	15	L	27	Before “feedback loop” insert ‘positive’.	Positive can’t be used because the public thinks positive is always a good sign. But the

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							sentence was edited to make better reading.
	P	Tolman	15	L	41	After 'leading to' insert 'a'.	Thank your for your comment. The suggested change has been made.
	P	Kopp	15	R	9	[to R13] Carbon dioxide concentrations will remain elevated for millennia, not merely centuries, after emissions are reduced (e.g., Archer, 2005). This sentence is also unclear in that it suggests that methane concentrations may decay within days rather than years of reducing emissions. I suggest the following wording: "After emission, the atmospheric concentration of carbon dioxide remains elevated for many centuries, with a significant fraction lingering for many millennia. In contrast, elevated concentrations of aerosols or methane would persist for days or decades, respectively, if emissions were reduced." D. Archer. Fate of fossil fuel CO2 in geologic time. Journal of Geophysical Research 118: C09S05.	The text has been edited appropriately with two new references, one being the Archer paper as suggested.
	P	Carns	15	R	16	"In contrast, while the concentrations of carbon dioxide and other long-lived gases go up rapidly after their emission, the climate effects of reductions in their emissions will not become apparent for at least several decades." Doesn't this understate the case somewhat, since the CO2 levels will take decades or centuries to fall by an appreciable amount?	The text has been modified to better address your point.
	P	Tolman	15	R	18	After 'gases' insert 'can'. [Whether the concentrations of long-lived GHGs go up rapidly depends on the rates of their emissions.]	The text in this section has been rewritten in a manner that eliminates this as an issue.
	P	Carns	15	R	29	"Globally, the net effect of these changes has probably been a slight cooling of the Earth's surface over the past 100 years." Can this sentence include an estimated magnitude to help define "slight"?	We feel that this is handled adequately through the references and the figure on the next page.
	P	Niblock	15	R	29	The report states: "Globally, the net effect of these changes has probably been a slight cooling of the Earth's surface over the past 100 years." This seems inconsistent with the notion of global warming during the last 100	We feel that this is handled adequately through the references and the figure on the next page.

					years. Why is “probably” used to characterize this cooling? Is this really less well known than warming?	
P	McCurry	15	R	34	Following the text of Line R33 it would be appropriate to insert a brief section with one or more figures that discusses global output of heat-trapping gases by each nation. This section should discuss the estimates of recent output, by nation, and the cumulative impact of historic emissions. Potential sources of this information include CCSP SAP 2.2 (King et al, 2007) and the US Dept of Energy’s Energy Information Administration.	We have decided that such an addition is not possible given space constraints.
P	Kopp	16	L	35	The phrase “Total Particles” in the figure is unclear. I suggest you replace it with “Total Aerosols” or “Total Aerosol Particles.”	No change was made as people who look at the figure without reading the text might misunderstand aerosols, e.g., think is referring to hair spray.
P	Pendergrass	16	L	44	The x-axis of this figure does not contain a label. The label should be “Radiative Forcing (Watts per square meter)” (IPCC AR4 WG1 Chapter 2, page 136.)	We are not using the term ‘radiative forcing’ in the document. Watts per square meter are mentioned in the caption.
P	Kruk (NOAA/NCDC)	16	R	11	[to R15] It would be ideal to see a graphical representation of these last few sentences. Specifically, similar to the existing bar figure on page 16, a graph that shows the sources and sinks of carbon dioxide and their respective emitted or absorbed (or potential to absorb), and their timescales.	The figure depiction of the information discussed in this comment is better placed in the figure on page 40 of the <i>National</i> Section.
P	Tolman	16	R	39	[to R43] [On first glance the word ‘Natural’ seems to apply both to Solar output and to Total net human activities; it should be centered on the Solar output bar. If the Total net human activities is not meant to include Solar output, it would be best to rearrange the figure to put the Solar output bar below the Total net human activities bar.]	The text has been modified to address your point.
P	Tolman	17	L	1	Replace “The rate of rise in global emissions” by ‘Global emissions’. [It is not the rate of rise in global emissions that has been accelerating, but the rate of emissions.]	The text has been modified to address your point.
P	Carns	17	L	27	"An important step in the data processing is to identify and adjust for the effects of changes in the instruments used to measure temperature, the measurement times and locations, and the local environment around the measuring site (such as the growth of cities, and the development of so-called “urban heat island” effects) or within a satellite’s field of view" Suggested revision:	The text has been modified to address your point.

					<p>"An important step in the data processing is to identify and adjust for the effects of changes in the instruments used to measure temperature, the measurement times and locations, and the local environment around the measuring site or within a satellite's field of view. For instance, the growth of cities can cause localized "urban heat island" effects."</p> <p>This sentence seems slightly out of place in a more generalized discussion of global-scale increases.</p>	
P	Kaiser (ORNL)	17	R	1	<p>I'm a bit concerned that readers without a basic understanding of atmospheric structure will be confused by the apparent discrepancy between the figures on pages 17 and 21 (giving the height of the bottom of the stratosphere as 6 miles) and the "All Factors" (F) plot on page 21. There are several references to the "cooling of the stratosphere" which is observed/modeled, but a layperson looking at (F) will see a lot of warming above the 6-mile level. Of course (F) reflects the latitudinal variation of tropopause height, but this variation has not been introduced to the reader. Perhaps it would not be "too" messy to tell them about the difference in tropopause height between the equator and the poles. It's either that or risk the "All Factors" (F) plot greatly contradicting "cooling of the stratosphere".</p>	The atmospheric structure figure on page 17 has been removed.
P	Pendergrass	17	R	1	<p>The mountain and the airplane are a nice touch in this plot, allowing people to relate the layers of the atmosphere to something familiar to them. However, the mountain should be labeled or improved since it is somewhat abstract and the coloration makes it blend in with the background. The clouds should be omitted because they are not representative of familiar clouds to most people (often these have much, much lower bases).</p>	The figure on page 17 has been removed.
P	Pendergrass	17	R	8	<p>It would probably be better to use height as the ordinate axis instead of pressure, since most readers probably do not know and do not need to understand the dependence of pressure on height. They would understand the figure better if the ordinate axis showed height in distance units.</p>	The figure on page 17 has been removed.
P	Pendergrass	17	R	12	<p>In the last sentence of the paragraph, it would probably be informative to mention that the decrease in uptake of carbon dioxide by the ocean is expected and will continue (see IPCC AR4 WGI Chapter 7 page 531). Add at the end of the paragraph, for example, "As the top layer of the ocean absorbs more carbon dioxide, the rate at which it absorbs is expected to continue to decrease because of the changes carbon dioxide has on ocean chemistry."</p>	We have reviewed this text and made some modifications in response to this and other comments.

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P	Covey (LLNL)	17	R	28	[to R50] The time series of globally and annually averaged surface temperature (figure on page 17, lines R28-R50) indicates that global warming has leveled off during the past decade. This would be more striking if 2008 data were included. Although such ups and downs are consistent with theory, a point the text already makes in a general sense, recent years have attracted great attention in the blogosphere and popular press. Hence they merit specific discussion. The authors should also consider referencing the recent model-based prediction of a temporary "leveling off" (Keenlyside et al., Nature 453: 84: 2008).	The point is interesting, but we don't have the space to refute these comments. We do, in the caption, address this a little bit by talking about the causes of the fluctuations. Data for 2008 has been added.
P	Pendergrass	18	L	15	In the last sentence of this paragraph, add "and the amount of moisture" after "atmospheric circulation." A very important aspect of the precipitation changes in a warmer climate is that warmer air can hold more water vapor, which should be stated in this paragraph (see, for example, Held and Soden 2006).	The text has been edited in response to this suggestion.
P	McCurry	18	L	18	The text is missing from this line.	The text has been reviewed for accuracy and completeness. No problem seen.
P	McCurry	18	L	24	The text is missing from this line.	The text has been reviewed for accuracy and completeness. No problem seen.
P	Carns	18	L	48	"Satellite data available over the past 15 years shows sea-level rising at a rate roughly double the rate observed over the past century." Slightly unclear. Does "the past century" refer to a 100-year period ending 15 years ago, or a 100-year period that includes the last 15 years?	The text has been edited in response to this suggestion.
P	Kopp	18	R	27	[to R28] Lumping the West Antarctic and East Antarctic Ice Sheets together gives rise to numbers that appear sensationally high without additional background information. I suggest replacing the sentence beginning "Melting of the entire Antarctic Ice Sheet..." with the following language: "The Antarctic Ice Sheet consists of two portions, the West Antarctic Ice Sheet and the East Antarctic Ice Sheet. The West Antarctic Ice Sheet, the more vulnerable of the two, contains enough water to raise global sea levels by about 16 feet. If the East Antarctic Ice Sheet melted entirely, it would raise global sea level by about 170 feet."	The text has been edited in response to this suggestion.

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P	Carns	18	R	28	<p>"Both of these ice sheets are currently melting around parts of their edges. Complete melting of either of these ice sheets over this century or the next is virtually impossible. The Greenland Ice Sheet has also been experiencing record amounts of surface melting, and a large increase in the rate of mass loss in the past decade."</p> <p>Confusingly laid out--the sentence beginning "Complete melting..." contrasts with the two sentences before and after it.</p> <p>Suggested revision: "Complete melting of either of these ice sheets over this century or the next is virtually impossible. However, both of these ice sheets are currently melting around parts of their edges. The Greenland Ice Sheet has also been experiencing record amounts of surface melting, and a large increase in the rate of mass loss in the past decade."</p>	The text has been edited in response to this suggestion.
P	Tolman	18	R	29	Delete 'of these ice sheets'. [The redundancy is not necessary.]	The text has been edited in response to this suggestion.
P	Kruk (NOAA/NCDC)	18	R	30	[to R31, and p.19, L1] Can the authors explain <i>why</i> a complete melting of these discussed ice sheets is "virtually impossible?"	References have been added to provide further information.
P	Tolman	18	R	30	After 'edges' insert', which are sliding into the sea at increasing rates'	The text has been edited in response to this and other suggestions.
P	Pendergrass	18	R	33	The y-axis of the figure is "Total Glacier Ice Decline," and the tick labels are all negative. If ice decline is negative, then ice is increasing, which is probably backwards. Change the label from "Total Glacier Ice Decline" to "Total Glacier Ice Change since 1960."	We have changed the figure labels to clarify this concern.
P	Pendergrass	18	R	33	There are a lot of challenges in determining the amount of global glacier ice and how it is changing, especially since it can't be directly measured. This figure would benefit from error bars or an error envelope showing the uncertainty in the global glacier ice change.	Thank you for your comment. Uncertainty information for this data set is not readily available for inclusion in this report. The global change is far outside the error bars.
P	Tolman	19	L	1	Replace 'virtually impossible' with 'highly unlikely. However, paleoclimate studies indicate that glaciation of Antarctica is reversible, and that the continent was glaciated during Cenozoic cooling when the CO ₂ concentration had fallen to about 450±100 ppm. This means that during this century the CO ₂ concentration could rise to a level that would commit us to complete melting of both Greenland and Antarctica." [See p. 225 in James Hansen et al., <i>Target Atmospheric CO₂: Where Should Humanity Aim?</i> <i>Open Atmospheric Science Journal</i> , Volume 2, 217-231	We have added 'thought to be virtually impossible.' The context is over the next century or two.

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					(²⁰⁰⁸); http://dx.doi.org/10.2174/1874282300802010217 For a figure showing the relationship between sea level and global average temperature from the paleoclimate record, see: The German Advisory Council on Climate Change Special Report 2006 at: http://www.wbgu.de/wbgu_sn2006_en/wbgu_sn2006_en_voll_3.html	
P	Pendergrass	19	L	23	[and L24, L27, L28, L32, L44, and R24] There are 5 phrases or words unnecessarily placed in quotation marks in the left column on this page. The quotation marks should be omitted.	We have deleted the inappropriate quotation marks.
P	Tolman	19	L	30	Delete ‘slowly’.	Thank your for your comment. The suggested change has been made.
P	Pendergrass	19	L	43	[and R23] The qualifier “so-called,” used twice on this page, is unnecessary and should be omitted.	We have removed ‘so-called’ as you have suggested.
P	McCurry	19	R	39	The text is missing from this line.	We have reviewed this paragraph for readability. No problem seen.
P	Ornstein	20	L	14	[to L19, and R1 to R3] Of somewhat less concern are what appear to be ‘possible exaggerations’ in connection with this Figure’s (Patterns of Temperature Change Produced by Various Atmospheric Factors) illustration of a multi-model average of the changes in atmospheric temperature in response to various forcings: The “Well-mixed greenhouse gases” (Part A of the Figure), does not include water vapor, the ‘strongest’ of the greenhouse gases (nor does Part F) – because it is decidedly not “well-mixed” in the atmosphere. In particular, because the temperature of the upper troposphere is below the dew point of water, the molar ratio of water vapor/CO2 drops very rapidly from the cloud tops to the tropopause. Although the physical modeling of the tropical environmental lapse rate is quite complicated, this inhomogeneity of greenhouse gas distribution suggests that the upper troposphere should probably not be warmer than the surface and lower troposphere – in contradiction to what the models show in Part A of the Figure. That this issue has been resolved, as implied on page 20, L14 through 19, and R1 through R3, is somewhat questionable with respect to the weather-balloon (radiosonde) records for the tropics, which admittedly involve data points that are few and far between. See	Thank you. The comment has been considered, but is judged to contain no suggestion relevant to improvement of the scientific content of the USP report.

Figure 6, below from your Global Climate Change, reference 17.

Here, the radiosondes show lower temperature changes in the lower troposphere (from the surface to about 400 hPa) than predicted by the models *both* for this illustration of the tropical troposphere, *and* in your Figure illustrated in the previous comment. The vertical resolution of satellite measurements is inadequate to address *this* question. The warmer upper tropical troposphere of the GCMs implies convective stability that is somewhat greater, compared to that expected from the (limited) radiosonde data. GISS Model E GCM underestimates both Amazonian precipitation (Schmidt et al., 2006) and the strength of monsoons (Rind et al., 2007). This may stem from some uncertain vertical convective parameterizations, shared by all GCMs. In turn this could be the result of the possible overestimation of the temperatures in the upper tropical troposphere just discussed, and as a consequence, an underestimate of deep convection and precipitation by most other GCMs, as well. This is one of the sources of the concern expressed here. Either the modelling of the dynamics of tropical vertical heat transfer by GCMs is somewhat faulty, or alternatively that the sparse radiosonde data is unrepresentative (notwithstanding your Global Climate Change, references, 49 through 53) which again, fail to address *this* question. Only future studies will resolve this issue. It is of some import because, it might mean that the GCM predictions of about 0.2°C/decade might yet need to be revised downward nearer to 0.1°C/decade. Of course, this only slightly delays the dire consequences of unmitigated warming – but may mean that the world has a bit more time to get things right.

I find it difficult to suggest language for ‘correcting’ this issue, except to suggest some dilution of confidence, here and there – with a few appropriate ‘weasle words’ ;-)

My References:
 Rind D, Lerner J, Jonas J. and McLinden C (2007) “Effects of resolution and model physics on tracer transports in the NASA Goddard Institute for Space Studies general circulation models” J. Geophys. Res. 112: D09315 Schmidt GA, Ruedy R, Hansen JE, Aleinov I, Bell N, Bauer M, Bauer S, Cairns B, Canuto V, Cheng Y, Del Genio A, Faluvegi G, Friend AD, Hall TM, Hu Y, Kelley M, Kiang NY, Koch D, Lacis AA, Lerner J., Lo KK, Miller RL, Nazarenko L,

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					Oinas V, Perlwitz Ja, Perlwitz Ju, Rind D, Romanou A, Russell GL, Sato M,, Shindell DT, Stone PH, Sun S, Tausnev N, Thresher D, Yao MS (2006) Present day atmospheric simulations using GISS ModelE: Comparison to in-situ, satellite and reanalysis data. J Climate 19:153–192, http://www.giss.nasa.gov/tools/modelE/	
P	Carns	20	L	31	"Another fingerprint of human effects on climate has been identified when one looks at a slice through the layers of the atmosphere, and studies the pattern of temperature changes from the surface up through the stratosphere." Awkward change in pronoun use. Suggested revision: "Another fingerprint of human effects on climate has been identified by looking at slices through the layers of the atmosphere, and studying the pattern of temperature changes from the surface up through the stratosphere."	The text has been modified to address this comment.
P	Knutson and Vecchi (NOAA/GFDL)	20	R	46	[to R49] This statement is much stronger than what was contained in the CCSP 3.3 Report which one of us (Knutson) worked on. The Syn Rep should defer to the original CCSP 3.3 Report.	We have changed the text and added a reference to CCSP 3.3, Chapter 3 as suggested.
P	Covey (LLNL)	21	L	5	[to R3] Re the difference between modeled and observed tropical lapse rate trends (paragraph on page 21, lines L5-R3) the current version of the text first says "This issue . . . is now largely resolved" but later concludes "When uncertainties in models and observations are properly accounted for, newer observational datasets (with better treatment of known problems) are in agreement with climate model results." It seems contradictory to first say that the problem is "largely" -- i.e. not entirely -- solved, then say without qualification that observations and models "are in agreement." This subject deserves more than one paragraph, given the attention it's received in both the press and the peer-reviewed literature. I think it would be fair to say that reconciliation between models and observations has come mostly from broadening the error bars. While the published literature makes it clear that broader error bars were appropriate, reconciliation by means of significant improvements in model and / or observational accuracy would be a more satisfactory situation, and presumably will happen eventually.	We disagree with the contention that the MSU issue needs to be discussed at length here. We do not find any inconsistency, and numerous references are provided to support the discussion.
P	Pendergrass	21	L	17	The second to last sentence in this paragraph is about uncertainties in data found by research. While uncertainty is not an incorrect description of the problems in reconciling	We disagree. The use of uncertainty is more appropriate than bias. We do not have an

					observed and modeled changes in upper tropospheric temperature, a more precise descriptor would be bias (Fu and Johanson 2004 for satellites, and Haimberger et al. 2008 for radiosondes).	unambiguous 'gold standard' for evaluating satellite and radiosonde data to access surface and tropospheric changes. Thus, the language of a structural uncertainty as given in CCSP 1.1 is implied here.
P	Pendergrass	21	L	18	[to R3] The last sentence of this paragraph is confusing. Instead, break it in two, for example, "Newer observational datasets better treat problems that are now known. When uncertainties in models and observations are taken into account, these newer observational datasets are in agreement with model results." This section acknowledges that models are important not only for attribution but also for prediction, so maybe the use of models should be justified earlier in this section.	We do not feel that the final sentence of this paragraph is confusing.
P	Ornstein	21	L	20	[to L50] At the bottom of page 21, L20 through L50, is a Figure labelled, "Patterns of Temperature Change Produced by Various Atmospheric Factors". It contains an insert which purports to indicate where the stratosphere begins (that is, the location of the tropopause). Although the tropopause (as indicated) is at near 7 miles at <i>temperate latitudes</i> , it is more typically at about 10 miles in the tropics. Thus, implying that the boundary between the troposphere and the stratosphere is at 7 miles, will lead to misinterpretation of the illustration; for example, the reader could easily come to the erroneous conclusion that the illustration shows heating in the lower stratosphere (as in Figure A and Figure F), in direct conflict with the text on page 20, L35 through L38. Either the text should be modified to indicate that the location of the tropopause varies with latitude, and/or the Figure should be modified.	We have provided a thin, solid black line to indicate the accurate location of the tropopause. We have also updated the figure caption and removed the schematic for clarity.
P	McCurry	21	R	12	The text is missing from this line.	We have reviewed the text for accuracy and completeness. No problem seen.
P	Tolman	22			Change 'only' to 'few'. [Earth's past history can suggest what changes might be expected, for example what the maximum rate of sea level rise might be.]	We prefer to leave the text as written.
P	Pendergrass	22	L	1	[to L 50] The justification for using climate models is out of place in a section about "lines of evidence showing ...climatic changes are largely human induced," which largely discusses fingerprinting.	We have decided to leave as written. Fingerprinting is an endeavor that requires not only observations, but also an assessment of model response to specific variables. Thus, climate model deficiencies are discussed here

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							for proper context.
P	Staudt	22	L	21	[to R48] I am pleased to see a clear statement about the strengths of climate models and the value they contribute for climate science.		Thank you.
P	Staudt	22	R	1	[to R6] The section heading only mentions global temperature increases, but the section deals with many other climate projections.		This is true here, and probably true for almost all section headings. The subheadings are also intended to help explain the topic of the section.
P	Cifelli	22	R	8	[to R15] This section should emphasize the recent work of Solomon et al. (2009, Proceedings of National Academies of Science), demonstrating that we have already passed the “tipping point” for CO2 emissions such that the planet will maintain elevated temperatures over the next millennia, even if emissions are stopped today. The issue now becomes focused on minimizing the amount of additional temperature rise (and associated sea level rises and precipitation changes) we have to live with.		This issue of mitigation has been carefully evaluated in light of this and other comments. We have decided to expand our treatment of mitigation through revisions in the ‘About this Report’, ‘Executive Summary’, and ‘Concluding Thoughts’ sections, as well as other areas in the text.
P	Pendergrass	22	R	29	The second to last sentence of this paragraph talks about how warm it will be in 2100. Climate sensitivity is a property of the climate system: the change in global mean temperature for a given global radiative forcing. While it does depend somewhat on the climate state, the phrase “how sensitive climate will be” makes it seem that we are unsure of climate sensitivity because it will change in the future. But, our uncertainty about climate sensitivity has more to do with our uncertainty about the properties of the climate system in general, rather than at a particular time. A way to reflect this would be changing the phrase to, “how sensitive the climate system is.” or “what the climate sensitivity is.”		Thank your for your comment. The suggested change has been made.
P	Staudt	22	R	36	[to R50] This paragraph does not seem to fit well in a section on temperature projections. I would suggest moving the section on emissions scenarios (p. 23-25) to the beginning of the section on climate projections that starts on p. 22. This will eliminate the need for this awkward introduction of the scenarios in the temperature subsection and, more generally, will provide an important context for interpreting the global model projections.		Thank your for your comment. The suggested change has been made.
P	Carns	22	R	44	"None of them involve stabilizing atmospheric concentrations of heat-trapping gases at a level that would avoid dangerous human interference with the climate system as required		This section has been edited in response to your suggestion.

					<p>by the United Nations’ Framework Convention on Climate Change, which was signed in 1992 by the United States and most other countries."</p> <p>This seems as though it would be covered by the statement shortly before it: "None of these scenarios assumes explicit policies to limit climate change." Even if it merits specific mention, this phrasing makes it difficult to tell why the 1992 Convention on Climate Change merits mention over the Kyoto Protocol or other policy proposals.</p> <p>Suggested change: deletion.</p>	
P	Staudt	22	R	44	<p>[to R50] The scenarios do provide some relevant insight into the question of long-term stabilization and the relative level of impacts associated with different emissions choices. I think it might be more accurate to say that none of the scenarios were developed with the intent of achieving specific stabilization levels. This means that the scenarios do not exactly address the question of how emissions will need to be reduced in order to avoid dangerous anthropogenic interference.</p>	<p>We have decided not to make a change to the text is accurate as written. We do not offer policy prescriptives in this report. Furthermore, we have added some mitigation discussion in the text now that highlight the differences between b1 and a2.</p>
P	McCurry	22	R	46	<p>The text is missing from this line.</p>	<p>We have reviewed this paragraph for readability. No problem seen.</p>
P	Staudt	23			<p>[to p. 25] This section is very important and should be moved to the beginning of the section on climate projections that starts on p. 22. This discussion provides an important context for interpreting the global model projections. It also makes the very important point that the “lower” (B1) emissions scenario is not a foregone conclusion and provides a brief overview of the scientific literature addressing lower CO2 stabilization goals. The discussion should go even further to make it clear that meeting stabilization goals of 450 ppm or lower will require the US and other nations to implement policies beyond what are currently in place.</p>	<p>This issue of mitigation has been carefully evaluated in light of this and other comments.</p> <p>We have decided to expand our treatment of mitigation through revisions in the ‘About this Report’, ‘Executive Summary’, and ‘Concluding Thoughts’ sections, as well as other areas in the text.</p>
P	Carns	23	L	7	<p>"...the sub-tropics expand further poleward" This is unclear. What is the definition of "sub-tropics"?</p>	<p>The text has been edited for clarification.</p>
P	Carns	23	L	37	<p>"This has already been observed, and is projected to continue, because in a warmer world, precipitation tends to be concentrated into more intense events, with longer periods of little precipitation in between" Suggested revision: "This has already been observed, and is projected to continue. In a warmer world, precipitation tends to be concentrated into more intense events, with longer periods of little precipitation in</p>	<p>Thank you. The suggested change has been made.</p>

					between."		
P	Staudt	23	R	1	[to R10] I'm surprised that this section does not cite the CCSP SAP 3.3 report, which addresses the issue of future hurricane activity in detail. Also, this paragraph in the USP conveys much more uncertainty about projections than the comparable paragraph in the SAP 3.3. For comparison, the summary of hurricane projections in the SAP 3.3 Executive Summary (p. 6): "For North Atlantic and North Pacific hurricanes, it is likely that hurricane rainfall and wind speeds will increase in response to human-caused warming. Analyses of model simulations suggest that for each 1°C (1.8°F) increase in tropical sea surface temperatures, core rainfall rates will increase by 6-18% and the surface wind speeds of the strongest hurricanes will increase by about 1-8% (Chapter 3, section 3.3.9.2 and 3.3.9.4). Storm surge levels are likely to increase due to projected sea level rise, though the degree of projected increase has not been adequately studied. It is presently unknown how late 21st century tropical cyclone frequency in the Atlantic and North Pacific basins will change compared to the historical period (~1950-2006) (Chapter 3, section 3.3.9.3)."		This section now cites SAP 3.3 and refers the reader to the 'National' Section where detailed discussion of Atlantic storms from SAP 3.3 is located. Globally, statements are trickier. SAP 3.3 focused on North America. Also there have been a number of new papers since SAP 3.3.
P	Staudt	23	R	4	[to R7] The cited reference (Vecchi, Swanson, and Soden, 2008) does not say anything about how "changes of wind speed and direction with height are also projected to increase in some regions." The sentence is unclear: how are wind speed and direction expected to change? Is it the vertical structure of these factors that is changing?		We've added two references that explicitly discuss wind shear.
P	McCurry	23	R	7	The text is missing from this line.		The text has been reviewed for accuracy and completeness. No problem seen.
P	Pendergrass	23	R	20	[and R22] In the last two sentences of the paragraph, "these processes" and "additional processes" affecting changes in ice seem excessively vague.		The text has been edited to clarify this section.
P	Carns	23	R	22	"Although these processes are not well understood, they are already producing substantial additional loss of ice mass, but it is difficult to predict their future contributions to sea-level rise." Suggested revision: "These processes are already producing substantial additional loss of ice mass. However, they are not well understood, and it is difficult to predict their future contributions to sea-level rise."		Thank you for your comment. The suggested change has been made.

P	Wolf	23	R	27	<p>[to R34]This section on projected sea level rise should more clearly state that the estimate given in the 2007 IPCC assessment does not provide an upper bound for sea level rise. According to the 2007 IPCC Synthesis Report, the “upper values of the ranges given are not to be considered upper bounds for sea level rise”:</p> <p>Because understanding of some important effects driving sea level rise is too limited, this report does not assess the likelihood, nor provide a best estimate or an upper bound for sea level rise. Model-based projections of global average sea level rise at the end of the 21st century (2090-2099) are shown in Table 3.1. ...</p> <p>The sea level projections do not include uncertainties in climate-carbon cycle feedbacks nor do they include the full effects of changes in ice sheet flow, because a basis in published literature is lacking. Therefore the upper values of the ranges given are not to be considered upper bounds for sea level rise. (IPCC 2007: 45).</p> <p>Thus, the USP report should revise the statement “The 2007 assessment by the IPCC, for example, which did not attempt to include the highly uncertain contributions to sea-level rise due to changes in ice sheet dynamics, projected a rise of the world’s oceans from 8 inches to 2 feet by the end of this century” to reflect that 2 feet is not an upper bound.)</p>	<p>A figure has been added that helps explain this. We are trying to be precisely correct and indeed the report says much of what the reviewer suggests.</p>
P	Kopp	23	R	39	<p>[to R41] It would be helpful to follow this sentence with a sentence giving a sense of the range of values discussed in the post IPCC AR4 literature. I suggest the following sentence, drawing on Rahmstorf, 2007; Pfeffer et al., 2008; and Grinsted et al., 2009.</p> <p>“Recent estimates suggests that global sea level rise of 3-4 feet by the end of the century is plausible, while a rise of about 6.5 feet is at the margin of possibility.”</p> <p>Grinsted, A., Moore, J. C., and Jevrejeva, S. (2009). Reconstructing sea level from paleo and projected temperatures 200 to 2100 AD, <i>Climate Dynamics</i>.</p> <p>Rahmstorf, S. (2007). A Semi-Empirical Approach to Projecting Future Sea-Level Rise, <i>Science</i>, 315, 368-370.</p> <p>Pfeffer, W. T., Harper, J. T., and O'Neel, S. (2008). Kinematic constraints on glacier contributions to 21st-century sea-level rise, <i>Science</i>, 321, 1340-1344.</p>	<p>We cite two of the references mentioned, but we do not feel it is necessary to give specific numerical values due to the large uncertainties in ice sheet dynamics out to 2100.</p>
P	Carns	23	R	40	<p>"...upper and lower limits on sea-level rise over this century are substantially greater than previously projected."</p>	<p>This text has been rewritten in response to this comment, though the exact wording recommended was not included because the</p>

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					"lower limits...are substantially greater" is a difficult construction to understand. Suggested revision: "...potential sea-level rise over this century will be substantially greater than previously projected.	available literature does not strongly mention this. Our text focuses on lower and upper bounds, not the central tendency.
P	McCurry	23	R	44	The text is missing from this line.	We have reviewed this paragraph for readability. No problem seen.
P	Kopp	23	R	47	This sentence omits to mention the importance of proximity to a melting ice sheet, which exerts an influence through the gravitational attraction of the ice sheet, the elastic deformation of the lithosphere by the ice sheet, and induced changes in Earth's rotation (Woodward, 1888; Farrell and Clark, 1976; Mitrovica et al., 2001, 2003, 2009). I suggest the middle clause of this sentence be modified to read: "but also on changes in regional currents and winds, proximity to the mass of melting ice sheets, and, particularly..." Farrell, W. E. and Clark, J. A. (1976). On postglacial sea level, Geophysical Journal of the Royal Astronomical Society, 46, 647-667 Mitrovica, J. X., Tamisiea, M. E., Davis, J. L., and Milne, G. A. (2001). Recent mass balance of polar ice sheets inferred from patterns of global sea-level change, Nature, 409, 1026--1029 Mitrovica, J. X. and Milne, G. A. (2003). On post-glacial sea level: I. General theory, Geophysical Journal International, 154, 253--267 Mitrovica, J. X., Gomez, N., and Clark, P. U. (2009). The sea-level fingerprint of West Antarctic collapse, Science, 323, 753 Woodward, R. S. (1888). On the form and position of mean sea level, USGS Bulletin 48.	Thank you. The suggested change has been made.
P	Pendergrass	23	R	48	If the intention of the first sentence in the paragraph is to convey that regional currents and winds are important for local sea level changes, but vertical land mass movements are the most important factor, then "particularly" should be replaced by "especially."	The text has been edited in response to this comment.
P	Wolf	24			Because ocean acidification poses a leading and significant threat to the world's oceans, this chapter would be greatly improved by the inclusion of a section on observed and projected ocean acidification, including information from recent scientific studies on the emissions stabilization target needed to avoid dangerous levels of acidification. Important studies that have found that ocean ecosystems will suffer significant damage at CO2 stabilization levels as low as 450 ppm, including damage to coral reefs and aragonite-	We have added a paragraph on ocean acidification to this section.

				<p>dependent organisms, include: Cao, L., and K. Caldeira. 2008. Atmospheric CO2 stabilization and ocean acidification. Geophysical Research Letters 35, L19609, doi:10.1029/2008GL035072. Hoegh-Guldberg, O., P. J. Mumby, A. J. Hooten, R. S. Steneck, P. Greenfield, E. Gomez, C. D. Harvell, P. F. Sale, A. J. Edwards, K. Caldeira, N. Knowlton, C. M. Eakin, R. Iglesias-Prieto, N. Muthiga, R. H. Bradbury, A. Dubi, and M. E. Hatziolos. 2007. Coral reefs under rapid climate change and ocean acidification. Science 318:1737-1742. McNeil, B. I., and R. J. Matear. 2008. Southern Ocean acidification: A tipping point at 450-ppm atmospheric CO2. Proceedings of the National Academy of Sciences of the United States of America 105:18860-18864.)</p>	
P	Wolf	24		<p>This section should include a discussion of the concept of the warming commitment (i.e. the amount of warming the world is committed to based on the greenhouse gas emissions already in the atmosphere). Two recent studies provide important information that our current warming commitment already places us in the realm of dangerous climate change, and that rapid reductions in greenhouse gas emissions are needed: Hansen et al. (2008) and Ramanathan and Feng (2008). Hansen et al. (2008) found that at current greenhouse gas emissions levels our climate commitment is ~2C warming of which 0.6C is attributable to fast feedback processes and an additional 1.4C is attributable to slow feedback processes (Hansen et al. 2008). Hansen et al. (2008) presented evidence that these slow feedbacks may begin to be realized within time scale as short as centuries or less, adding urgency to rapidly reducing our emissions trajectory before the climate system is forced beyond a tipping point (Hansen et al. 2008). With the current climate commitment of ~2C, no additional greenhouse gas forcing is required to raise global temperature to at least the levels of the Pleistocene, 2-3 million years ago, which is a degree of warming that would produce dangerous climate impacts (Hansen et al. 2008). Hansen et al. (2008) concluded that the overall target of at most 350 ppm CO2 must be pursued on a timescale of decades since paleoclimatic evidence and ongoing changes suggest that it would be dangerous to allow emissions to overshoot this target for an extended period of time. Similar to Hansen et al. (2008), Ramanathan and Feng (2008) provide evidence that our current warming commitment has placed us within the realm of dangerous anthropogenic interference with the climate system. Ramanathan and Feng (2008) estimated that greenhouse gas emissions since the pre-industrial era</p>	<p>This issue of mitigation has been carefully evaluated in light of this and other comments. We have decided to expand our treatment of mitigation through revisions in the 'About this Report', 'Executive Summary', and 'Concluding Thoughts' sections, as well as other areas in the text.</p>

						<p>have committed the world to a warming of 2.4°C (ranging from 1.4°C to 4.3°C) above pre-industrial surface temperatures. The earth has experienced only ~25% of this warming commitment to date, because the rest of the warming commitment has been masked by the cooling effect of aerosols, compensation by increases in surface albedo due to land-use changes, and delays due to the thermal inertia of the oceans (Ramanathan and Feng 2008). About 90% of the remaining 1.6°C warming commitment will be realized during this century at a rate determined by the rate of unmasking of the cooling effect from aerosols as air pollution is curbed and by the rate of release of greenhouse gas forcing stored in the oceans (Ramanathan and Feng 2008). Importantly, our current warming commitment of 2.4°C above pre-industrial levels exceeds the dangerous anthropogenic interference (DAI) thresholds of 1.7°C to 2°C above pre-industrial levels as defined by leading climate scientists and international bodies (Ramanathan and Feng 2008). Citations for these studies are as follows: Hansen, J., M. Sato, P. Kharecha, D. Beerling, R. Berner, V. Masson-Delmotte, M. Pagani, M. Raymo, D. Royer, and J.C. Zachos. 2008. Target atmospheric CO₂: Where should humanity aim? <i>The Open Atmospheric Science Journal</i> 2: 217-231. Ramanathan, V., and Y. Feng. 2008. On avoiding dangerous anthropogenic interference with the climate system: formidable challenges ahead. <i>Proceedings of the National Academy of Sciences of the United States of America</i> 105:14245-14250.)</p>	
P	Staudt	24	L	7	<p>The charts should clearly state what the baseline time period is. Ideally, the same baseline would be used for all the projections in the report to allow more facile comparison of different charts. For example, I'm guessing that the baseline for this chart is not the same as the maps on p. 28-29. In addition to helping improve the readability of the report, having consistent (or at least clear discussion of the baseline and implications of baseline choice in each case) is important because otherwise it may appear as if the results are being manipulated to illustrate specific points.</p>	<p>These do use the same baseline and this is now clearly stated.</p>	
P	Staudt	24	L	7	<p>The caption should be clear that the two stabilization scenarios are “designed to stabilize atmospheric carbon dioxide concentrations at 450 or 550 parts per million <u>without any overshoot</u>.” Also, the source of the stabilization scenarios should be included.²⁵</p>	<p>We disagree, as few people would understand what overshoot refers to. The source of the stabilization scenario is clearly described in the reference cited for the figure.</p>	
P	Pendergrass	24	L	30	<p>The legend entry for the observed global average temperature says it is for 1900-2000, but the line extends beyond 2000. The years stated in the legend should be corrected to</p>	<p>The legend has been changed.</p>	

						agree with the plot.	
	P	Tolman	24	L	49	Delete 'changes in the' and after 'temperature' insert 'changes relative to the average for 1950-1970' [or whatever period you are using for the reference temperature]	Thank your for your comment. The figure caption has been modified.
	P	Spanger-Siegfried	24	R	1	I would encourage he authors to make clear that the lower-emissions scenario is nothing more than one plausible future, but by no means a floor on emissions. As is articulated in the section on emissions scenarios (p. 24), avoiding dangerous climate change requires that atmospheric CO2 concentrations be brought even lower than those projected in the B1 emissions scenario. For the benefit of the reader, these points should be connected and made clearly and prominently.	We have reviewed the text and feel that this point is adequately covered. In particular, the figure caption on p. 25 notes that the '...IPCC scenarios ... assume no explicit climate policies'.
	P	Pendergrass	24	R	22	The aspect of the interference that is subject to interpretation is how much of it is dangerous. This would be more clear in the last sentence of the paragraph if "such interference" were "dangerous interference" instead.	We feel that a second use of the word 'dangerous' is not needed in this paragraph.
	P	Wolf	24	R	25	[to R36] The USP states that "atmospheric concentrations of carbon dioxide would need to stabilize in the long term at around today's levels" to avoid dangerous anthropogenic interference with the climate system (DAI). However, a study by Hansen et al. (2008) concluded that atmospheric concentrations of carbon dioxide would need to stabilize to at most 350 ppm to avoid DAI: If humanity wishes to preserve a planet similar to that on which civilization developed and to which life on Earth is adapted, paleoclimate evidence and ongoing climate change suggest that CO2 will need to be reduced from its current 385 ppm to at most 350 ppm, but likely less than that (Hansen et al. 2008:217). Thus, the USP should modify this section to include Hansen et al. (2008) and reflect this study's finding that atmospheric concentrations of carbon dioxide will need to be reduced from current levels of 385 to avoid dangerous climate change. Hansen, J., M. Sato, P. Kharecha, D. Beerling, R. Berner, V. Masson-Delmotte, M. Pagani, M. Raymo, D. Royer, and J.C. Zachos. 2008. Target atmospheric CO2: Where should humanity aim? The Open Atmospheric Science Journal 2: 217-231.)	We have reviewed the text and feel that mentioning 'today's level' adequately covers this point.
	P	Spanger-Siegfried	24	R	25	[to R36] It's not clear to me why this important information on dangerous climate change and how it may be avoided should be embedded in an otherwise technical section on emissions scenarios. I would suggest that this is a fundamental piece of current knowledge on climate change and it should be pulled out and moved to a position of	The Executive Summary has been revised to address this point.

						prominence in the Executive Summary or the Global Climate Change chapter's introduction.	
	P	Staudt	24	R	25	[to R50] These two paragraphs are somewhat inconsistent. The first says that to meet the 2F warming goal, "atmospheric concentrations of carbon dioxide would need to stabilize in the long term at around today's levels." But, then the next paragraph and the accompanying charts focus on stabilizing at 450 or 550 ppm, 70-170 ppm above today's levels. I'm guessing that this is likely because emissions scenarios for stabilizing around 350-400 ppm are not yet widely available. The text should make it clear that emissions scenarios for even lower stabilization targets will also need to be considered.	The section goes on to suggest that stabilization around 400 parts per million of "equivalent carbon dioxide" would yield about an 80 percent chance of avoiding exceeding the 2°F above present temperature threshold. It should also be noted that The USP specifically avoids policy recommendations.
	P	Carns	24	R	29	"To have a good chance (but not a guarantee)..." Suggested revision: "To have a good chance (although not a guarantee)..."	We have decided to leave this as written.
	P	Tolman	24	R	38	Replace 'above' by 'below'.	The text has been changed as suggested.
	P	Tolman	24	R	42	[and R43] Replace 'stabilization scenarios' by 'latter'. [Avoid repeated words.]	We have reviewed this sentence and decided to leave it as written.
	P	Tolman	24	R	45	[and R46] Change 'this is 70 to 170 ppm above the current concentration of about 380 ppm' to 'these are about 65 and 165 ppm above the current concentration of about 385 ppm'	The suggested change has been partially incorporated.
	P	Tolman	24	R	48	Change 'Resulting' to 'The resulting'.	We prefer to leave this as written.
	P	Tolman	24	R	49	After 'CO2' insert 'reached'.	We prefer to leave this as written.
	P	Tolman	24	R	50	After 'is' insert 'to CO2 concentration.'	We prefer to leave this as written
	P	Staudt	25			[to p. 26] Abrupt Climate Change section: This section misses an opportunity to educate the reader about the role of positive feedbacks in the climate system and their potential to trigger an abrupt change. Of particular importance are some of the recent observations	While we would like to expand the discussion, space limitations prohibit us from doing so.

					and findings regarding carbon release from melting permafrost and methane clathrates and the possibility for the sea-ice feedback to become more powerful as the Arctic sea ice has been rapidly melting in recent years.		
P	Pendergrass	25	L	1	The units in the ordinate labels for the emissions figures should be a rate (mass emitted per unit time) rather than just a mass of carbon. Instead of Gigatons, the units should be Gigatons per year (see SRES).		We feel that the aggregate carbon measure for individual years is appropriate as written.
P	Tolman	25	L	2	In the title of the graphs insert 'Global' before 'Emissions'.		We have made this change.
P	Tolman	25	L	5	[to L9] Change the label of the y-axis to read 'Carbon (Gigatons per year)'.		We feel that the aggregate carbon measure for individual years is appropriate as written.
P	Tolman	25	L	27	[to R27] After 'gigatons' insert 'per year'		We feel that the aggregate carbon measure for individual years is appropriate as written.
P	Tolman	25	L	28	Add the following: "Another danger is that thawing of Arctic permafrost and frozen sea floor could increase the anaerobic decay of organic matter and the melting and release of methane from methane hydrate, a material composed of about 13% methane by weight and 87% water ice, which is stable only under sufficiently low temperature and high pressure. If the release of methane gas really gets going, it could result in a runaway situation in which methane release causes more warming and further methane release – dwarfing the direct emissions from human activities. Estimates of the amount of methane hydrate on the sea floor range from 1000 to 22,000 gigatons, with most at about 10,000 gigatons. This can be compared with about 800 gigatons of carbon as CO ₂ in the present atmosphere. And methane is a much more powerful greenhouse gas than CO ₂ . Scientists have reported a release of at least 2000 gigatons of carbon as methane about 55 million years ago in an extinction event know as the Paleocene-Eocene Thermal Maximum, when sea surface temperatures increased about 9°F in the tropics and 16°F at the poles. Could this happen again?" [References: James C. Zachos et al., Rapid Acidification of the Ocean During the Paleocene-Eocene Thermal Maximum, <i>Science</i> , 308, pp. 1611-1615 (2005). See: http://www.sciencemag.org/cgi/content/abstract/sci;308/5728/1611 Barbara Maynard, Burning Questions about Gas Hydrates, <i>Chemistry</i> , pp. 27-33 (Winter		We have added some additional text on abrupt climate change (from SAP 3.4), including discussion on the AMOC and methane release: There are also concerns regarding the potential for abrupt release of methane from thawing of frozen soils, from the sea floor, and from wetlands in the tropics and the Arctic. While analyses suggest that an abrupt release of methane is very unlikely to occur within 100 years, it is very likely that warming will accelerate the pace of chronic methane emissions from these sources, potentially increasing the rate of global temperature increases. (ref SAP 3.4, chapter 5) An important component of the Earth's climate system is the operation of the ocean currents that transport vast quantities of heat around the globe. One branch of the ocean circulation is in the North Atlantic. In this region, warm, less-salty water flows from the tropics to the North Atlantic in the upper

					2006). See: http://www.iupac.org/publications/ci/2006/2804/2804-pp3-7.pdf David Archer, Fate of fossil fuel CO2 in geologic time, <i>Journal of Geophysical Research</i> , 110, C09S05 (2005). At: http://geosci.uchicago.edu/~archer/reprints/archer.ms.fate_co2.pdf	<p>layer of the ocean, while cold, saltier water flows back from the North Atlantic to the tropics in the ocean's deep layers, creating a "conveyor belt" for heat. Changes in this circulation have profound impacts on the global climate system, from changes in African and Indian monsoon rainfall, to atmospheric circulation relevant to hurricanes, to changes in climate over North America and Western Europe.</p> <p>Recent findings indicate that it is very likely that the strength of this North Atlantic circulation will decrease over the course of this century in response to increasing greenhouse gases. The best estimate is that the strength of this circulation will decrease 25 to 30 percent in this century, leading to a reduction in heat transfer to the North Atlantic. It is considered very unlikely that this circulation would collapse entirely during the next 100 years or so, though it cannot be ruled out. While very unlikely, the potential consequences of such an abrupt event would be severe. Impacts would likely include sea-level rise around the North Atlantic of up to 2.5 feet (in addition to the rise expected from thermal expansion and melting glaciers and ice sheets), changes in atmospheric circulation conditions that influence hurricane activity, a southward shift of tropical rainfall belts with resulting agricultural impacts, and disruptions to marine ecosystems. (ref SAP 3.4, chapter 4)</p>
P	Carns	25	L	30	figure caption "...current two decades..." Should this be "...past two decades..."?	The text has been changed to clarify this.
P	Tolman	25	L	30	[to R30] [I don't see the green and black curves for the two stabilization scenarios in the lower left hand (expanded) box. Are they actually there?]	This has now been addressed in the figure caption. The stabilization scenarios start later

							than 1990 and at a different level than the other scenarios so it would not make sense to graph them on the scale of the insert.
P	Wolf	25	L	33	[to L39] This section should be clarified to (a) more accurately reflect the scientific studies on which it is based, and (b) provide the reader with important risk-assessment information on the probability of avoiding dangerous climate change at different stabilization targets. The USP states that “only the 450 ppm stabilization target has the potential to keep the global temperature rise at or below about 3.5°F from preindustrial and 2°F above current.” The reader should be provided with the estimated probabilities from Meinshausen et al. (2006: Figure 6) of exceeding 2°C (3.5°F) above pre-industrial levels at different stabilization targets of heat-trapping gases (CO ₂ eq), including targets below 450 ppm. According to Meinshausen et al. (2006: Figure 6), the probability of exceeding 2°C is 50% (range: ~27-78%) at a stabilization target of 450 ppm CO ₂ eq. Thus the USP should more clearly state that a 450 ppm CO ₂ eq stabilization target only has a medium chance of 50% of avoiding dangerous climate change. In addition, the USP should include information from Meinshausen et al. (2006) that stabilizing at 350 ppm CO ₂ eq has a much better chance (~15%) of avoiding dangerous climate change. This will provide the reader with important information on the risks associated with stabilization targets of 350 ppm CO ₂ eq versus 450 CO ₂ eq, and be more consistent with information on page 24 that a stabilizing CO ₂ at today’s levels or below is needed to have a reasonable chance of avoiding dangerous climate change.)		We have added a sentence at the end of the paragraph to read: “Scenarios that stabilize carbon dioxide below 450 ppm (not shown in the figure) offer an increased chance of avoiding dangerous climate change.”
P	Tolman	25	L	34	Replace ‘the potential’ by ‘a reasonable chance’.		We feel that potential suggests a 50/50 chance, but reasonable suggests more. Therefore, we are leaving this as written.
P	Tolman	25	L	36	After ‘current’ insert ‘average temperature’.		The suggested change has been made.
P	Carns	25	L	37	"...about 3.5°F from pre-industrial and 2°F above current, a level beyond which many concerns have been raised about dangerous human interference with the climate system." "Dangerous human interference with the climate system", or similar phrases, shows up a few times in this section. The phrasing implies that rising greenhouse gases will _cause_ human interference in the climate system, when in fact rising greenhouse gases		While we would like to expand the discussion, space limitations prohibit us from doing so.

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					<p>_represent_ human interference in the climate system. "Dangerous human interference with the climate system" is also somewhat vague. Suggested revision: Replace "human interference with the climate system" with more specific descriptions of possible effects. For instance, for the example above, one might use "dangerous destabilization of the climate system" or "sharply increased rates of adverse weather events, sea level rise, and other effects."</p>	
P	Tolman	25	L	39	<p>Add the following sentence: "Hansen and others have recently reported that the sensitivity of the change in global average temperature to doubling of CO2 concentration, based on paleoclimate data, is closer to 11°F (6°C) than the 5.4°F (3°C) that has been accepted by scientists in the past. The implication is that we will need to <u>reduce</u> atmospheric CO2 concentrations to 350 ppm or less if we are to avoid dangerous interference with the climate system." [James Hansen et al., ^{Target Atmospheric CO2: Where Should Humanity Aim?} <i>Open Atmospheric Science Journal</i>, Volume 2, 217-231 (2008), http://dx.doi.org/10.2174/1874282300802010217]</p>	<p>We have added a sentence at the end of the paragraph to read: "Scenarios that stabilize carbon dioxide below 450 ppm (not shown in the figure) offer an increased chance of avoiding dangerous climate change."</p>
P	McCurry	25	L	39	<p>The text is missing from this line.</p>	<p>We have reviewed this paragraph for readability. No problem seen.</p>
P	Pendergrass	26	L	3	<p>[and L4] The sentence starting with "Examples..." talks about "changes," but there is only one change listed: a drastic change in drought characteristics. The sentence should be in the singular instead of the plural, e.g., "An example of such a change is a rapid shift in drought frequency or duration."</p>	<p>The plural usage is correct as we mention both drought frequency and drought duration.</p>
P	Tolman	26	R	28	<p>Delete ‘,’.</p>	<p>We cannot locate these punctuation marks. No change.</p>
P	Carns	27	L	23	<p>"The maps show annual temperature difference from the 1961-1990 average for the 3 years that were the hottest on record in the United States: 1998, 1934 and 2006." Why use 1961-1990 as a comparison? It would be nice to say a word or two about why this particular time period was chosen. Also, the years are displayed in chronological order on the graph, so they should be listed that way in the caption: 1934, 1998, and 2006.</p>	<p>The research was based on the 1961-1990 period, driven by data quality and completeness. The order of the dates in the caption reflects their descending rank as the top three years that were the hottest for the U.S.</p>
P	Tolman	27	L	45	<p>Change the order from '1998, 1934' to '1934, 1998' to reflect the sequence shown in the figure.</p>	<p>The order of the dates in the caption reflects their descending rank as the top three years</p>

							that were the hottest for the U.S.
P	Carns	27	R	10	"The heaviest downpours have increased approximately 20 percent on average in the past century, and this is projected to continue, with the strongest increases in the wettest places." Increased 20% in frequency, or 20% in overall magnitude?		This point has been clarified – it is magnitude.
P	Knutson and Vecchi (NOAA/GFDL)	27	R	14	[to R15] <i>"The destructive energy of Atlantic hurricanes has increased in recent decades and is projected to increase further in this century"</i> . No. Change to: <i>"The destructive energy of Atlantic hurricanes has increased in recent decades, though these changes have not been confidently attributed to anthropogenic climate change. The intensity of Atlantic hurricanes is projected to increase at a more gradual rate during the coming century as greenhouse warming proceeds."</i> Or here is a shorter version: <i>"The destructive energy of Atlantic hurricanes has increased in recent decades, but whether this increase in basin-wide activity will continue in this century remains uncertain."</i> The single sentence as originally written is misleading and incorrect. The statement implies that the rising trend in PDI since 1950 or since 1980 will continue on into the future. This is not what climate models are projecting. Rather, dynamical models are projecting relatively little change in PDI in the future (some showing a decrease), but, more consistently, the higher resolution models project an increase in the intensity of the strongest storms. The latter is projected to change at a rate of 1-8% per deg C of SST warming.		This has been revised to be consistent with SAP 3.3, along the lines of the suggestion.
P	Tolman	27	R	19	After 'more' insert 'rapidly'.		We have decided to leave this as written. We intended to suggest that increases are expected, but not refer to the rate of increase in this key message.
P	Pendergrass	27	R	25	[to R29] The second and third sentences of the section sentences are intended to relate changes on the global scale to changes on the national scale, and explain why we expect greater variability on the national scale than the global scale. While it is true that most of the US is a continental climate, the second sentence ("Therefore...") is certainly not the only reason we expect more variability, and there are parts of the country that are very		We have addressed your concern by revising the paragraph.

					much moderated by the influence of the ocean (e.g., the West Coast, parts of Alaska, and Hawaii). Another reason that we would expect the nation to have greater variability than global mean changes is that the nation is a smaller sample size than the globe. The US is mainly in the midlatitudes, where weather is highly variable. In contrast, half the globe is in the tropics, which experience much less variability from year to year, decreasing the variance of global mean quantities. This sentence should be changed to reflect that the lack of ocean is not the only, or even the main reason for the increased variability of climate in the US relative to the global mean.	
P	Pendergrass	27	R	29	[to R32] The logical conclusion of the fourth sentence is that in global warming, <i>everywhere</i> on the planet must warm. This is not necessarily true; global warming means that there will be warming in the global mean sense, not uniformly everywhere on the planet.	We have changed from ‘truly global’ to ‘global in scale’ to address this point.
P	Staudt	28			[to p. 29] The maps on these pages provide a clear and powerful perspective on how much warming the US will likely see. It is important that they show both a lower and higher emissions pathway. I think the text should reiterate that this lower emissions scenario does not keep global warming below the 2F above today’s levels, which many believe is necessary to avoid dangerous anthropogenic interference. Also, I find it awkward to have the baseline temperatures be 1961-1979. Most of the policy dialogue refers either to temperatures above pre-industrial or above “today’s” levels. Using this mid-century baseline forces the reader to figure out how much warming there was from preindustrial times until the 1960-70’s. Also, because the 1960-70’s were relatively cool, it might look like that baseline was chosen to exaggerate the warming.	We chose the base period based on availability of model data. Much consideration was given early in the process to determining the appropriate base period from which to show observed and projected temperature change. We selected the base period 1961-1979 to be consistent with the focus of this report, which is to address changes that have occurred during the most recent 50-year period when anthropogenic influences have been greatest. We feel depicting changes relative to the early part of this period is the best way to communicate this. We have altered the figure to make the base period clearer.
P	Tolman	28	L	8	After ‘pages’ insert ‘below’.	We prefer to leave this as written.
P	Tolman	28	L	21	Add the following: “The major reason that the largest temperature increases occur in the Arctic is that more solar radiation is absorbed when highly reflective snow and ice are replaced by much darker soil and deep blue water. Another factor is that liquid water has a higher vapor pressure than ice, so that water vapor contributes more to the greenhouse	We have decided to leave the text as written, because the discussion is not relevant and too detailed here. Some of this discussion is covered later in this section.

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					effect as the ice melts.”	
P	Tolman	28	L	23	Delete the first appearance of ‘emissions’.	We feel that repeating this information is important for clarity.
P	Carns	28	R	3	<p>"The Environmental Protection Agency has identified a potential funding shortfall for drinking water and wastewater infrastructure of over \$500 billion by 2020. Heavy downpours will exacerbate existing problems in many cities, especially where stormwater catchments and sewers are combined. Drinking water and sewer infrastructure is very expensive to install and maintain. Climate change will present a new set of challenges for designing upgrades to the nation’s water delivery and sewage removal infrastructure."</p> <p>These sentences should be re-arranged for clarity, and rephrased slightly. Suggested revision: "Drinking water and sewer infrastructure is very expensive to install and maintain. The Environmental Protection Agency has identified a potential funding shortfall for drinking water and wastewater infrastructure of over \$500 billion by 2020 if expenditures remain at current levels. Heavy downpours will exacerbate existing problems in many cities, especially where stormwater catchments and sewers are combined. Climate change will present a new set of challenges for designing upgrades to the nation’s water delivery and sewage removal infrastructure."</p>	While we agree that these are important points related to impacts, we feel they are better made within the Water Resources section.
P	Pendergrass	30	R	8	The color bar for this figure only appears on the following page (31). If this report is intended to be read as I am reading it, online in PDF form, and not in book form, the color bar should also appear on this page.	The figure has been modified so that it now appears on a single page.
P	Tolman	31	L	2	Delete ‘potential water resource benefits from’ and ‘by the competing influences of’. [Simplify for clarity.]	We prefer this sentence as written.
P	Tolman	32	L	1	Replace ‘The’ by ‘Precipitation in the’, and ‘have’ by ‘has’.	We are satisfied with the language on this page as written.
P	Tolman	32	R	50	Insert ‘are’ before ‘based’.	The suggested change has been made.

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P	Tolman	33	R	7	[to R8] After 'though' insert 'the number of', and replace 'do' by 'does'.	We are satisfied with the language on this page as written.
P	Knutson and Vecchi (NOAA/GFDL)	33	R	10	[to R11] "These trends are projected to continue throughout this century." You should say, "These trends in storms <i>outside of the tropics...</i> " to clarify that the sentence does not refer to the hurricane trends. None of the mentioned hurricane trends are necessarily expected to continue over the next century.	The suggested change has been made.
P	Carns	33	R	10	The hatching on this graph is visually noisy and actually makes it more difficult to distinguish between blue and brown areas. Simply increasing the intensity of the blue or brown color to indicate significance would be a better solution.	We have modified this figure as suggested.
P	Tolman	33	R	33	Replace 'Divisions with hatching indicates' by 'Hatching indicates'.	The figure has been moved to the 'Water Resources' Section and the suggested change has been made.
P	Pendergrass	33	R	49	The color scale used in this figure is not very intuitive. Making red earlier melt and blue later melt is intuitive, but the intermediate colors do not follow each other well, especially the earlier melt dates. Restricting the colors to shades of red and blue would help. It might also help to vary the size of the markers, with the biggest markers representing the biggest changes in snow-melt dates, and the smallest markers for the smallest changes.	We have modified this figure as suggested.
P	Carns	34	R	23	"A day so hot that it occurs once every 20 years at the beginning of the 20 th century will be approximately 10°F hotter than a day that is rare at present." This is very difficult to interpret. Suggested revision (based on my guess as to what the sentence is meant to say): "At the end of the century, the most extreme hot days (once-in-twenty-years events) will be as much as 10°F hotter than today's extremes."	We have modified the text in response to your suggestion.
P	Knutson and Vecchi (NOAA/GFDL)	35			This page on Atlantic hurricanes has quite a few serious problems. The Synthesis Report authors seem to be trying to "improve upon" the CCSP 3.3 Report at this late stage. As a Lead Author (Knutson) on CCSP 3.3, my opinion is that in trying to make these "improvements" at this late stage, they have actually introduced numerous errors of content and errors of omission into the document, rendering it unacceptable as written.	We have made a number of changes as described in the succeeding comments.
P	Knutson and Vecchi (NOAA/GFDL)	35	L	1	[to L4] " <i>The destructive energy of Atlantic hurricanes has increased in recent decades and is projected to increase further in this century</i> ". No. Change to: " <i>The destructive energy of Atlantic hurricanes has increased in recent</i>	We have changed this to address your suggestion.

						<p><i>decades, though these changes have not been confidently attributed to anthropogenic climate change. The intensity of Atlantic hurricanes is projected to increase at a more gradual rate during the coming century as greenhouse warming proceeds.</i></p> <p>Or here is a shorter version: <i>“The destructive energy of Atlantic hurricanes has increased in recent decades, but whether this increase in basin-wide activity will continue in this century remains uncertain.”</i></p> <p>The single sentence as originally written is misleading and incorrect. The statement implies that the rising trend in PDI since 1950 or since 1980 will continue on into the future. This is not what climate models are projecting. Rather, dynamical models are projecting relatively little change in PDI in the future (some showing a decrease), but, more consistently, the higher resolution models project an increase in the intensity of the strongest storms. The latter is projected to change at a rate of 1-8% per deg C of SST warming.</p>	
	P	Knutson and Vecchi (NOAA/GFDL)	35	L	26	[to L28] “Confidence in the tropical storm and hurricane record is greatest from 1900 to present.”	We are unclear on the meaning of this suggestion – part may have been cut off.
	P	Knutson and Vecchi (NOAA/GFDL)	35	L	34	[to L37] “Considering the more reliable period of data (since 1900) there is a significant upward trend in both the number of hurricanes and the number of strongest hurricanes.”	We have removed references to century-scale trends, added in language specifically from 3.3, and substantially edited this section in response to this comment.
	P	Niblock	35	R	14	As in many other charts, this one once again makes use of counts rather than measures. The implication is correlation where it is doubtful one exists.	The presentation of counts here is scientifically appropriate.
	P	Knutson and Vecchi (NOAA/GFDL)	35	R	36	<p>Figure caption. “The number of strongest hurricanes have not been adjusted owing to the fact that storms of this strength are unlikely to be missing in the observational record of the pre-satellite era.”</p> <p>These statements are an oversimplification and actually misleading, because they ignore important findings, for example, on high hurricane counts from the late 1860s-1880s, and incorrectly assert that major hurricanes would have been reliably identified <i>as major hurricanes</i> over the entire basin in the pre-satellite era. Counts of cat 1-5 hurricanes, even without any adjustments for limited ability to detect maximum intensities, were so high in the 1860s-1880s that there is not even a statistically significant increase since</p>	We have updated the figure in response to these suggestions. We have also extensively revised the figure caption.

1855, 1860, or 1865 (CCSP 3.3, Fig. 2.17). This is a strong argument against claims that there has been a significant long-term increase in Atlantic hurricane counts basin-wide. As noted in the text, there is also no evidence of a trend in U.S. landfalling hurricanes (strong or otherwise).

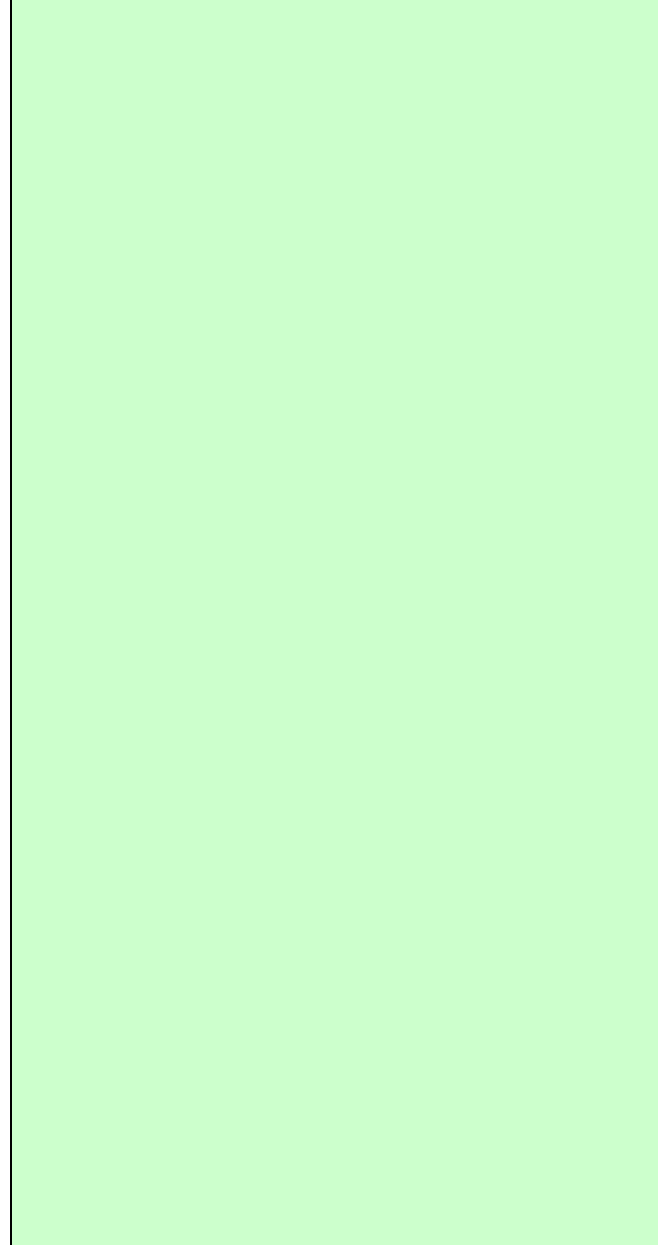
Note that one needs to rely on the pre-1900 data to make this important inference about basin-wide hurricane counts; however, while we can see why one might think that not all storms from the earlier years were seen and identified as such, what is the justification for ignoring high counts of hurricanes in the earlier period?

As noted in the CCSP report, trends computing beginning from around 1900 are from a local minimum in time series and thus tend to exaggerate the long-term trend obtained from using earlier data.

A major concern with using earlier records (pre-satellite, pre-1900, etc.) is that storms that never made landfall were not nearly as well monitored as today, if detected at all, leading to a negative bias in earlier intensity estimates. Ship track density appears to have been insufficient to even detect all such tropical storms. In the case of major hurricanes, while the storms were intense and therefore unlikely to have been overlooked completely, being able to identify them as major hurricanes, rather than as cat 1-2 hurricanes or tropical storms, is a different matter entirely. To correctly identify open-basin hurricanes as major hurricanes would have required some ship to be unlucky enough to pass through the limited area of maximum winds seen by modern aircraft and satellite reconnaissance, and also lucky enough to survive and report the findings. This is very unlikely given the limited density of shipping traffic reporting from those days, which has been scrutinized for missing storms. These problems would very likely lead to *undercounts* of tropical storms, hurricanes, and major hurricanes—not over-counts.

The authors need to re-read the material from CCSP 3.3 p. 60-61. Here is how this was summed up (from p. 61):

“In summary, we conclude that there have been fluctuations in the number of tropical



storms and hurricanes from decade to decade, and data uncertainty is larger in the early part of the record compared to the satellite era beginning in 1965. Even taking these factors into account, it is likely that the annual numbers of tropical storms, hurricanes, and major hurricanes in the North Atlantic have increased over the past 100 years, a time in which Atlantic sea surface temperatures also increased. The evidence is *not compelling* for significant trends beginning in the late 1800s. The existing data for hurricane counts and one adjusted record of tropical storm counts both indicate no significant linear trends beginning from the mid- to late 1800s through 2005. In general, there is increasing uncertainty in the data as one proceeds back in time. There is no evidence for a long-term increase in North American mainland land-falling hurricanes.”

While the statement is not perfect in my view, it represented a negotiated statement among differing opinions on the CCSP 3.3 panel. Note that in the above quote, which we recommend for the Synthesis Report, we’ve changed “less compelling” to “not compelling” to be consistent with the CCSP 3.3 executive summary text (P. 6 or CCSP 3.3) which was a change overlooked in the late updates to the main CCSP 3.3 text. It is important in particular that the lack of significant trends from the late 1800s is pointed out, since if the Synthesis Report presents only the “significant” result from 1900 alone, readers might mistakenly conclude that there is a strong case of a significant long-term trend in Atlantic hurricane activity, which there is not. The presence of high counts from the earlier periods here is a very useful addition, as it implies that the “significant trend” from 1900 is probably an analysis artifact obtained by computing a trend from a local minimum in a time series containing substantial multi-decadal variability. Trying to “circumvent” this finding by presenting only the 1900 onward trends using statements like: “Confidence in the tropical storm and hurricane record is greatest from 1900 to present.” and “Considering the more reliable period of data (since 1900) there is a significant upward trend in both the number of hurricanes and the number of strongest hurricanes.” is really just cherry-picking, and doesn’t inform readers about the true fragility of claims of statistically significant trends in the basin or of the high hurricane counts from the earlier decades.

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						The excerpt above from CCSP 3.3 would be appropriate text to use on p. 35 of the Synthesis Report. Also the Figure on p. 35 should be modified to include the basin-wide hurricane counts from 1851 onward, as in Fig. 2.17 of CCSP 3.3. Major hurricane counts from the pre-satellite era, if shown at all, should be used with extreme caution and a huge grain of salt, as they alone show a significant trend from the mid to late 1800s. We, along with number of other hurricane researchers, have no confidence that the major hurricane records are complete from the earlier decades. The major hurricane count record is probably greatly compromised by under-sampling in the earlier years. Whether a complete major hurricane count record would show a trend or not is anyone's guess. The source of the adjustments to the tropical storm counts in the Figure should also be given.	
P	Pendergrass	36	L	1	Tick marks for sea surface temperature should be chosen with cleaner numbers (e.g., halves and whole numbers).	The suggested change has been made.	
P	Tolman	36	L	23	Delete 'absolute'. [It appears to contribute nothing.]	Aboslute has been removed.	
P	Knutson and Vecchi (NOAA/GFDL)	36	R	5	[to R14] The introduction of such findings as the Elsner et al. 2008 work at this late stage of the process raises many more problems for the Synthesis Report. Is it a Sythesis or an Update or an Improvement? The Elsner et al study is still subject to much debate in the tropical cyclone community as to its relevance for the greenhouse warming issue and as to how reliable the adjusted data are for the Indian Ocean basin. Its late inclusion also raises questions such as why were other new findings not included? We recommend to delete this whole paragraph and stick with the topics that were examined, reviewed, vetted, and included in topical summaries by the CCSP 3.3 author team.	Details from the Elsner report have been removed, but that report builds on other work that indicates a relationship between hurricanes and SSTs so the basic point is still made.	
P	Knutson and Vecchi (NOAA/GFDL)	36	R	5	[to R18] The introduction of such findings as the Elsner et al. 2008 work (p. 36) at this late stage of the process raises many more problems for the Synthesis Report. Is it a Synthesis or an Update or an Improvement? The Elsner et al study is still subject to much debate in the tropical cyclone community as to its relevance for the greenhouse warming issue and as to how reliable the adjusted data are for the Indian Ocean basin. Its late inclusion at the Synthesis stage also raises questions such as why other new findings were not included. We recommend deleting this whole paragraph (p. 36, R5-18) and sticking with the topics that were examined, reviewed, vetted, and included in topical summaries by the CCSP 3.3 author team. The same recommendation would also apply for any other	The USP relies on SAPs and other assessments for its key information. But to stop there and not use peer-reviewed material that is more recent - some SAPs are fairly dated- would do our readers a disservice.	

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						“late-breaking” changes introduced at the Synthesis Report stage, bypassing the major review and lead author team vetting process.	
P	Knutson and Vecchi (NOAA/GFDL)	36	R	14	[to R18] The Webster et al. results have been superseded by the Kossin et al. study, which is based on a more carefully homogenized approach. Also, in the CCSP 3.3 we purposefully chose not to emphasize global results such as these in the CCSP 3.3 report, as our charge was to look at the basins affecting U.S. coastlines and islands. We recommend deleting the sentence.		This sentence has been removed.
P	Knutson and Vecchi (NOAA/GFDL)	36	R	37	[to R38] “which is a virtually certain outcome...” change to “the latter being a virtually certain outcome...” Only sea level rise is virtually certain...increasing hurricane intensity is not.		We have made the change as suggested.
P	Tolman	37	L	18	[to L19] [How can it be true that the destructive energy of tropical storms and hurricanes has decreased in the Eastern Pacific, when the most destructive storms (Category 5) have increased in intensity?]		These statements are justified by the references and are not in contradiction with one another in our view.
P	Tolman	37	L	37	After ‘due to’ insert ‘sinking coastland in some areas,’. [This is needed to explain why sea level rise is different in different places.]		This has been addressed by a major rewrite of this section.
P	Tolman	38	L	14	[to L23] [It would be helpful to have a visual – perhaps a map of storm tracks – to show how winter season storm tracks have been shifting northward.]		We are unable to find a peer-reviewed figure or information similar to your requests. So though it was a good suggestion, no change was made.
P	Kruk (NOAA/NCDC)	38	L	42	[to L44] The wording here implies that lake-effect snow cannot occur with air temperatures less than 15°F or more than 32°F. This statement is not entirely accurate and anyone living in the Great Lakes region knows it can snow at just about any temperature, no matter how cold. Moreover, what is left out of this discussion is that the production of lake-effect snow is driven by the change in temperature from the surface of the water to about 5000 feet. If the ice-free water is 33°F and the “cold air” running over this surface is 32°F, there is not likely to be lake-effect snow. Consequently, I recommend adding one more sentence explaining this “delta T’ requirement for snow production and removing the “absolute” temperature range provide on line L43.		We have edited the text to make this point in a simple, short manner.
P	Pendergrass	39	L	33	Instead of “North Pole Ice Extent.” the label should be “Arcitic Sea Ice Extent.” The North Pole is a point so it does not make sense to measure ice extent there.		We have made the suggested change.

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P	Tolman	39	L	50	Replace 'estimated data' by 'estimated area'.	The sentence in question has been removed.
P	Tolman	39	R	28	Replace 'have been' by 'was'.	The lead author preferred "have been" over "were" and since the meaning is the same, no change was made.
P	Kruk (NOAA/NCDC)	39	R	34	[to R38] Wasn't the 2008 sea ice extent the second lowest on record? Would stating this specifically make more of an impact to the reader rather than saying it was simply lower than the long-term average?	The point made is true for minimum sea ice but not for total annual sea ice, so no change was made.
P	Pendergrass	40	L	3	In the Global Climate Change chapter of this report, the terms "heat-trapping gases" and "greenhouse gases" are used interchangeably. I suggested that one of these terms be chosen, defined, and consistently used in that section, and the term used here and throughout the report should be consistent with this choice.	This is addressed by the suggested addition at p. 14, L11: 'These gases are called greenhouse (or, heat-trapping) gases.'
P	Carns	40	L	8	"Roughly one-third of the carbon dioxide released from fossil fuel burning remains in the atmosphere after 100 years, and roughly one-fifth of it remains after 1,000 years. As a result, the United States is responsible for about 28 percent of the human-induced heat-trapping gases in the atmosphere today." Juxtaposing these two sentences seems to be conflating CO2 (first sentence) with all human-induced heat-trapping gases (second sentence.) While it is true that CO2 is the most important heat-trapping gas, it isn't the only one. Suggested revision: Rewrite the second sentence to use CO2 statistics instead of overall greenhouse gas statistics.	We have revised the text to address your point.
P	Staudt	40	L	15	[to L29] The discussion of carbon sinks misses an important opportunity to connect the dots for readers between carbon sinks on forested and other landscapes with the projected trends in extreme events and wildfire. In recent years we have relied on our natural landscapes to absorb about 20% of the CO2 emissions from fossil fuels. But, global warming makes this sink less reliable because it makes our forests more vulnerable to catastrophic loss from fires, insect infestations, and severe storms. Emissions box: The discussion in the Emissions box gives too little attention to direct human causes of CO2 emissions and too much attention to the question of carbon storage in forested and other natural landscapes. This box would be an excellent place to provide some insight on what US emissions from fossil fuels would need to be in order to	We have modified this text in response to the reviewer's suggestion.

					meet potential stabilization targets. How much will US emissions need to be reduced by 2020 or 2050 to meet a 450 ppm target?		
P	Tolman	40	L	47	[to L48] Replace 'Carbon' by 'U.S. carbon'. Delete 'from U.S. emissions'.		The caption has been revised, but we feel that the meaning of "U.S. carbon" is unclear so it has not been used.
P	Pendergrass	41	L	24	[to L32] The very first sentence of this chapter is too long to be understood and should be two sentences. In addition, the wording "The warming observed over the past several decades is consistently associated with changes..." is confusing and unclear. An improvement might be "A number of observed and expected changes in the water cycle are associated with the warming observed over the past several decades. Examples of these are changes in precipitation patterns and intensity, ..." (finish the rest of the original sentence).		This portion of the text has been restructured to clarify, and bullets have been employed to break up the long sentence
P	Pendergrass	41	L	35	[to L37] The second to last sentence of the paragraph is confusing because of the list contradicts itself. Stating explicitly the spatial dependence of changes would clarify. For example, replace "too little water, too much water, and degraded water quality" to "too little water in some places, too much water in others, and degraded water quality."		These changes imply that too little water and too much water are mutually exclusive with respect to location. In reality, the same location could be subject to all of these conditions separated by relatively short periods of time hence the implied spatial exclusivity is misleading. We have rewritten the sentence to read: "Some locations will be subject to all of these conditions during different times of the year."
P	Pendergrass	41	R	24	[to R27] The first two punctuation marks in this heading (comma after altered and semicolon after cycle) are grammatically incorrect. This can be remedied by omitting them ("Climate change has already started and will continue to alter the water cycle affecting ...").		The suggested change has been made.
P	Pendergrass	41	R	29	[to R46] This paragraph only discusses precipitation changes due to mean temperature increase. Changes in circulation associated with warming are also very important for precipitation changes (this was noted in the Global Climate Change chapter, p18, L9-16), and this should be noted in the introduction to water cycle changes as well.		We have added the following sentences: "In addition, changes in atmospheric circulation will tend to move storm tracks northward with the result that dry areas will become drier and wet areas wetter. Hence, the arid American Southwest will experience longer and more

							severe droughts from the combination of increased evaporation and reductions in precipitation.”
P	Pendergrass	42	L	2	This figure has a lot going on. Omitting some elements to simplify the figure could help clarify the main point. The hot dry area could be more clearly delineated from the hot wet area, and a few key, clear points could be emphasized to show the most important differences between the regions.		This figure is the result of considerable input, and we have decided to leave it as written.
P	Carns	42	L	3	It isn't clear what the label "Changes Common to Both Regions" is meant to refer to. The bracket below it, which is presumably meant to clarify this, doesn't have an obvious connection to anything in the picture. Suggested revision: if the label and bracket are meant to apply to the top region of the figure, extend the bracket further out to make this clear. "Decreases in Snowfall Due to Warming Lead to Proportional Increases in Rainfall" Suggested revision: "Greater Fraction of Precipitation Falls as Rain rather than Snow" Also, why is this a circle? A circle implies some kind of cycle, which snow-to-rain isn't.		This figure is the result of considerable input, and we have decided to leave it as written.
P	Tolman	42	L	37	[to L43] [Data points seem to be missing from the southern part of the U.S. Perhaps there should be a note of explanation.]		The caption has been revised to provide the suggested explanation.
P	Carns	42	R	36	"In most areas of the country, the fraction of precipitation falling as rain versus snow has increased during the last 50 years." Typo; should be "precipitation."		Thank you. The suggested change has been made.
P	Carns	42	R	39	"Despite this general shift from snow to rain, snowfalls along the downwind coasts of the Great Lakes have increased where reduced ice cover, due to warming lengthens the period of open water, allowing strong evaporation when temperatures are still cold enough to produce heavy snow." Grammatical issues. Suggested revision: "Despite this general shift from snow to rain, snowfalls along the downwind coasts of the Great Lakes have increased where reduced ice cover lengthens the period of open water, allowing strong evaporation when temperatures are still cold enough to produce heavy snow."		This sentence has been restructured for clarity.

P	Pendergrass	42	R	39	[to R48] The second sentence of this paragraph is long and confusing. It should be split in two and the second part needs clarification. A possible improvement might be, “Despite this general shift from snow to rain, snowfalls along the downwind coasts of the Great Lakes have increased. Reduced ice cover due to warming lengthens the period of open water, allowing strong evaporation when temperatures are still cold enough for the production of heavy snow.”	This sentence has been restructured for clarity.
P	Kruk (NOAA/NCDC)	42	R	48	[to R50] The sentence states that the southern portions of the U.S. should see a reduction in heavy snowfall, yet the corresponding graphic at the bottom of page 42 has a big blue square (indicating more snow) in southwestern Virginia. How do the authors explain this disconnect? Also with regards to the figure at the bottom of page 42, why is there a small empty blue square in extreme northern Wisconsin? Shouldn't it be filled in solid blue?	<p>The graphic and the referenced statement are not dealing with the same phenomenon. The text talks about incidence of ‘heavy snowfall’ while the image is showing how snow is changing to rain in winter. The graphic also does not cover the entire South. Also note that there are approximately 20 big blue squares on the maps. By comparison there are approximately 100 large red circles. Despite some local effects, the preponderance of the measurement supports the claim of more rain.</p> <p>We have also added the following: “Heavy snowfall and snowstorm frequency have increased in many northern parts of the United States. In the South, however, where temperatures are already marginal for heavy snowfall, climate warming has led to a reduction in heavy snowfall and snowstorm frequency. These trends suggest a northward shift in snowstorm occurrence.” Reference CCSP 3.3 Extremes, p. 74.</p>
P	Carns	43	R	27	As on p33, the hatching on this graph is visually noisy and makes the graph more difficult to read. Suggested change: replace hatching with more-intense colors.	This figure has been revised and the caption simplified.

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P	Tolman	43	R	46	[to L47] Replace “Areas with hatching indicates significant trends.” with “Significant trends are indicated in areas with hatching.”	We have made the suggested change.
P	Kruk (NOAA/NCDC)	44	R	4	Suggest deleting the phrase “while it sounds counterintuitive....” This introductory phrase adds “opinion” to the document and it might be better off to leave it as simply a factual report on the current state of the science. Moreover, what may seem “counterintuitive” to one may seem quite obvious to another.	After consideration, we prefer the current phrasing.
P	Carns	44	R	4	"While it sounds counterintuitive, a warmer world produces both wetter and drier conditions because even though global precipitation increases, the regional distribution of precipitation changes." Suggested revision: "While it sounds counterintuitive, a warmer world produces both wetter and drier conditions: even though global precipitation increases, the regional distribution of precipitation changes."	The suggested change has been made.
P	Tolman	44	R	6	Insert ‘total’ before ‘global precipitation’.	The suggested change has been made.
P	Pendergrass	44	R	22	[to R29] A clear and catchy way to express an important idea in this paragraph would be to say that “wet areas get wetter and dry areas get drier.” To my knowledge, this phrase comes from a (very simplified) argument in Held and Soden (2006), page 5698, about an atmosphere where the flow is unchanged (which is not true in reality). It is imperfect and originates in a different context than national climate change, but it is a clear way to say that areas that are typically not dry like the Northeast will see more rain, while areas like the Southwest that are arid will see more drying.	The paragraph has undergone substantial revision to improve its clarity.
P	Carns	46	L	24	"One to two week earlier spring runoff in snowmelt-dominate streams in the Northeast have also been recorded." Suggested revision: "Spring runoffs one to two weeks earlier than normal have also been reported in snowmelt-dominated streams in the Northeast."	We have added language referring to the Northeast (and West).

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P	Tolman	46	R	8	Change 'streamflow is low' to 'streamflows are low'.	The suggested change has been made.
P	Carns	46	R	23	"Water quality changes during the last century were likely to be attributable to causes other than climate change, primarily changes in pollutants ¹¹ . There are only a few studies on the impacts of climate change on water quality; to date, water quantity impacts have been the focus of most climate change research." This should be its own paragraph.	We have split the paragraph to address your concern.
P	Carns	47	L	19	"Land subsidence (sinking) due to over-pumping of groundwater is a serious problem; the San Joaquin Valley in California, Houston, Texas, and areas in Arizona have suffered permanent declines of up to 30 feet after extended periods of over-pumping." This sentence seems out of place in a paragraph about effects on the quality/quantity of groundwater itself. Suggested revision: delete or move the sentence.	The sentence has been revised and moved to the 'Transportation' Section.
P	Carns	47	L	25	Sea-level rise is expected to increase salt water intrusion into coastal freshwater aquifers, making them unusable without desalination. Increased evaporation or reduced recharge into coastal aquifers will exacerbate salt water intrusion." This should be its own paragraph, or possibly part of the previous paragraph.	We feel that this is appropriately placed in the text in its current location.
P	Niblock	47	L	33	The chart contains the comment "The recent large jump in water temperature is related to the recent large reduction in ice cover (see Midwest region)." This statement alludes to the chart on page 121 regarding ice cover but ignores the large variability in both temperature and ice cover, the latter of which seems to be within natural process limits.	We have modified the figure caption to address your suggestion.
P	Tolman	47	R	21	Change 'conflicts between water' to 'conflicts over water'.	Correction made.
P	Tolman	47	R	27	Change 'conflict' to 'conflicts'.	We have decided to leave as written.
P	Carns	47	R	29	"The Environmental Protection Agency has identified a potential funding shortfall for drinking water and waste water infrastructure of over \$500 billion by 2020 if expenditures remain at current levels." This sentence appears almost word-for-word on page 48. Suggested revision: delete the sentence from page 47.	We have removed this material from this location.

P	Tolman	48	L	26	Change 'population trends' to 'increasing population'.	Here, we use 'population trends' to reflect that most, but not all areas are experiencing increasing population.
P	Tolman	48	L	37	[to L38] Delete 'to today'. [It adds nothing.]	We have restructured the sentence to clarify.
P	Niblock	49	R	2	<p>1. The chart and text do not indicate anything other than variability within natural process limits. The data show nothing about global or regional warming. Without the source data, further evaluation of the chart requires approximation. I approximated the data by sampling the chart at 50 year intervals. Reading from the chart permitted an approximate analysis that is presented in attached Figure 1. Sampling every 50 years and eyeballing the chart misses some of the extremes and introduces some relatively small error. The upper and lower control limits are somewhat closer to the mean than they would be with the full data set but the result is still instructive. There is no signal generated by the data that indicates any action should be taken. The data are all well within the natural process limits.</p> <p style="text-align: center;">Figure 1</p>	<p>We believe that the review misunderstands the purpose of the graphic. The graphic is intended to support the key message on this page. Paleoclimate and observational data support this message. The graphic is not intended to show climate trends for the late 20th century.</p> <p>We have modified the figure caption to include the following: "Droughts shown in the period 1100-1300 significantly exceed those that have occurred over the past 100 years.</p>
P	Niblock	51	L	38	The chart shows correspondence in the levels of the lakes, implying that they have experienced similar inflows and outflows during the time both operated. There is nothing that indicates generalized warming is the cause. Lake Mead experienced a similar drought in the mid 1950s, early 1960s and early 2000s. In each instance lake levels recovered, or in the last instance appear to be recovering.	We feel that the chart has been appropriately characterized in the spotlight.
P	Scott	52	L	25	Reducing wastewater production is key to preserving usable quantities of fresh water. Furthermore, utilizing renewable sources of energy is vital, because energy will always be required to treat and transport fresh water for human use. The USDA/DOE lifecycle inventory (referenced above) also concluded that biodiesel reduces wastewater production by 79% and reduces hazardous waste production by 96% compared to petroleum diesel ¹ . As climate change alters precipitation patterns in the US, wise use of water resources can be expected to be of even greater importance in the near future. Biodiesel as an alternative to petroleum is a wise use of water resources.	We contend that this information is not appropriate for inclusion because it is not presently supported by the peer-reviewed literature.

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P	Tolman	52	L	49	Replace 'pumping, drinking, and waste water treatment' by 'water pumping and treatment'. [As written it sounds like a lot of energy is required to drink water.]	We have modified the sentence to say "...energy is used by the water sector for pumping, drinking water treatment and wastewater treatment."
P	Tolman	52	R	7	Replace 'nearly all' by 'many'. [Cooling water is not required for wind power or solar PV – the two most rapidly growing forms of renewable power.]	We feel that this is correct under current uses.
P	Tolman	52	R	8	[to L9] [What is meant by 'thermoelectric cooling'? Some reference or explanation is in order here.]	We have changed the sentence to begin: "Withdrawals of freshwater used to cool power that use heat to generate electricity are very large, nearly equaling..."
P	Tolman	52	R	13	Replace 'weight' by 'weight for a given volume'. [It is, after all, the density of water than is high.]	We have changed the sentence to read: "significant weight due to its relatively high density and its high heat capacity"
P	Scott	53	R	29	[to R33, and p. 57, L30-R50] The US biodiesel industry can mitigate these impacts to energy and national security by offering a decentralized fuel production system. In contrast to the gulf coast's concentration of fuel resources and infrastructure in increasingly hurricane prone areas, 176 biodiesel plants have been constructed all across the country. These plants are often built in the geographic vicinity of feedstocks used by each plant. They are also capable of using feedstock transported by barge, rail, and truck. The versatility of these biodiesel plants to use different kinds of feedstocks from different geographic areas reduces their susceptibility to interruptions such as those experienced in the gulf coast during recent emergencies. Because biodiesel plants are distributed across America, they are far less likely to suffer operational interruptions at multiple facilities due to a single natural disaster or terrorist attack. These attributes should be highlighted in any national plan to prepare this country for life in an era of global climate change.	We contend that this information is not appropriate for inclusion because it is not presently supported by the peer-reviewed literature.
P	Tolman	54	L	29	At the end of the sentence add: "Current contributions of wind, solar PV and geothermal energy to U.S. energy supply are too small to display in this figure."	These additional minor sources are not included because we do not have aggregate statistics for all other sources (beyond 'major' sources).
P	Tolman	54	L	34	[to L50] [The pie chart could be improved by moving the slice representing Other Gases next to Natural Gas. It doesn't make sense between Petroleum and Nuclear.]	This has been changed.

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P	Tolman	55	L	19	Insert the word 'outside' after 'warming'.	We prefer the phrasing 'global warming' and have made the change accordingly.
P	Niblock	55	L	29	The chart omits historical data for heating and cooling loads measured in degree-days. Is that information available? If so, why not present it? The omission minimizes the information communicated with the chart.	This has been left as written. The aim here is to look toward the future; it includes historical levels.
P	Pendergrass	55	R	1	[to R25] This figure shows the change in population over 37 years, with shading that indicates the change in numbers of people. One sentence in the caption states "Areas with increases of more than 1000 people are all shown in maroon." For the shading to make sense, the data must have units of the number of people per unit area. Is this people per municipality? Per county? If it's a gridded dataset, then it might be people per square mile. Whatever it is, it should be stated on the figure and/or in the caption.	This has been clarified in the figure and caption.
P	Tolman	55	R	18	[The label 'Number of People' is an inadequate description. Do you mean number per square mile, per zip code, per county, or what?]	This has been clarified in the figure and caption.
P	Tolman	56	L	28	[and R28] Insert the word 'thermal' before 'power'.	We have adopted your suggestion.
P	Scott	56	R	19	[to R23] In contrast to the amount of water required for electrical energy or conventional petroleum diesel, relatively small amounts of water are required to make biodiesel. The average water consumption among present-day biodiesel plants is 0.32 gallons of water per gallon of biodiesel. The entire US industry consumed less than 225 million gallons of water for the entire year of 2008. This is less water than the excess capacity of a typical metropolitan area on a single given day.	We do not feel that the inclusion of biodiesel is a relevant addition at this point in the text.
P	Scott	56	R	19	[to R23] The infrastructure required to build and maintain transportation corridors such as Louisiana Highway 1 represent an indirect carbon emission from concrete production and construction activity that should be applied to fossil fuels. These indirect emissions make low-carbon alternatives such as biodiesel even more attractive as a mitigation strategy for global warming.	This is a conclusion not supported by available published research.
P	Niblock	57	L	31	Although offshore oil production can be damaged by extreme hurricanes, those events are random in both their timing and magnitude. While this is a scary story, there is no showing that the likelihood of large storms in the region affected is increased by generalized warming.	These events are random at a local scale, but their intensity and its effects are not random at a regional scale.

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P	Niblock	58	L	3	This chart is misleading because it lumps together the counts of a variety of causal factors that may each have separate and different relationships to temperature. It is misleading because there is no consideration of delays in transmission system improvements (such as the transmission line for San Diego) that have resulted from environmental interventions in regulatory proceedings. An evaluation of each causal factor with statistical process methods is likely to show that the changes which have occurred are within natural process limits.	No change has been made - the chart stands on its own. Climate and a variety of other things have been changing. The caption also states that the figure does not demonstrate a cause-effect relationship between climate change and grid disruption. Non-weather related disturbances are showing no trend.
P	Tolman	58	L	6	Delete 'of Florida'. [It is redundant and adds nothing.]	This change has been made.
P	Scott	59	L	41	[to L44] Biodiesel is a good example of a renewable energy that can reduce the magnitude of climate change. Biodiesel's versatility isolates it from the effects of climate change. This versatility comes primarily from the ability to use a multitude of different feedstocks and driving research to develop new feedstock on marginal and degraded land, as well as arid land and salt-loving crops.	We have decided not to include because of the lack of peer-reviewed citations that support this point.
P	Scott	60	R	23	[to R22] Distinctions should be made between biodiesel and other types of biofuels as the effect of water availability is addressed. As described above, biodiesel uses minimal amounts of water and provides a sound mitigation strategy as well as a viable adaptation mechanism.	We have decided not to include this because of the lack of peer-reviewed citations that support this point.
P	Tolman	61	L	30	Replace '2008 and 1993' by '1993 and 2008'. [Put in chronological order.]	We agree and have put in chronological order.
P	Kruk (NOAA/NCDC)	62	R	16	[to R30, and p.63, L30-L38] This section does not offer much in terms of what we can or should expect in terms of storm surge projections in future climates. While it is important to mention the areas that may be impacted by presumably greater storm surge (or more frequent) events, it would be helpful to add some discussion on the actual expected (or modeled) frequencies or values in storm surge events. How many more 100-year events will we experience in the next century than we did in the past? Will they become less frequent but be larger events? How do storm surge futures link with hurricane frequency or extra-tropical cyclone frequency/intensity?	Detailed information on projected storm surge is not available. Information on sea level rise and more intense storms is mentioned in the <i>National Section</i> . We considered referring people to the <i>National Section</i> for more information but (a) it breaks up the flow of the text, (b) sea level rise and such is mentioned in many places in the text without referring people to the <i>National Section</i> , and (c) many of the readers will have already read the earlier material so it won't be necessary. No change

							made.
P	Scott	71	L	38	<p>[to L51] To address the increased demand for agricultural productivity, it is important to address the technological advances that are and can be expected to continue providing increases in production yield with reduction in inputs. It is also important to highlight the need for sustained research and investment to continue this vital trend. Biodiesel is a factor in driving such research and investment as it increases market value of otherwise low-value co-products or wastes. Public efforts to support biodiesel simultaneously provide domestic energy infrastructure and increased food security through innovation and economic sustainability of farm businesses.</p> <p>Climate change mitigation strategies should also include sustainable agricultural practices such as no-till and cover crops that can increase the sequestration of carbon while farming. Exporting these technologies to developing nations where their practice is less common is also a valuable strategy.</p>		This is addressed later in this section, where we feel it is better placed. It becomes redundant if added in this location.
P	Downer	79			<p>As president of the Andean Tapir Fund, I am very alarmed that Global Warming will be the death knell of the endangered Mountain Tapir, inhabitant of the northern Andes from ca. 1500 to 4500 meters. It depends on the Andean Forests and Paramos but these are drying up at a most alarming rate. With these goes the water supplies for plants, animals and people downslope. The Andean glaciers are fastly melting away, and it is imperative not only for the mountain tapir, but for the rest of life and Andeans that those forests and paramos that remain be preserved/conserved. A critical issue here concerns the livestock culture that is very inappropriate in the Andes and ends in desertifying vast stretches that were before vital watersheds composed of forest and paramo or puna.</p> <p>P.S. Andean Tapir Fund is now trying to save the remaining forests and southermost paramos of the Piuran Cordillera/Cordillera de las Lagunillas in northern Peru. Local grassroots citizens and conservationists are pitted against gigantic mining cartels that are trying to impose open-pit mining for copper and other metals that would prove tragic for the endemic wildlife and for the vital watersheds here. This is in the area of high endemism known as the Huancabamba Depression. See www.andeantapirfund.com</p>		This document looks at the United States. Discussion about the Andes is not in the scope of this report.

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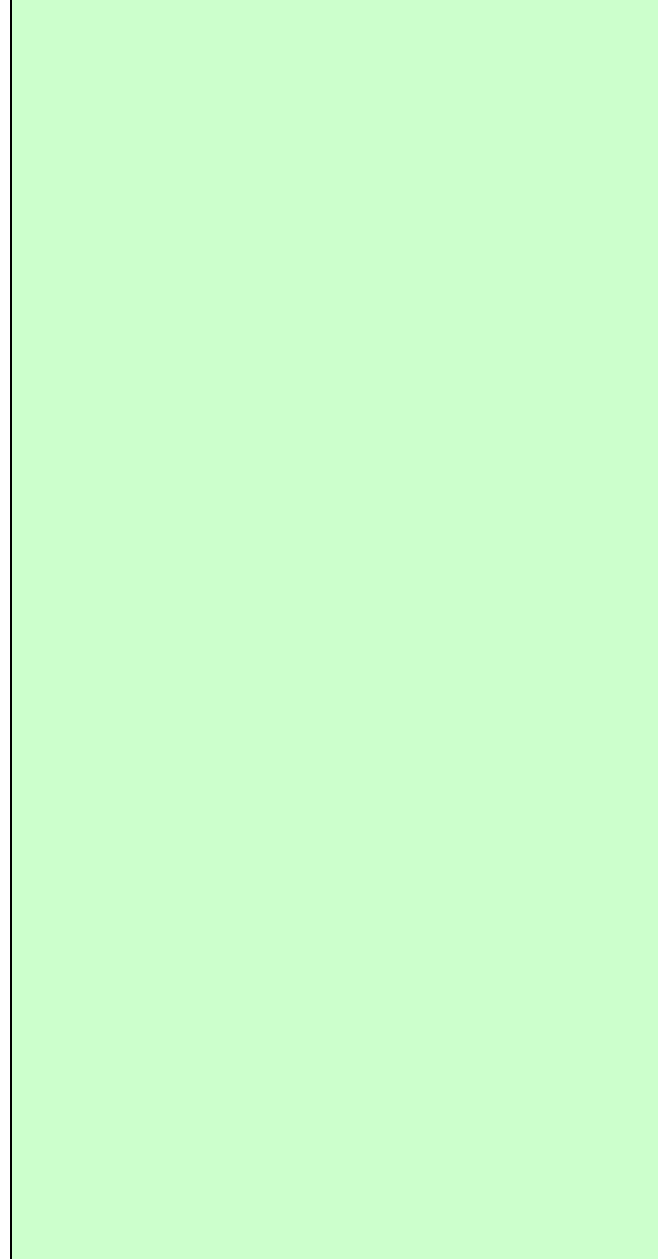
P	Scott	79			As natural ecosystems become increasingly stressed from the effects of climate change, it is important to avoid additional stress that would have a cumulative negative effect on natural ecosystems. Pollution prevention should be part of this adaptation strategy. In addition to GHG reductions, biodiesel is nontoxic and biodegradable. Studies show that 100% biodiesel degrades by 88% in 28 days, and 20% biodiesel blended with petroleum helps it degrade four times faster than petroleum diesel alone ³ . This means biodiesel has a very short-term and minimal effect if accidentally released into the environment. Biodiesel production also eliminates the risk of crude oil spills as the raw materials are organic in nature.	The details in this comment are not directly related to the basic scope of this report, as it doesn't get that detailed. Therefore, no specific comment on biodiesel is made here.
P	Staudt	79			I'm surprised that this chapter does not describe arguably the most stunning conclusion of the IPCC Working Group II report, i.e., "Approximately 20-30% of plant and animal species assessed so far are likely to be at increased risk of extinction if increases in global average temperature exceed 1.5-2.5oC. * N [4.4, T4.1]" (WGII Executive Summary).	We have added an example to address this point.
P	Staudt	82	R	44	[to R50] Warmer temperatures also enhance bark beetle outbreaks by allowing the beetles to have a more rapid reproductive cycle. See CCSP SAP 4-4: "Warmer temperatures facilitate bark beetle outbreaks in two ways: (1) drought stress makes trees more vulnerable to attack, and (2) insect populations respond to increased temperatures by speeding up their reproductive cycles (e.g., to one-year life cycles)." (Page 3-18, L31-33) See also the discussion on p. 84, L16ff of the USP draft, which includes multiple temperature dependencies.	In the interest of brevity, the box on bark beetles has been removed and, as pointed out, this is discussed elsewhere in the chapter.
P	Niblock	83	R	2	The discussion of this chart does not identify, nor does it quantify the effect of changes in federal and state forest management policies and practices. It is known that these policies and practices accumulated large inventories of woody fuels. Changes in the policies and practices resulted in the intentional setting of many fires, several of which got out of control and caused fires of far larger extent than intended. Was this taken into account in the correlation alluded to in paragraph 1?	The discussion of this figure does not address causes. The text does describe the relationship between climate warming and fire but does not indicate that there are no other relationships at work.
P	Staudt	83	R	20	Another major consequence of more extensive bark beetle infestations is the potential for large releases of CO2 to the atmosphere as these forests burn or decompose. Thus, we can not rely on western forests to continue to be an important sink or storage reservoir for emissions of CO2 from fossil fuel burning as we move into the future.	Changes in forests and their potential for being sinks or sources of CO2 are now mentioned in the end of National. The beetle box has been removed for interest of brevity.

P	Wolf	88	R	13	[to R19] The caption for the pika states that more than one third of 25 studied pika populations have gone extinct in the past decades, citing Beever et al. (2003). Beever et al. (2003) stated that 6 of 25 pika populations went extinct, with a seventh population left with only one individual. Krajick (2004) updated that number to 9 of 25 pika populations, which equates to more than one third of studied populations having gone extinct as the caption notes. Thus, Krajick (2004) should also be added as a citation: Krajick, K. 2004. All downhill from here? Science 303:1600-1602.)	This has been addressed.
P	Staudt	89	R	6	[to R28] This section does not do justice the issue of how global warming may impact the capacity for forests to store carbon as the climate warms. The fact is that several climate trends (in particular, increasing forest fires, insect infestations, severe storms, and water stress) imply that we can not rely on forests to continue storing carbon, even as climate policy discussions are incorporating forest carbon sequestration. It is also odd that one of the two paragraphs in this section focuses on other (valuable but not directly relevant to the topic) services that forests provide.	This has already been addressed in the 'National' Section. The text on the 'Ecosystems' Section focuses on the current situation. No change made here.
P	Stewart	89	R	6	This is the only section in the report that mentions forests. The implication is that all forests in the United States are federally owned and managed essentially as parks or open space. The section in the report is a reasonable statement for National Parks and much of the National Forest system, but federal forests constitute only 33% of forests in the United States. Family forests are a larger share at 35%, other private owners make up 21% and a variety of state and local owners control the remaining 10% (Butler 2008). While it may be true that change to federal forests will be considered detrimental in that it is a change from current conditions, private forest owners can provide a variety of positive responses. Managed forests can increase their production of woody residues that can be a biofuel feedstock that does not require the diversion of agricultural lands (English 2006). If they prices justify forest management, more acres can be converted from marginal agriculture to forests and thereby increase terrestrial carbon stores as well as increase the production of forest products that have downstream climate benefits (McCarl 2007). In addition, (Upton 2008) documents the significant climate benefits that accrue from the use of wood products in buildings. The focus on existing carbon storage is interesting in describing the current baseline but does little to identify a path towards major reductions in national GHG emissions. In	This section makes no implcation that all forests in the US are federally owned and managed. Many of this reviewer's concerns are addressed in the section on Forests and carbon storage or on the last page of the National section. A more indepth discussion of the role of forests in mitigation is beyond the scope of this report.

addition to the energy saving benefits mentioned by (Upton et al. 2008), (van 't Veld and Plantinga 2005) notes that increasing carbon prices will place greater emphasis on the climate benefits from bioenergy and products rather than increased carbon storage in forests. It may be that these issues should be in a different section than 'ecosystems' but it was hard to identify any other areas where forests were discussed. As your report describes elsewhere, piling more carbon into forests may simply increase the amount of CO2 released in future wildfires.

The second paragraph seems to suggest that the only climate benefit of forest carbon is as a store to balance CO2 emissions. This seriously undercounts the benefits of bioenergy and the substitution of GHG intensive materials with wood products (Schneider and McCarl 2005). Another perspective was advanced in 1996, included in the Third IPCC report, and has been confirmed in a number of countries since then. Schlamadinger and Marland (1996) suggested that "At the growth rates and efficiencies of harvest utilization adopted in many of our base scenarios, the net C balance at the end of 100 years is very similar whether trees are harvested and used for energy and traditional forest products, or reforestation and forest protection strategies are implemented." The same view was reiterated in a recent article in *Science* : "Joint use of carbon sequestration and the provision of forest-derived products (e.g., timber and biomass for energy) will optimize the contribution of forestry in climate mitigation. "(Canadell and Raupach 2008) . A more reasonable view is that forest area will increase if the climate benefits of bioenergy and wood products begin to show up in higher prices. A recent analysis of forest area in the United States identified an overall increase in forest area with the timber returns as the driver for increase in forest area between 1982 and 1997 (Lubowski et al. 2008). The increased carbon sink of the standing timber may be a side benefit rather than the primary benefit. The expansion of forest land is rarely at the expense of high quality cropland and is more typically involves pastureland or marginal croplands (Plantinga and Wu 2003).

Butler, B. J. (2008). Family Forest Owners of the United States, 2006. F. S. U.S. Department of Agriculture, Northern Research Station. GTR NRS 27: 72.
 Canadell, J. G. and M. R. Raupach (2008). "Managing Forests for Climate Change Mitigation." *Science* 320(5882): 1456-1457.



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PUBLIC COMMENTS

					<p>English, B., D. De La Torre Ugarte, K. Jensen, C Hellwinckel, J. Menard, B. Wilson, R. Roberts, and M. Walsh (2006). 25% renewable energy for the United States by 2025: Agricultural and economic impacts, Department of Agricultural Economics, The University of Tennessee.</p> <p>Lubowski, R. N., Andrew J. Plantinga, Robert N. Stavins (2008). "What Drives Land-Use Change in the United States? A National Analysis of Landowner Decisions." <i>Land Economics</i> 84(4): 529-550.</p> <p>McCarl, B. and Roland Sands. (2007). "Competitiveness of terrestrial greenhouse gas offsets: are they a bridge to the future?" <i>Climatic Change</i> 80: 109-126.</p> <p>Plantinga, A. J. and J. Wu (2003). "Co-Benefits from Carbon Sequestration in Forests: Evaluating Reductions in Agricultural Externalities from an Afforestation Policy in Wisconsin." <i>Land Economics</i> 79: 74-85.</p> <p>Schlamadinger, B., N. Bird, T. Johns, S. Brown, J. Canadell, L. Ciccicarese, M. Dutschke, J. Fiedler, A. Fischlin, P. Fearnside, C. Forner, A. Freibauer, P. Frumhoff, N. Hoehne, M. U. F. Kirschbaum, A. Labat, G. Marland, A. Michaelowa, L. Montanarella, P. Moutinho, D. Murdiyarsa, N. Pena, K. Pingoud, Z. Rakonczay, E. Rametsteiner, J. Rock, M. J. Sanz, U. A. Schneider, A. Shuidenko, M. Skutsch, P. Smith, Z. Somogyi, E. Trines, M. Ward, and Y. Yamagata. 2007. "A synopsis of land use, land-use change and forestry (LULUCF) under the Kyoto Protocol and Marrakech Accords." <i>Environmental Science and Policy</i>: 271-282.</p> <p>Schneider, U. A. and B. C. McCarl (2005). "Implications of a carbon-based energy tax for U.S. agriculture." <i>Agricult. Resour. Econ. Rev.</i> 34(2): 1-14.</p> <p>Upton, B., Reid Miner, Mike Spinney, Linda S. Heath (2008). "The greenhouse gas and energy impacts of using wood instead of alternatives in residential construction in the United States." <i>Biomass and Bioenergy</i> 32(1): 1-10.</p> <p>van 't Veld, K. and A. Plantinga (2005). "Carbon sequestration or abatement? The effect of rising carbon prices on the optimal portfolio of greenhouse-gas mitigation strategies." <i>Journal of Environmental Economics and Management</i> 50(1): 59-81.</p>	
P	Pendergrass	89	R	30	<p>[to p. 90, R10] This subsection about recreation and tourism seems to be about the services natural environments provide in general rather than about ecosystems. It might be more appropriate for a different chapter.</p> <p>Reference Held, I.M., and B. J. Soden, 2006: Robust responses of the hydrological cycle to global warming. <i>Journal of Climate</i>, 19(21), 5686-5699.</p>	We do not agree that there is another location where this would be more appropriate.
P	Staudt	89	R	30	<p>While the lost recreational opportunities are indeed important, there are many other ecosystems services threatened by global warming that deserve discussion as well. In particular, natural ecosystems provide an enormous service in terms of regulating water storage in the landscape, mitigating flood impacts, and cleansing water.</p>	This is addressed in other locations, both in this section and in the first two paragraphs of the <i>Ecosystems Section</i> . We now have changed the text to make it abundantly clear that other examples (beyond the two we list) could have been made.

P	Niblock	94	L	2	The chart does not show a link between greenhouse gas emissions and increasing temperature. The chart does contribute to a foreboding sense of disaster.		This figure is just a simple statement of the relationship. Yes, temperature and greenhouse gasses weren't linked here, that is done in the global chapter.
P	Scott	95	L	27	[to R50] Biodiesel use in diesel engines results in significant decreases in particulate matter, carbon monoxide, and polyaromatic hydrocarbons. Biodiesel used in heating oil applications significantly reduce nitrogen oxide and sulfur emissions. All of these emission reductions have direct, positive impacts on human health ⁴ . As many of these compounds combine to create smog in urban areas, and urban air quality can be expected to decrease with higher temperatures, biodiesel can, once again, be an effective strategy for climate change mitigation and adaptation.		All the adaptation boxes are examples of adaptation measures that have been tried. As far as we know, no municipality has yet changed all or most of their communities' diesel to biodiesel as a means to limit pollution. Therefore, we do not have an example to add to the adaptation box. Hence, no change was made.
P	Kruk (NOAA/NCDC)	100	L	20	Panel "a" on the location of hurricane landfalls: it is unclear as to why the entire states of South Carolina and Alabama are fully color-filled, and why most of Georgia is not. The figure caption simply says that it is the location of hurricane landfalls, but the map doesn't seem to make much sense seeing that the upstate of South Carolina is far-removed from the coastline. Also, why the gap in extreme south Florida? Perhaps the authors/editors can offer some explanations to better describe this panel within the text. Further, why is a short 5-year period (1995-2000) being selected for this analysis?		The text in the figure caption has been edited to explain this better.
P	Tolman	101	L	33	Replace 'set' by 'range'.		We have made this change as suggested.
P	Tolman	101	L	44	Replace 'due to' by 'because of'.		We have made this change as suggested.
P	Tolman	101	L	48	Replace 'they occur' by 'climate change occurs'.		We have made this change as suggested.
P	Niblock	105	R	2	This is a subtle form of a count – it shows the number of hours – rather than an event count. The usual method for expressing heat load is degree-days. Departing from the standard method makes less information available and raises the question of whether information is being obscured. A backward-in-time projection of the trend line indicates		Although this is a non-standard indicator, it is intended to be an index of human comfort, not an absolute value of temperature or heat load. Hours per day is appropriate because it reflects

						that before 1880 the temperature in Phoenix never exceeded 100 °F. This strains credulity. Extrapolation into the future is also meaningless. The trend line implies a correlation with time that just does not exist and is thus misleading.		the increase in nighttime (minimum) temperatures over this period, which strongly influences comfort. While we agree that back-extrapolation and forward projection of what is the best-fit linear trend for these data would likely be in error, such extrapolation is not intended, nor would it be appropriate in <i>any</i> correlation analysis.
	P	Niblock	107	L	33	Aside from the obvious – an insurance claim is not necessarily a loss – counts are again used to imply a measure. The counts, shown to imply a relationship with temperature, are not sufficient for that purpose.		The figure has been modified to make it clear that these claims have been paid. The literature cited establishes a causal link between temperature and lightning (37, 51, 52). The chart augments that line of evidence by illustrating that the physical phenomenon also manifests, not surprisingly, in an impact on the particular industry (insurance) being discussed in this passage.
	P	Niblock	107	R	2	There is no indication that the dollar losses are in constant dollars. If no adjustments for inflation were included, the later years would naturally show higher losses. There is no indication of any adjustment for population changes. If the same storms occurred and the population was greater, the economic damage would be higher. The chart seems to imply that warming has some effect on economic loss but there is not sufficient evidence to conclude that the loss increase was not a consequence of inflation and increased population.		The reviewer is correct; the values are indeed constant 2005 dollars. This has been clarified on the y-axis label. Also, his other point has been clarified in the text below the figure. As for population, the multivariate drivers of rising losses (climate change being only one) are discussed amply in the nearby text and throughout the report. There are also countervailing factors (e.g., improved building codes) that have arguably "masked" losses that would otherwise have manifested. In response to this comment, we have revised the text to show the population increase over the time period. According to the data file at US Census Bureau

							[http://www.census.gov/compendia/statab/tables/09s0012.xls], US pop in 1980 was 226,545,805 and that in 2005 was 296,507,061, for an increase of 1.3x. Adding this to the loss amount in 1980 (~\$3B) would result in a value of ~\$4 billion in 2005. Disaster losses in 2005, however, were \$75B, so clearly population does not explain this 15-20-fold increase.
P	Kruk (NOAA/NCDC)	109				This section begins without a sectional page heading like the rest of the chapters in this report. It would be nice to see the references from CCSP and IPCC that were selected for this chapter at quick glance akin to the other chapters.	This applies to all regions - we don't have space to add all the report icons.
P	Alvarez	113	L	24		The qualifier “heavy” is somewhat generic and does not convey the severity of recently more common extreme rain events with rates of precipitation ranging up to 3 or 4 inches an hour. Change: change “heavy downpours” to “extreme rain events”	We have decided to leave this as written. We feel that ‘downpour’ is a broadly understood term.
P	Pendergrass	113	R	50		The first sentence of the caption is incomplete. It should probably read “This is a summary...” instead of “This summary...” The interpretive sentence might also be revised. From the table, it is clear that most of the temperature changes have occurred in the last few decades, but the precipitation changes appear more complicated. The second sentence would be more accurate if it said specified that “Most of the temperature changes have occurred over the last several decades.”	This has now been addressed.
P	Niblock	114	R	2		Here again a count is used to imply a relationship. Heat loads on equipment and people are usually given in heating or cooling degree-days. Why not use conventional measures?	The metrics that we use are easily understood as a reference point by lay readers and policy makers, more so than the terms “heating and cooling degree days”.
P	Alvarez	114	R	26		Need to focus of the potentially most damaging impact: storm surge. Change: change line to read “ rainfall intensity, and more severe hydrodynamic pressure and wave impact from higher and faster flowing storm surge”.	We feel that the suggested change is too complex for the target audience, but have modified the text to address the point the reviewer makes.
P	Alvarez	115	R	37		the report is weak in that it largely leaves out <i>storm surge</i> , which is perhaps the worst cause of potential damage to costal communities in the Southeast, particularly the large urbanized centers in the coastal regions of Florida and the Gulf Coast. Storm surge is	The storm surge discussion has been strengthened and a sentence added to highlight the point, but not in the complex

						<p>already being exacerbated by climate change directly through sea level rise and will continue to be incrementally and progressively more exacerbated in the future. While robust debate continues relative to circumstantial evidence that may link climate change to hurricane intensity, the link between sea level rise and higher, faster flooding and stronger storm surge is quite clear and undeniable. As sea level continues to rise, storm surge will become increasingly more damaging through hydrodynamic pressure and wave impacts, raising the possibility that buildings in the coastal regions may suffer catastrophic damage due to storm surge drive forces that will surpass the design criteria under which they were originally built.</p> <p>Change: in Page 115, Line R44, add the following language: “Also the built environment in the coastal region is likely to suffer catastrophic damage from the impact of storm surge, which may result in loads acting on buildings that exceed their original design criteria by a large margin.</p>	<p>language proposed by the reviewer.</p>
P	Alvarez	116	L	45	<p>It is recommended to focus on the high value at risk represented by the built environment, not only for the actual replacement costs of the physical buildings and infrastructure, but mainly because of the essential function they play in sheltering the full range of human activity.</p> <p>Change: add the following: “and catastrophic damage to the built environment”.</p>	<p>We are not mentioning the built environment here, as an earlier sentence that was added discusses current buildings and infrastructure.</p>	
P	Pendergrass	116	R	1	<p>[to R30] The maps shown in this figure panel do not immediately look like maps. It might be helpful to choose an earth-like color rather than red. To contrast with the blue water, brown might work. Also, without turning the figure the compass rose looks like a “Z” instead of an “N.”</p>	<p>These two points have been addressed.</p>	
P	Alvarez	116	R	34	<p>A focus on the built environment is needed.</p> <p>Change: after “coastal forest” ADD: “and to the built environment”</p>	<p>The built environment has been highlighted elsewhere based on another comment of the reviewer. The recommended insert is not appropriate in this sentence, which is about effects on natural systems. The subsequent sentence refers to impacts on the built environment.</p>	
P	Alvarez	116	R	35	<p>The correct use of proper specific terminology is essential. With respect to hurricanes, categories 3, 4 and 5 in the Saffir-Simpson Scale of hurricane intensity are referred to as “major” hurricanes. The word “strong” is generic while the word “major” is specific.</p>	<p>We have replaced “major” with “strong.”</p>	

						Change: delete “strong” replace with “major”	
	P	Alvarez	116	R	37	A focus on the built environment is needed. Change: after “and public infrastructure” ADD: “ the built environment”	We disagree with this comment. The built environment includes “public infrastructure” and “personal property” includes the homes and businesses.
	P	Niblock	117	L	2	The overlay of temperature and number of storms is misleading. It implies a correlation where none is demonstrated. It presents counts, and counts of events are not particularly meaningful. Measures of the time between events or the frequency of events could be useful. If this were done it is likely that no trend would be observed.	The figure has been removed.
	P	Alvarez	118	L	14	We need to specifically address storm surge. Change: change heading to read: “Adaptation: Reducing Exposure to Flooding and Storm Surge”	The heading has been changed as recommended.
	P	Niblock	118	L	15	It is well known that levees are used in Europe to reclaim land from the sea for a variety of uses. If the argument is that it cannot be cost-effective here, then that should be established with data and analysis.	We have changed the figure caption from “to the 100-year level” to “increase protection against storm surge”. This change helps convey the fact that levees can be used to reduce storm surge impacts.
	P	Alvarez	118	L	16	Reference to adaptation of the built environment would enhance this section. Change: change line to read: “Four main types of adaptation”	The adaptation box on page presents the IPCC’s three main options: “protect, accomodate, retreat”. We prefer to use the same classes of coastal adaptation strategies.
	P	Alvarez	118	L	27	Also, on page 118, Line L27, ADD: “The fourth adaptation option is to radically change the approach and methodology for building design and construction, by using design criteria that is based on future impacts a building may suffer during its usable service life, such as higher loads from hydrodynamic pressure and wave impact caused by storm surge during hurricanes”.	As noted above, the adaptation box presents the IPCC’s three main options: “protect, accomodate, retreat”. We prefer to use the same classes of coastal adaptation strategies. Changes in building design and construction fall into the category of “accommodate” and we give the specific example of elevating buidlngs on stilts.

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P	Pendergrass	119	L	12	In the second sentence of the paragraph, the “icy” part of the description of “cold, icy winters” Midwestern winters doesn't seem apt. Some parts of the Midwest certainly have snowy winters, while others do not, but nowhere in the Midwest is a large fraction of winter characterized by ice cover. Also, as someone who has spent most of her life in the Midwest, this doesn't ring true with my experience. I suggest changing “cold, icy winters” to “cold winters.”	We have updated the reference in response to the suggestion.
P	Pendergrass	119	L	44	[to L45] In the sentence that begins with “Events such as the Chicago heat wave...,” change “700-plus deaths” to “over 700 deaths.”	We have updated the reference in response to the suggestion.
P	Niblock	120	L	2	The chart provides little information. It presents only counts, not measurements such as degree-days, or time between heat waves, or frequency of heat waves. No historical data of substance is given.	We disagree with this comment. The chart shows the likelihood of such multi-day heat wave events. We feel that it contains a great deal of information.
P	Staudt	121			In the discussion on Great Lakes water levels it would be helpful to note that other assessments have been done on projected levels with various climate change scenarios. For example, in an earlier study (Lofgren et al., 2002), use of Canadian Centre for Climate Modeling and Analysis model input data indicated that water levels could drop more substantially by 2090 – i.e., decreases of 0.99 meters for Lake Ontario, 1.13 meters for Lake Erie, and 1.38 meters for Lakes Michigan-Huron. (Lofgren BM, Quinn FH, Clites AH, Assel RA, Eberhardt AJ, Luukkonen CL. 2002. Evaluation of potential impacts on Great Lakes water resources based on climate scenarios of two GCMs. Journal of Great Lakes Research 28:537-554)	We are well aware of the earlier studies by Lofgren and others that got larger water changes. Those studies either used earlier climate model results that were not reliable or, steady-state estimates that would not apply during this century. The results presented in the figure are based on a much more recent version of the NOAA GLERL Great Lakes watersheds model than that used in Lofgren et al. (2002). No change made.
P	Pendergrass	121	L	27	[to L50] Small squares are not very good data markers. It might be better to leave them off, or to use unfilled circles, bigger than the squares.	We feel that larger circles instead of squares would “bunch up” at one of the data points hiding one of the values. No change made.
P	Niblock	121	R	2	The chart presents a trend line that is misleading in several ways. The coefficient of determination for the trend line is omitted in the discussion of the chart, and examination of the data indicates it is rather low. Consequently the trend line explains little of the variation. Second, the trend line implies that at some fairly near-term there will be no ice coverage, and that in the recent past the coverage was more than 100%. Correlation of ice coverage with year is close to nonsense. If the data are evaluated using statistical process control methods a different result emerges. The data are sufficiently uncertain	We have identified a better reference and confirmed that the data prior to 1973 were inhomogeneous, which led us to start the data for this chart in 1973.

						that the natural process limits are larger than the variation shown. In other words, the data are so uncertain that no conclusion can be drawn about a systematic change in the process. In short, if we knew how to change the process to achieve a higher or lower mean value, the data would not provide a signal that any change should be made; i.e. the signal to noise ratio is negligible.	
P	Niblock	132	L	40		This chart does not appear to show any trend, but instead appears to show variation with regression to a mean value of about 14.7 million acre-foot. The assertions in the text do not appear to be substantiated.	The text of the caption has been edited in response to this comment. In particular, we now explicitly note that the statement about future drought is based on modeling studies.
P	Pendergrass	134	R	41		[to R50] This inset box does not mention where the Madrean Pine-Oak Woodlands are located. Having spent little time in the Southwest, I don't know where they are, as I'm sure many readers wouldn't. A mention of the location should be added.	The box has been edited as suggested to include 'located on mountaintops in Arizona, New Mexico, and West Texas.'
P	Pendergrass	137	L	14		[to L15] In the second sentence, the phrase "with higher emissions scenarios resulting in the upper end of this range," is not very clear. Also, this sentence (starting on L10) is very long and contains a qualifying parenthetical statement. It would be better end the sentence before this phrase and start a new, clearer one, such as, "Higher emissions scenarios would result in warming in the upper end of the projected range."	We have revised the text as suggested.
P	Carns	137	R	22		"Larger changes are expected due to increased warming, with runoff projected to shift 20 to 40 days earlier in this century." Suggested revision: "Larger changes are expected due to increased warming, with runoff projected to shift 20 to 40 days earlier within the next century."	We have changed 'in' to 'within' as suggested, but, as used in this report, the next century begins in 2100.
P	Pendergrass	137	R	22		[to R24] The paragraph begins with "Larger changes..." where the larger changes will be in the future as compared to observations of the recent past. The beginning of a paragraph should not contain an unstated reference like this. Instead, start with an explicit reference such as, "Future changes are expected to be larger than those already observed, with runoff..."	We have updated the wording to read "This trend is expected to continue in the future."
P	Carns	137	R	24		"Reductions in summer water availability will vary with midwinter temperatures experienced in different parts of the region." Vary with midwinter temperatures? It isn't clear why runoff wouldn't vary with spring or summer temperatures, instead.	We have made this change.

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P	Carns	138	L	1	"Extreme high and low streamflows also are expected to change with warming" This sentence should be preceded by a paragraph break	We have made this change.
P	Carns	139	L	14	"Decreasing irrigation supplies and increased competition from weeds, pests, and disease are likely to have negative effects on agricultural production." Suggested revision: "Decreasing irrigation supplies, pests, disease, and increased competition from weeds are likely to have negative effects on agricultural production."	We have revised the text following the suggestion.
P	Carns	139	L	14	"Decreasing irrigation supplies and increased competition from weeds, pests, and disease are likely to have negative effects on agricultural production." Suggested revision: "Decreasing irrigation supplies, pests, disease, and increased competition from weeds are likely to have negative effects on agricultural production."	We have decided to leave as written because we feel that it is precisely accurate as written.
P	Pendergrass	140	R	7	[to R9] In the first sentence on the page, the phrase "atmospheric dynamics that influence wind-driven "pile-up" of sea level along the coast" is vague and could be clarified. "Atmospheric dynamics" is probably an inappropriate description for non-scientists and has successfully been avoided in the rest of the report; and is not necessary in this context. In general, "atmospheric circulation" has a similar meaning and would be more understandable for most people. Also, instead of a "pile-up" of sea level, a "pile-up" of water would be more physically intuitive and clearer. Replace the original phrase with "wind-driven "pile-up" of water along the coast."	We have revised the text following this suggestion.
P	Pendergrass	144	L	19	[to L29] The yellow, blue, and pink color scheme (as it appears on my computer) is difficult to look at, especially the pink/blue boundary in the right panel. Instead, choose a color scheme with smaller wavelength separation.	We are relying on the published version of this figure that was provided to us by Busey et al. and we cannot change it.
P	Pendergrass	149	L	21	[to L22] In the second to last sentence of the paragraph, the phrase "a phenomenon known as an "anticyclonic eddy" which temporarily raises local sea level" makes it sound like something mystical happened. Instead, it would be better to say "an ocean circulation event which temporarily raised local sea level." The sentence should emphasize that this was a small-scale, transient oceanic current or circulation that affected sea level, but need not mention the term "anticyclonic eddy" since that is unnecessary jargon.	We have modified the text in response to this suggestion.

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P	Niblock	149	R	2	The chart does not include information about tidal levels that might establish the significance of the average sea level. Generally, counts of incidents are of little use in analysis of time-series events, and measures such as time between events or event frequencies are preferable.	We think that the reviewer is asking for an Extreme Value Analysis, but that would not address the point intended by the graph and text. In support of this idea, the text includes a line that states, “The interval between such extreme events has decreased from more than 20 years to approximately 5 years as average sea level has risen.”
P	Kruk (NOAA/NCDC)	151			Is CCSP SAP 4.1 used to supplement this section? If it is, please make sure it is included in the list on page 7 of the report. If not, should it be given some consideration since it specifically discusses coastal climate change impacts?	Yes, SAP 4.1 is used and its icon has been incorporated in the list.
P	Spanger-Siegfried	151			In light of the rapidly changing body of published sea-level rise research, the heavy reliance on earlier findings (up to the IPCC AR4) may paint an incomplete picture of coastal risk.	The report includes consideration of the more recent literature on sea-level rise, including the projections beyond those made by IPCC AR4.
P	Kruk (NOAA/NCDC)	153	L	22	Figure caption: is “exacerbate” the right word here? Don’t the authors mean that dead zones will actually increase in areal coverage? If so, then a different word is needed that describes the increasing extent of dead zones.	We have replaced ‘exacerbate’ with ‘expand and intensify’.
P	Wolf	153	R	6	[to R29] This section on ocean acidification would be improved by adding quantitative estimates of observed and projected changes in ocean acidity to provide the reader with a concrete, science-based perspective on levels of change. Thus, the USP should specify that surface ocean acidity has risen by about 30% since 1750, equating to a decrease in pH of 0.11 units (Orr et al. 2005). The pH of the ocean may drop by another 0.3 or 0.4 units (equating to a 100 to 150% increase in acidity) by the end of this century (Orr et al. 2005, Meehl et al. 2007). If carbon dioxide emissions continue unabated, resulting changes in ocean acidity could exceed anything experienced in the past 300 million years (Caldeira and Wickett 2003). Further, an important point that should be included is that ocean acidification is irreversible on practical time scales. That is, even if carbon dioxide emissions were halted immediately, the ocean would continue to absorb the excess carbon dioxide in the atmosphere, resulting in further acidification until the planet’s carbon budget returned to equilibrium.)	We have added a paragraph on ocean acidification with appropriate references in response to this and other comments.
P	Shapiro	155			There are no recommendations for mitigation in this report. Given that there is strong empirical data on numerous measures that can reduce the human contribution to climate	This issue of mitigation has been carefully evaluated in light of this and other comments.

					change, this is a glaring omission. This report should provide at least an introductory guide to the public on locating reliable information on successful and unsuccessful mitigation strategies.	We have decided to expand our treatment of mitigation through revisions in the 'About this Report', 'Executive Summary', and 'Concluding Thoughts' sections, as well as other areas in the text.
P	Spanger-Siegfried	155			The lack of discussion on mitigation in this recommendations section is very confusing. To walk the reader through such a thoughtful, sobering discussion of potential impacts then fail to even recommend mitigation as an option is troubling. This need not be a mitigation report, but naming known solutions to a potentially devastating problem is only responsible. I would encourage the authors to correct this.	This issue of mitigation has been carefully evaluated in light of this and other comments. We have decided to expand our treatment of mitigation through revisions in the 'About this Report', 'Executive Summary', and 'Concluding Thoughts' sections, as well as other areas in the text.
P	McCurry	155	L	3	This section should be expanded to include recommendations on mitigation activities, and not just on additional research. As noted in the 'About This Report' section (Page 12, Lines L1 to L12) this report's purpose does include discussion of mitigation and so a brief discussion of key mitigation recommendations is warranted.	This issue of mitigation has been carefully evaluated in light of this and other comments. We have decided to expand our treatment of mitigation through revisions in the 'About this Report', 'Executive Summary', and 'Concluding Thoughts' sections, as well as other areas in the text.
P	Arndt (WMO-WCRP)	155	L	22	In addition to understanding the impacts of climate change there is a need for expanding our understanding of climate and Earth system processes, climate variability and change, climate predictability and the role of human on climate. These themes have been the focus of the World Climate Research Programme since its inception.	While we appreciate your point and the fine work of your group, space limitations and the scope of the report prohibit us from including this information.
P	Fitzpatrick	155	L	22	Add a new recommendation or incorporate into Recommendation 1. Title: "Regular and rapid assessments of new climate science findings" "There is a need for regular, rapid assessments as climate science reveals the global climate system is responding faster than projected in the recent IPCC reports. National assessments should be produced on a regular basis, updating particularly relevant science (e.g. increased sensitivity of the climate system to sea level from ice sheet contributions)."	The question of new assessments is dealt with in the Concluding Thoughts Section. We feel that this topic is properly placed in that location.

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P	Fitzpatrick	155	L	22	Decision makers need adequate information about potentially high consequence, low probability events (such as large-scale flooding, extreme weather events, etc.), as well as unintended consequences that are indirectly related to climate change (e.g. increased food prices). These were recommendations in the 1 st review draft (p. 164-165). Have these been deleted from the recommendation section?	The recommendations have been broadened and simplified. We reference SAP 3.3 for more detailed information.
P	Tolman	155	L	42	After 'atmosphere,' add 'oceans,'. [The increasing acidity of the oceans could have important effects on the food chain.]	We have revised the text to include mention of marine and ocean acidification issues.
P	Tolman	155	R	32	After 'atmospheric' add 'ocean'.	We have changed the text.
P	Tolman	155	R	44	Change 'form' to 'from'.	This has been corrected.
P	Arndt (WMO-WCRP)	156	R	3	The various techniques in modelling and downscaling global climate information to regional scales are currently being assessed by the World Climate Research Programme. The ultimate goal is to advance significantly the production of Regional Climate Downscaling (RCD)-based high resolution climate change projections on time scales relevant to risk management and adaptation planning.	We appreciate the work being done by your organization. We have decided not to change the text given the focus of the report and of this section.
P	Arndt (WMO-WCRP)	156	R	9	Model representation of extremes in climate predictions on seasonal, decadal and longer time scales is another current focus within the World Climate Research Programme.	As noted in the previous answer, we appreciate the work being done by your organization. We have decided not to change the text given the focus of the report and of this section.
P	Milmoie	156	R	15	-Recommendation 3 (P156; R15): Expand capacity to provide decision makers and the public with relevant information on climate change and its impacts. -I appreciate the inclusion of this communication / public relations effort in your future goals. You open with a great statement, saying that the U.S. has great potential, but quickly kill the momentum by then talking about the need for additional research. How are you going to share information? Will this be a two-way communication process? How are you adapting to better meet the needs and concerns of your constituents?	This has been addressed with several new text changes.
P	Arndt (WMO-WCRP)	157	L	2	The timely transfer of climate information products to decision makers and practitioners will increase the lead time for managing risks associated with climate variability and change. Establishing proper mechanisms for timely and efficient delivery of climate information and knowledge to decision makers is a major challenge/opportunity for the	We have considered your point, and while delivery is important, it is not a focus of this report.

					future.	
P	Tolman	157	L	40	<p>[There are six questions below (with footnotes beneath) that seem to fall into the area of improving our ability to understand abrupt and potentially irreversible and very damaging changes in the climate system:</p> <ol style="list-style-type: none"> 1. Are Hansen et al. right when they say that the sensitivity of global average temperature to a doubling of atmospheric CO₂ concentration, based on Earth's climate history, is close to 6°C rather than the widely accepted value of 3°C? James Hansen et al., <i>Target Atmospheric CO₂: Where Should Humanity Aim? Open Atmospheric Science Journal</i>, 2, pp. 217-231 (2008); http://dx.doi.org/10.2174/1874282300802010217 2. Once the CO₂ concentration is doubled, what is the likely behavior of global average temperature as a function of time? How long does it take before a new equilibrium is achieved? 3. Is the German Advisory Council report right that Earth's climate history for the past 35 million years shows that equilibrium sea level changes approximately linearly with temperature, with an increase in sea level of about 20 m for each 1°C change in global average temperature? German Advisory Council on Global Change (WBGU), Ch. 3, Sea-level rise, hurricanes and coastal threats Figure 3.1-1 (2006); http://www.wbgu.de/wbgu_sn2006_en/wbgu_sn2006_en_voll_3.html 4. Once the CO₂ concentration is stabilized (net anthropogenic emissions are zero), what is the likely behavior of sea level as a function of time? A fit to recent rates of sea level rise has been described by Stefan Rahmstorf, A Semi-Empirical Approach to Projecting Future Sea-Level Rise, <i>Science</i>, 315, pp. 368-379 (2007); http://www.pik-potsdam.de/~stefan/Publications/Nature/rahmstorf_science_2007.pdf 5. What is the global amount of methane hydrate (in Gt carbon) in the Arctic and on the 	<p>We have reviewed your comments, and feel that the USP addresses these at a more general level.</p>

					<p>sea floor, and what is its distribution as a function of depth, latitude and longitude? Barbara Maynard, Burning Questions about Gas Hydrates, <i>Chemistry</i>, pp. 27-33 (Winter 2006); http://www.iupac.org/publications/ci/2006/2804/2804-pp3-7.pdf</p> <p>1. As the earth continues to warm, what is the likely trajectory of methane release to the atmosphere as a function of time? At what point is the release likely to reach a tipping point and become self-sustaining, when the warming caused by released methane causes more to be released, as happened during the PETM? David Archer, Destabilization of Methane Hydrates: A Risk Analysis, WBGU Special Report (2006); http://www.wbgu.de/wbgu_sn2006_ex01.pdf James C. Zachos et al., Rapid Acidification of the Ocean During the Paleocene-Eocene Thermal Maximum, <i>Science</i>, 308, pp. 1611-1615 (2005); http://www.sciencemag.org/cgi/content/abstract/sci;308/5728/1611</p>	
P	Gilbert	157	R	43	<p>In chapter “Recommendations for Future Work” (p. 155) at end of “Recommendation 5” on 157 add:</p> <p>“Recommendation 6: Actively investigate means by which government, industry, and society work together to generate mitigations for reducing greenhouse emissions.”</p> <p>[I leave it to experts at CCSP to add subsequent discussion – WG]</p>	<p>This issue of mitigation has been carefully evaluated in light of this and other comments. We have decided to expand our treatment of mitigation through revisions in the ‘About this Report’, ‘Executive Summary’, and ‘Concluding Thoughts’ sections, as well as other areas in the text.</p>
P	Gray	159			<p>The paper under comment offers unsubstantiated wordy generalisation as uncontested truth and simply leaves out information running counter to what seems to be a preferred attitude rather than a reasoned position.</p> <p>There is indeed correlation between CO₂ increase and warming but the published data show CO₂ to be a consequence and not a cause. There has always been more CO₂ around after warming. Throughout geological time, however, far from being an agent of spiralling warming, increased CO₂ has never prevented subsequent, sometimes dramatic, cooling. On those two grounds alone the paper founders.</p> <p>The central premise of the paper under comment turns out to be a fallacy. That being so the only recommendation is to abandon the paper. It cannot be fixed.</p>	<p>The comment has been considered, but is judged to contain no suggestion relevant to improvement of the scientific content of the USP report.</p>

P	Milmoe	159				<p>-“Concluding Thoughts”, beginning P159. Here is THE ONE key message that I see in this report. I feel it is very poorly worded throughout the document, but here are the components:</p> <p>-This report confirms, solidifies, and extends these conclusions...(P159, L21) -...that human-induced climate change is happening now, and that environmental and societal consequences and vulnerabilities are already apparent (P159;L18) -that the number and size of many climate change impacts are occurring faster than previous assessments had suggested (P159, L25).</p> <p>This message set forth is a milestone in United States and worldwide history. As a concerned citizen, I strongly prefer that you wordsmith these messages into a single, clear and compact statement. Introduce this at the beginning of the document and continue to make reference to it throughout.</p>	This paragraph has been reorganized in response to this comment.
P	Spanger-Siegfried	159				Again, the critical mitigation take-home message is almost entirely missing. I encourage the authors to correct this.	This message has now been underscored in the ‘Concluding Thoughts’ Section.
P	Shapiro	159	L	30		[to L32] It is good to include the most recent data, but this section would be more effective if it indicated the direction of that new information (viz. towards greater and faster climate change).	This has now been addressed.
P	Gilbert	159	L	44		<p>In chapter “Concluding Thoughts” (p 159) under “Responding to Changing Conditions” at end of paragraph 2 add:</p> <p>“However, to avoid the worst eventual impacts of climate change, reasonable immediate action need to be taken, through installing new legislation and policies, to curb emissions of greenhouse gasses. These immediate actions should not be delayed just because longer-term assessments also might be beneficial.”</p>	This recommendation is policy prescriptive, which is not appropriate for the USP. No change made.
P	Staudt	159	R	15		<p>[to R38] The discussion of the value of assessments should cite the 2007 NAS report on the topic: Analysis of Global Change Assessments: Lessons Learned. http://books.nap.edu/catalog.php?record_id=11868</p>	No citations are made in this section. The discussion is based on this assessment.

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P	Shapiro	159	R	16	[to R38] This section lacks an evaluation of the difference between the risks of underestimating and overestimating the velocity and magnitude of climate change. The cost of the former is likely to prove a social, political and economic disaster, while the cost of the latter is a measurable overexpenditure of money. Surely, the difference in magnitude of these two outcomes needs to be presented.	We are not making this comparison. We feel that it would likely be considered advocacy, which is not in our charge.
P	Staudt	159	R	41	The discussion of past assessments produced by the CCSP and GCRP gives the inaccurate impression that the 2000 National Assessment report, <i>Climate Change Impacts on the United States</i> , was not scientifically rigorous. The fact is that the report achieved both extensive levels of stakeholder involvement (notably absent from the current report) and a rigorous, detailed review of the best available science. In general, I found (and greatly appreciated) that the USP explicitly builds on the strong foundation established by the National Assessment, rather than essentially ignoring it as has been the case in some previous CCSP publications. This is why the statements in this section that, perhaps inadvertently, seem to disparage the scientific contributions of the National Assessment, appear to be out of sync with the rest of the USP. In fact, it would be more accurate to characterize the lack of stakeholder involvement in the USP as a shortcoming of the process. Arguably more stakeholder involvement would have made the current report more relevant to decision maker needs than it is	This has been addressed.
P	O'Brien (NOAA/NOS)	163			Table of Primary Sources of Information: (a) The National Ocean Service (NOS) recommends that the <i>Synthesis and Assessment Product (SAP) 4.1: "Coastal Sensitivity to Sea-Level Rise: A Focus on the Mid-Atlantic Region"</i> be included as a primary source of information in the <i>Final USP Global Climate Change Report, Impacts in the United States</i> . (b) NOS comments that the <i>SAP 5.2: "Best practice approaches for characterizing, communicating, and incorporating scientific uncertainty in decisionmaking"</i> is also not included in this draft USP. This document should be included as a primary source of information in the <i>Final USP Global Climate Change Report, Impacts in the United States</i> (or reason given for its exclusion).	We have ensured that the appropriate icons are included, and have also ensured that both of these SAPs are included in the document.
P	Lampel	164			On page 164, I respectfully suggest the "ACRONYMS" section be expanded to a "Glossary" or "Terms and Definitions" section in order to provide a quick and easy way for individuals to better understand the terms used throughout the report. (This especially would be helpful for individuals who will skim the report, or only read certain chapters.)	We have deliberately minimized the number of acronymns used in this document. Futher, we have attempted to define terms as they are used throughout the text. Therefore, we are

					<p>Defined terms could include: climate noise, climate change; greenhouse gases; global warming; adaptation, mitigation, etc.</p> <p>Further, although the characterizations of the different likelihoods of various outcomes are provided early in the report (page 12), it may be helpful to also provide the definitions of "likely," "very likely," and "virtually certain" in the suggested Glossary/Terms and Definitions section.</p> <p>Should the ACRONYMS section be expanded or not, it would be helpful to add its page number to the Table of Contents section for quick reference.</p>	<p>leaving as written.</p>
P	Pendergrass	165		<p>References</p> <p>IPCC AR4 WG1 Chapter 2. Forster, P., V. Ramaswamy, P. Artaxo, T. Berntsen, R. Betts, D.W. Fahey, J. Haywood, J. Lean, D.C. Lowe, G. Myhre, J. Nganga, R. Prinn, G. Raga, M. Schulz and R. Van Dorland, 2007: Changes in Atmospheric Constituents and in Radiative Forcing. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.</p> <p>IPCC AR4 WG1 Chapter 7 Denman, K.L., G. Brasseur, A. Chidthaisong, P. Ciais, P.M. Cox, R.E. Dickinson, D. Hauglustaine, C. Heinze, E. Holland, D. Jacob, U. Lohmann, S Ramachandran, P.L. da Silva Dias, S.C. Wofsy and X. Zhang, 2007: Couplings Between Changes in the Climate System and Biogeochemistry. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.</p> <p>SRES Nakićenović, N. and R. Swart (eds.), 2000: Special Report on Emissions Scenarios. A special report of Working Group III of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK, and New York, 599 pp. http://www.ipcc.ch/ipccreports/sres/emission/index.htm</p>	<p>We have incorporated most of these references, as appropriate, with our revisions.</p>	

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					<p>Fu, Q., and C.M. Johanson, 2004: Stratospheric influence on MSU-derived tropospheric temperature trends: A direct error analysis. <i>J. Clim.</i>, 17, 4636–4640.</p> <p>Haimberger, L., C. Tavalato, and S. Sperka, 2008: Toward elimination of the warm bias in historic radiosonde temperature records – some new results from a comprehensive intercomparison of upper air data. <i>Journal of Climate</i>, 21(18), 4587-4606.</p> <p>Held, I. M., and B. J. Soden, 2006: Robust responses of the hydrological cycle to global warming. <i>Journal of Climate</i>, 19(21), 5686-5699.</p>		
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