The Honorable Ed Schafer
Secretary
US Department of Agriculture
Jamie L. Whitten Federal Building Room 200-A
12th & Jefferson Drive SW
Washington, DC 20250

February 15, 2008

Dear Secretary Schafer:

Synthesis and Assessment Product 4.3 (SAP 4.3), *The Effects of Climate Change on Agriculture, Land Resources, Water Resources, and Biodiversity*, is one of 21 Synthesis and Assessment Products being developed by the U.S. Climate Change Science Program (CCSP) to address top-priority climate change research, observation, and decision support. The U.S. Department of Agriculture (USDA) is the Lead Agency in the preparation of SAP 4.3. Thirty seven authors from academia and Federal service prepared SAP 4.3 under USDA leadership through its Global Change Program Office and in cooperation with the University Corporation for Atmospheric Research (UCAR).

The U.S. Department of Agriculture established the Committee for the Expert Review of Synthesis and Assessment Product 4.3 (CERSAP) in accordance with the provisions of the Federal Advisory Committee Act (FACA), 5 U.S.C. App.2 § 9 (c), to provide advice to the Secretary of Agriculture on the conduct of SAP 4.3.

The CERSAP was given seven inquiries to address. Those inquiries, and CERSAP findings on each, are listed below.

1. *Are the goals, objectives, and intended audience of the product clearly described in the document? Does the product address all the questions as outlined in the prospectus?*

CERSAP finds that the goals, objectives, and intended audience for SAP 4.3 are clearly described in the document, and that the report's charge is appropriately addressed.

2. *Are the findings and recommendations adequately supported by evidence and analysis? If any recommendations are based on value judgments or the collective opinions of the authors, is this acknowledged and are adequate reasons given for reaching those judgments?*

SAP 4.3's findings and conclusions are well supported by evidence and the authors' analyses, as is the confidence ascribed to each. In keeping with the original requirements of the report, no recommendations have been made.

3. *Are the data and analyses handled competently? Are statistical methods applied appropriately? Are uncertainties and confidence levels evaluated and communicated appropriately?*

SAP 4.3's analysis is sound, thorough, and competent. As SAP 4.3 relies on the existing scientific literature, no new data were generated in producing SAP 4.3; therefore statistics are not at issue for the report. Confidence levels are evaluated and communicated appropriately.

4. *Are the document's presentation and organization effective? Are the questions outlined in the prospectus addressed and communicated in a manner that is appropriate for the intended audience?*

The document's presentation and organization are effective. The questions posed by SAP 4.3's prospectus are addressed and communicated in an effective way for its intended audience.

5. *Is the document scientifically objective and policy-neutral? Is it consistent with the scientific literature, including recent National Research Council reports and other scientific assessments on the same topic?*

CERSAP finds SAP 4.3 scientifically objective and policy-neutral. It is consistent with the scientific literature, including NRC and IPCC assessments.

6. *Does the summary concisely and accurately describe the content, key findings, and recommendations? Is it consistent with other sections of the document?*

The Executive Summary concisely and accurately describes SAP 4.3's content and key findings, and is consistent with the document as a whole.

7. *What significant improvements, if any, might be made in the document?*

In June, 2007, CERSAP reviewed the first draft of SAP 4.3 and provided 364 comments and suggestions for its improvement. Following revisions occurring in response to public comment on SAP 4.3 and interagency technical review, the CERSAP met again in February 2008. Suggestions from that meeting have been incorporated into the report. At this time, then, we believe no significant improvements can be made to SAP 4.3 within the report's prospectus-defined scope.

Improvements in the CCSP process itself, however, would lead to improved future assessments:

a. First, the scope of this report limits the authors to consider the effects of climate change on these natural resources and ecosystem services, excluding consideration of potential adaptive responses, as adaptation is the subject of a separate (and uncorrelated) SAP. The effects of climate change on natural resources are uniformly significant, are often highly nonlinear, and can be

altered through economic adaptation. Consequently, future effects of climate change are highly dependent on mitigation efforts and carry with them some level of uncertainty. As a result, the actual effects may be substantially modified from those the authors of SAP 4.3 were charged with evaluating. Thus, the predicted effects on natural resources should be considered a likely example of the types of effects we might expect to see within the next 30 years, but should not be viewed as an explicit forecast. A more integrated assessment in the future which considers such relationships and feedbacks between climate, biotic and economic systems, would better inform decision makers.

b. Second, we believe that portions of the established process for producing and reviewing the SAPs may impact the perceived technical credibility of the Assessments. CERSAP recommends that, for future assessments, the CCSP reexamine its review process so that non-Federal participants may, for example, maintain confidence that substantive changes will not occur to the document after they have completed their final review and provided a recommendation for placement in the interagency clearance process. Also, sufficient time must be available for adequate drafting and review to assure participants that scientific integrity is a paramount consideration in the process.

We find SAP 4.3 (version dated 2-13-08) to be a current, accurate, and comprehensive evaluation of the effects of climate change on agriculture, forests, arid lands, water resources, and biodiversity in the U.S., meeting or exceeding the standards enumerated above, and recommend that it be placed into the interagency clearance process and be adopted by CCSP.

CERSAP believes that SAP 4.3 makes an especially significant contribution in its consideration of current monitoring systems. CERSAP agrees with the finding that, in aggregate, monitoring systems are insufficient to provide timely detection and quantification of climate change driven changes of the resources covered by SAP 4.3. CERSAP urges an assessment of a broad spectrum of current monitoring systems that addresses necessary enhancements and crucial integration of those systems, which is needed to provide adequate detection and quantification capabilities. Specifically, the monitoring of climate change and its effects must be accomplished within an integrative framework that considers the Earth's changing climate, the responses of organisms and ecosystems to that climate, and the impacts of those alterations to human societal systems to be most effective in the development and evaluation of the necessary adaptive action plans. As SAP 4.3 demonstrates, the effects of climate change are already apparent and are increasing in magnitude. Consideration of climate change effects in ongoing land planning, resource management, program policy, and research activities is essential to assure sustainable availability of SAP 4.3 resources, which are necessary for the future well being and security of our Nation.

Sincerely,

Thomas Lovejoy
Chair, CERSAP
President, Heinz Center for Science, Economics, and the Environment

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SAP 4.3
Response to June 2007 Comments of CERSAP Expert Peer Review Committee

Comment #	Page	Lines	Comment	Author Response
Ag-1	n/a	n/a	Pull out common threads on climate that impact all sections. Then individual sections can zero in on particular aspects germane to that particular sector. Need to have a range of regional temperature and precip changes to expect. One temperature change of 0.8o C does not capture the range of impacts. Frequency distributions and extreme events need to be considered (need some information from SAP 3.3)	The whole document has been reorganized to follow each climatic factor through it's main effect and then the interactions
Ag-2	8	8 to 10	Change to: You need to greatly expand this section. Most of the authors used 0.8C for their model projections, although even here there were consistencies- some used “approximately 1C”; some discussed “2030” while others stated “in the next 30 years.” We all know that there is considerable variability in the projections of air and surface temperature increase in the next 30 years, largely due to uncertainty in what emissions will be, along with variability in model outputs. Moreover, there is spatial variability in temperature in the US. Finally, there will be significantly higher increases looking farther into the future. As you state, no one can state with certainty what the future will bring. The key here is not to predict PRECISELY what will happen in 30 years, but to prdict which crops, grasses, animals, non-commercial species, etc are likely to be most SENSITIVE to changes in temperature. For example, if grasses appear to show increases in productivity with increasing temperature up to temp increases of 4C, then this is key, as it contrast sharply to many C4 and even c3 crops, which show an inflecti	The value was chosen for its illustrative value for these analyses.
Ag-3	9	19	"impact of the sun" should be "impact of solar energy fluctuations"	OK

Comment #	Page	Lines	Comment	Author Response
Ag-4	17	29 to 34	Change to: "from other commodity production. Because of this diversity, the potential impacts of climate on agriculture are expected to occur across all regions of the U.S. and understanding the impacts of climate on agriculture is not isolated to a particular region. To evaluate the potential impacts of climate on agriculture the current scientific literature was reviewed for crop, fruit, and nut production, pasturelands, rangelands, and livestock production. Temperature, carbon dioxide, rainfall, ozone, and relative humidity are"	Modified this section
Ag-5	18	6	But what about higher rises, e.g. 1.5C or even higher??	Modified the sentence to indicate that 0.8C change is the illustrative value for these analyses.
Ag-6	18	22	Is this really the same for all crops, or is this a mean value?	Added the phrase in most crops
Ag-7	19	9	Again, is this 0.8C? Makes it sound as if 0.8 C is a given, when in fact it is just a midrange (if even that) value…	Modified the sentence to include both the temp and CO2 values used in the analysis

Comment #	Page	Lines	Comment	Author Response
Ag-8	22	23	Most change occurred over a shorter time frame that that- this is an underestimate of the true rate of change since it was no where near linear	This section does not attempt to address the type of response to any one stimulus. There has been an increase in productivity with the increase in CO2 and a further increase with CO2 and temperature.
Ag-9	22	5-Apr	"… mm change …predict a 1% change…" no sign of change is given. Need to state that a xx% increase (decrease) leads to a yy% increase (decrease) …	OK
Ag-10	24	14 to 16	Need to reference these models better	added model descriptions
Ag-11	24	21	Change to: Economic Adaptation to Climate Change	This section is deleted
Ag-12	24	24	Need to distinguish from evolutionary adaptation, which I assume will be discussed elsewhere in the report?	This section is deleted
Ag-13	25	20	Again, confusion here over “economic/production” adaptation, genetic selection, and evolutionary adaptation- these are artificially selected…	This section is deleted
Ag-14	26	7 and 8	Change to: breed for, and it may not be possible to identify an alternative variety that is selected to be physiologically more adapted to the new climate, *and* is also tolerant of local soils and	This section is deleted
Ag-15	28	2 to 3	Change to: but organic matter is mostly carbon derived from CO2 in the atmosphere [via plant photosynthesis], so it reduces the amount of this greenhouse gas in the	This section is deleted

Comment #	Page	Lines	Comment	Author Response
Ag-16	29	5 to 18	Change to: production systems. Because of this diversity changes in climate will likely impact agriculture in many regions of the US. Agriculture within the United States is complex: crops are grown in different climates and soils, and different livestock types are produced in numerous ways. There are 116 Agriculture within the United States is complex: crops are grown in different climates and soils, and different livestock types are produced in numerous ways. There are 116 animal production, e.g., cheese or eggs). These commodities are distributed across the United States as shown in the following example diagram for corn planted acres in 2002 (Fig. 1). Although corn is grown extensively across the United States there is a concentration in the Midwest where the weather and soil are more favorable for production. In	Modified the section to change the structure.
Ag-17	29	8	This paragraph contains many redundancies in language and needs careful editing.	Modified the section to change the structure.
Ag-18	30	1 to 2	This section needs clarficiation- does this mean that these crops are able to survive here because they don't freeze during the winter? Each of these paragraphs needs a general "tie in" I assume the point her is there there are climatic restrictions to each crop type- frtuit trees are restrictired by how cold it gets in winter, etc. This needs to be made clear.	OK
Ag-19	30	21	"…each year losses in crop value…" "losses" should be replace with "reductions from optimal"	OK

Comment #	Page	Lines	Comment	Author Response
Ag-20	31	9 to 10	Sentence makes no sense.	Changed this section
Ag-21	31	13 to 14	***But this is a mid range of the most recent projections*** This cannot be sidestepped. The potential implications of using >0.8C (or, <0.8C) increase need to be highlighted right up front, and the most recent projections need to be addressed**** This is **extremely** important. All projections have large margins of error surrounding them, and the projection for 2030 used here is probably conservative, given recent emission trends. Moroever, it definitely will be much higher within 50 years. The findings need to be based not only on "midline" or "conservative" estimates, but also on the other scenarios- there is a very good chance the increase will be more than 0.8C, but this report makes it sound like 0.8C is a given… What will happen if the increase is 0.4C? 1.5C? How big of a difference will that make to the industry? Catastrophe? If so, it can't be ignored as a possibility…. **Why was 2030 chosen, and how was the value of 0.8C selected- this needs to be justified** None of the processes described here are linear or even monotonic, and so the choice of year and the choice of temperature dec	OK
Ag-22	32	22	Includes direct effects on pollinators?	The effect of temperature on pollinators was not considered in this analysis.
Ag-23	34	17	Change to: accelerated by increasing temperature up to a species-dependent optimum temperature	Modified the sentence
Ag-24	35	21	Change to: temperature in field conditions may not be due to temperature alone, as high temperatures	OK
Ag-25	36	11	Again, need to present a wider range of scenarios*** Discuss sources of uncertainty, specifically in CO2 production and therefore in temperature rise- from what we have seen, 0.8C is a bitconservative.	See Comment Ag-2.

Comment #	Page	Lines	Comment	Author Response
Ag-26	36	20ff	discussion of Lobell and Asner results are stated to be compromised and unreasonalbe - then why include them here?	OK
Ag-27	39	1 to 2	But these are plant temperatures, not air temperatures, correct? They are not the same thing…	These are air temperatures
Ag-28	42	4 ff	Sentence starting with Baker needs work,	rewrote sentence
Ag-29	42	14	Pollen sterility *declines* as temp increases?? I can imagine that viability declines but I doubt sterility declines.	Agree
Ag-30	45	10 to 11	Don't know if it matters or not, but there is a definite change in writing style here and first use of first person..	OK
Ag-31	46	20 to 23	Change to: (Craufurd et al., 2003). As air temperature in the southern USA already averages 26.7ºC during the peanut growing season, any temperature rise will reduce seed yields (4.1% per 1ºC, or 3.3% for a 0.8ºC rise in range of 26-27ºC) using the relationship of Prasad et al. (2003). At higher temperatures, 27.5 to 31ºC, peanut yield declines more rapidly (6.9%	OK
Ag-32	47	2	Change to: the collapse of the quota system, has been the strong move of production from south	OK
Ag-33	48	6	Change to: is 7° and 22ºC for rate of leaf appearance, rate of truss appearance, and rate of progress to	OK
Ag-34	48	17	Change to: that only one of five cultivars of tomato successfully set any fruit at chronic exposures to	OK
Ag-35	48	18	Are these day/night temperatures?	Yes.

Comment #	Page	Lines	Comment	Author Response
Ag-36	49	7	Change to: 2.3.3 2.3.3 Crop Responses to CO2	OK
Ag-37	49	23	Change to: enclosure-confounding effects. In some cases the results corroborate previous enclosure	OK
Ag-38	50	1 to 2	Change to: reported. Although the continuously increasing “ambient” reference concentration is a cause for lesser response, the smaller increment of CO2 enrichment requires even better	OK
Ag-39	51	18	Change to: over the next 30 years is anticipated to have a negligible effect (1.0%, Table 3) on maize	OK
Ag-40	51	12 ff	Use of verbiage like "a 1 degree rise in temp cause a 3% biomass response" should be avoided. Be specific - increase or decrease?	OK
Ag-41	51	15	"is cause for concern" should be "calls for careful interpretation"	Partially Agree.
Ag-42	52	various	again, xx causes a "response". Be specific	OK
Ag-43	53	5 to 6	Change to: In fact, some of the increased yield of crops like soybean currently attributed to technological innovation over the past 4 to 5 decades is in fact attributable to the rise in	OK
Ag-44	60	15	Change to: dislodging of crops. Wetter conditions at harvest time could increase the potential for	The proper term is lodging.
Ag-45	62	4	Change to: temperature can hasten plant maturity (refer back to particular previous section), thereby	Added section 2.3.2
Ag-46	65	9	What about in US? This is a pretty blanket statement to make…	The reviewer appears to be referring to the geographic location of a particular monitoring station. It is provided for clarity.
Ag-47	65	12	EC not defined	The correct symbol is the degree sign instead of an E
Ag-48	66	4 to 5	Again, midline projection at best – need an entire section at beginning talking about how this figure is justified, and what it means to use other figures given nonlinearity of responses to temperature, and fact that yields first increase and then decrease with increasing temperature	This comment is unclear, this section discusses response of ET to various parameters and not yield, the authors fail to see the connection on this comment.

Comment #	Page	Lines	Comment	Author Response
Ag-49	66	various	per % should be (I think) per 1%	The assumption is that unless a specific number is given it is 1%
Ag-50	66	6, 7	this sentence if very vague	Agree
Ag-51	68	13ff	The sentence starting "The sizes.." is very vague and needs work.	Agree
Ag-52	69	1ff	sentence on Gedney results: there were no changes in precip that could have accounted for the streamflow change?	The authors have rechecked Gedney, and no, precipitation went down, contrary to the streamflow trend.
Ag-53	70	19	Change to: al., 2007). The slope in Bernacchi's Figure 4 shows a 12% reduction over three years.	Agree
Ag-54	70	16ff	Allen results: was increase due to enhance IR or plant physiology?	Plant physiology. New phrase added.
Ag-55	73	9 to 10	Need wider range of projections. Along with associated probablilites- I can't emphasize this enough. For example, even if there is only a 20% chance that temperature will increase by 1.5C, but the effects will be catastophic, this needs to be considered- same thing for an 0.4C increase, etc. 0.8C is far from a givem- there is a fairly wide margin of error about what will happen by 2030- moreover, the US climate most definitely will heat beyond 0.8C within 50 years. Many of the projections of increased yield shown year will therefore be incorrect. You need to show impacts of multiple scenarios, and explain that each would have different impact on crops because of nonlinearities/relationship between temperature and productivity. The key then will be to determine which crops are most sensitive to small changes in temperature- which are on the "cusp" of a positive feedback from CO2 and a negative feedback from temperature – for example, some crops may show a negative response to increasing temperatures, period. Some may show an initial positive response to increasing CO2/temperatu	See response to Comment Ag-2

Comment #	Page	Lines	Comment	Author Response
Ag-56	76	23 to 24	References?	Agree.
Ag-57	81	13	Not sure what you mean- seems redundant if hasn't been done for anything other than soy?	The effects of ozone on soy are a useful example.
Ag-58	82	5	Seems to be some inconsistency in this report- uses both projections of "2030" and "next 30 years" Or am I missing something [was this report written several years ago?]	Agree
Ag-59	82	8	Again, what "30 year span"?	The report focuses on a 25-50 year time period, this chapter, as explained previously, has made calculations based upon thirty year estimations.
Ag-60	83	15ff	the discussion of NPN structure is irrelevant and should be deleted	It is an important monitoring network, but perhaps not needed in this specific discussion.
Ag-61	84	15	Report needs some overall edited- keeps shifting back and forth between past and future tense	Agree
Ag-62	84	1ff	IPM material sounds too promotional	The information is necessary to the topic. The specific language has been altered.
Ag-63	85	4	See comments above on need to incoporporate uncertainty in projections of temperature/CO2 increases. This section seems very redundant (I know it is a synthesis, but it reads almost word for word).	Agree
Ag-64	86	2 to 10	**This is key- need to expand on this, not just in synthesis but in entire report- don't just examine static points (0.8C) but look at entire relationship between productivity and temp/CO2	An explanation of the use of 0.8oC is given under comment Ag-2.
Ag-65	87	18	subscript not used above	Agree
Ag-66	89	18	Change to: downward shift in their optimal temperatures for photosynthesis.	Agree
Ag-67	89	20	See comments in above section on use of 0.8C	See response to Comment Ag-2
Ag-68	90	6	"This review…" should be replaced with" The literature is sparse on the prediction of…"	Agree
Ag-69	90	16	"change… causes change…" be specific, see Ag-41, Ag-43	Agree

Comment #	Page	Lines	Comment	Author Response
Ag-70	93	1	Change to: cropping, even under no-till conditions (Izaurralde et al., 2007). However, winter hay	No comment required.
Ag-71	94	8 to 9	Change to: Surface application of manure to pastures contributes to the maintenance and improvement of soil quality and pasture productivity as well as to the recycling of	No comment required.
Ag-72	96	5	Change to: precipitation and CO2 concentration originate from their regions of origin or from regions	Agree
Ag-73	103	na	Only one invasive is mentioned, Is this the only invasive in agriculture?	deleted this section
Ag-74	105	8	sentence needs work	Agree.
Ag-75	109	3 to 4	But this all depends on water, right??	That wasn't the intent of this sentence, which is a discussion of monitoring protocols.
Ag-76	113	4 to 13	This is a good explanation- maybe move it up earlier in the report, before the crop section?	This information bears repeating since many may only read a specific section.
Ag-77	114	14	Change to: 2.5.4.2 Increases in temperature	The section discusses CO2 enrichment.
Ag-78	114	16	This is a little generic- I assume you mean increases in surface and air temperature which result in increased plant temperature…. I know that sounds nit-picky, but “warming” is pretty wishy washy (warming of what?)	OK
Ag-79	114	22	Change to: for a given species typically peak at plant temperatures that are intermediate in the range	OK
Ag-80	115	2	Change to: high- and mid-latitude and high-altitude rangelands. Conversely, increasing plant	Agree
Ag-81	116	9ff	First paragraph of this section is vague and maybe irrelevant	Agree.

Comment #	Page	Lines	Comment	Author Response
Ag-82	117	5	I don't get what oak savannas have to do with pasturelands…. Are you just using this as an example because there are no data for pasture species? If so, need to make this clear…	The reference to oak savannah is used because they are a type of rangeland vegetation. This section concerns rangelands, not pasturelands as the reviewer suggests.
Ag-83	117	21	sentence incomplete	OK
Ag-84	118	12 to 17	This is interesting, although rest of report is pretty locked into 0.8C rise… if I am understanding correctly, these species will show an increase in productivity over a fairly wide range of air temperature increases, even up to 4C? That is worth emphasizing, especially given the contrast to crops- in fact, I would think the contrast would be one of the main features of this report, as would the disparity between different regions of the US***	This section concerns effects of temperature on species composition, not productivity as the reviewer suggests. The topic is also not so relevant to contrast with cropping systems since such species changes will occur more naturally in rangeland ecosystems, compared to cropping systems where adaptations will concern thinks like deciding which particular plant species are chosen to plant or changes in plant genetics.
Ag-85	122	2	this section is in need of a good editing for precision of writing	Agree.
Ag-86	128	10	sentence needs shortening	OK

Comment #	Page	Lines	Comment	Author Response
Ag-87	131	8	eliminate last sentence of this paragraph	OK
Ag-88	132	8	What about prediction/forecasting?	Implicit in this statement is the need for prediction/forecasting.
Ag-89	133	1ff	Monitoring section very poorly written.	OK
Ag-90	135	1	Inconsistent with other projections (2030)- why?	The 2040 year is given in this case because that is how the authors of the study performed their analysis. It is still well within the timeframe of interest for this report.
Ag-91	137	11	How does this compare to background (non severe) years?	These comparisons are made relative to the conditions today, no change made
Ag-92	137	16	This section is too narrowly focused on one region of the US and one species	There is too limited a body of information for inclusion in this analysis on other species.
Ag-93	147	7 to 9	This is really good- exactly what other sections shoud do if at all possible, to run a sensitivity analysis	Thanks.
Ag-94	149	17ff	magnitude of warming causing this effect not given, sam for swine	OK
Ag-95	152	23	Change to: reflect these interactions remain ill-defined, but research to improve them is underway.	OK
Ag-96	155	1 to 2	It also depends on our ability to effectively forecast when planting should occur.	Agreed, forecasting becomes important in the process.
Ag-97	156	5	Expand	OK
Ag-98	163	fig 7	y-axis units not right	Agree

Comment #	Page	Lines	Comment	Author Response
Ag-99	171	4 to 5	These temperatures are key- they reflect the scenarios and regions where climate change will have a positive or negative impact on crops in different regions of the country- they, along with optimal temperature, could be used to estimate the "tipping point" for different regions of the country	We agreed that this would be an excellent summary to be able to provide values for each region and crop; However, the available databases and literature do not include sufficiently specific information on the temperature and precipitation changes required to derive such scenarios.
Ag-100	180	1	This is really good- include more of this in text of report	These subjects are discussed to some degree in section 2.4.7 and 2.4.8
Ag-101	183	14 to 15	Change to: and air quality; and biodiversity conservation. While not all of these services have easily-quantified market values, all services have considerable economic value (Costanza	OK
Ag-102	381	22 to 23	See comments above in reference to "the anticipated increase" – there is a large margin in error around this figure that needs to be considered and discussed. Also, the report bounced between "the next 30 years" and "2030"	We have focused the discussion on the term the next 25-50 years, so both references are correct.
Ag-103	383	1 to 2	Change to: Crop water use (requirement) will be increased at least 1.2% from anticipated increases in temperature, and reduced 1.4 to 2.1% by the rise in CO2, giving a net	OK
Ag-104	383	10	Be careful- one projection is increases in extreme events- including colder winters. Include level of confidence.	This general information is more appropriate in an introduction than in this chapter specifically. See section 2.5 for information on extreme events in this context.
Ag-105	383	15	Change to: Farmer adaptation to these climatic changes should include shifting sowing dates	OK
Ag-106	387	1	440 ppm is probably optimistic	This value is from the IPPC 2001 estimates which we used as the guide for the changes
Ag-107	n/a	n/a	Consider eliminating the section on ozone influence on crops. Acid rain, for instance, is not included. The section as written has much misinformation. Ozone production is dependent on sunlight and not directly on climate change.	There is evidence that ozone changes are related to climate change.

Comment #	Page	Lines	Comment	Author Response
Ag-108	n/a	n/a	Management adjustment/adaptation is not considered. Focus of this document is not adaptation, but there should be some statement that impacts mentioned here should be considered as maximum impacts that may be reduced by adaptation.	OK
Ag-109	n/a	n/a	Table 13 needs to be revised.	OK
Ag-110	n/a	n/a	Now the document has 150 pp in the agriculture section. The document needs to be reduced in size and much more concise and precise without rambling sections that reduce credibility. Eliminate redundancy and sweeping generalizations that recount the obvious. For example, p. 23 and p. 134 are identical; similarly for other points. Major findings on pp. 17-24 are all repeated later as major findings in subsections--these need to be eliminated.	OK
Ag-111	n/a	n/a	Connectivity among agriculture, eliminate overlap. Natural synergies are missed--rangeland and livestock are separated. Pastureland can be considered as part of crop land (albeit having perennial plants) since it is highly managed--the crop is harvested by animals rather than machines. Rangeland is a more multi-species ecosystem. Pastureland can be merged with either rangeland or crops.	It was decided to keep these separate in the discussion but are merged in the synthesis section
Ag-112	n/a	n/a	Transport of animals in agriculture; indoor production and outdoor production. During times indoor animals are outdoors they are highly vulnerable.	OK
Ag-113	n/a	n/a	Animal section focuses too much on beef production and not adequate attention to other species.	There is little information on other species and since most are grown under controled environments the effect of climate change is on the building management rather than directly on the animal.
Ag-114	n/a	n/a	Regional distribution is not complete, too much focus on high plains and misses dairy and poultry.	Comments on dairy added, poultry is grown under confined environments
Ag-115	n/a	n/a	Human food production is not adequately addressed.	Beyond the scope of this report

Comment #	Page	Lines	Comment	Author Response
Ag-116	n/a	n/a	Irrigated agriculture and dependence on water supply on natural rain/snow and snow storage. Also allocation of available water to agriculture.	This subject is covered in the water resources portion of this report
Ag-117	n/a	n/a	Many of the above [general] comments apply to pastures and rangelands, especially at the redundancy of material related to general effects of climate change on these systems.	The reorganization of the chapter eliminates the redundant sections.
Ag-118	n/a	n/a	A specific remark regarding sequestration potential, the estimate of 12-22 Tg per ha per year seems outrageously high. Numbers I can recall are around < 1 MT per ha per year, so there is like 7 orders of magnitude difference.	Agree.
Ag-119	n/a	n/a	Include wildlife regarding benefits of pasture's ecosystem services to wildlife and domestic animals	-
Ag-120	n/a	n/a	change "downward shit" downward shift	OK
Ag-121	n/a	n/a	Discussion of CO2 effects on ecosystem processes should seek consistency and more clarity on the effects on physiological processes related to photosynthesis and respiration, and how this translates to changes in NEE (ie there should be a more synthetic approach to discussing CO2 enrichment effects so that full carbon cycle considerations are made clear and that consistent terminology and considerations are used in discussing response to elevated CO2)	For the objectives of this report, which include brief descriptions of ecosystem mechanisms, and are more concerned with ecosystem responses than the C cycle (which is the focus of another report), we feel level of detail on C in this report is sufficient.
Ag-122	n/a	n/a	Discussion on Invasives underwhelming. There needs to be more of a balanced approach in discussing critical issues.	OK
Ag-123	n/a	n/a	Clarify difference in ranching systems relative to pastoralism and why this makes a difference to issues related to climate change	OK
Ag-124	n/a	n/a	Discussion of ecosystem responses to CO2 and Climate Drivers seem to be biased to mesic grasslands and pastures. The response along the temperature and precipitation gradient determines much of the response to CO2 and climate drivers. So temperature increases do not always dictate growing season response, in areas like Colorado up to Montana, the grasslands respond as much to moisture regime as they do to temperature changes.	The very first statement in the rangeland section is that rangeland dynamics are drive more by water dynamics than other parameters, we think this is sufficient to address this concern

Comment #	Page	Lines	Comment	Author Response
Ag-125	n/a	n/a	Discussion of altered precipitation should include some consideration of rain for snow switch and how this may affect grassland/rangeland community dynamics and invasive species dynamics.	We agree that this dynamic is critical to agriculture and without definitive indications of this change it is not possible with any certainty to address this question
Ag-126	n/a	n/a	Overall, the sections do are consistent and suffer from redundancy and sometimes inconsistency in the points made. Many sections do not real conclude to make a clear point of the section.	The reorganization of the chapter adds clarity to the discussion
Ag-127	n/a	n/a	Need uniformity on abbreviations throughout.	Agree
Ag-128	n/a	n/a	Need uniformity on US, U.S., USA, or United States; also on US$	Agree
Ag-129	17	24	There is no discussion on impacts and opportunites for soil. What are the impacts of temperature and moisture on soil, specifically SOM? Soil C sequestration in cropland? This was mentioned for rangeland. Soil management. Change in nutrient cycling?	The literature on cropland SOM is largely related to mitigation rather than impacts, which exceeds the scope of this report.
Ag-130	17	27	Change to: "of $200 trillion in 2002 "	It's actually billion rather than trillion.
Ag-131	17	30	What does "this" diversity refer to? Change to: "because of the diversity of commodities and…"	Given the previous sentence ("…wide range of plant and animal production systems."), the authors believe the phrase is clear.
Ag-132	17	29 to 31	This sentence is not clearly written	OK
Ag-133	17	34	It is not just rainfall but snow. Change "rainfall" to "precipitation."	Agree.
Ag-134	18	20	If other things are equal. Pests, diseses, nutrients, water.	OK

Comment #	Page	Lines	Comment	Author Response
Ag-135	20	3	Replace "rape" with "canola."	Current terminology is preferable for the intended audience.
Ag-136	20	15	Check the units. 12 terra grams per hectare per year?? Should this be 12 Tg/y?	Agree
Ag-137	22	23	Is this solely attributed to CO2 or are there other factors (precipitations, N deposition, management)	OK
Ag-138	29	4	Change to: ($200 trillion in	It's billion.
Ag-139	30	6	Delete "as shown in the following figure"	OK
Ag-140	30	13	Delete "as shown in the following map."	OK
Ag-141	30	14	Change to "in excess of $200 trillion and distributed "	It's billion.
Ag-142	34	5	Replace "rape" with "canola."	OK
Ag-143	39	18	Remove comma	OK
Ag-144	47	5	Remove comma	OK
Ag-145	67	5 to 7	Change to: "The latent energy associated with evapotranspiration from soybean is 10 to 60 W/m2 less in the FACE plots compared to the control plots at ambient CO2 when the crop had ample water (Figure 9 adapted from Bernacchi et al., 2007).	OK
Ag-146	67	21	Replace "workers" with "researchers"	OK
Ag-147	68	1	Replace "one" with "estimate"	OK
Ag-148	70	9	Remove comma	OK
Ag-149	70	23	Is this unit supposed to be ppmv?	OK, should be ppm
Ag-150	71	1 to 2	Change to: The slope in Bernacchi's Figure 4 shows a 12% reduction over three years. Allen et al. (2003) observed a 9% reduction in ET	Agree
Ag-151	75	8 to 9	Change to: However, the projected 0.8ºC would increase the ET by 1.2%,	OK

Comment #	Page	Lines	Comment	Author Response
Ag-152	77	13	Change to: However, an increase in short- to medium-term drought will tend to	OK
Ag-153	80	19	Change to: Elagoz and Manning, 2005	OK
Ag-154	84	19	This section could benefit by a summary figure with crops by regions and % change on y-axis	There is not ample certainty from which a regional summary figure could be drawn
Ag-155	89	6	Check units	OK
Ag-156	89	2	Change to: negative response in terms of plant	-
Ag-157	91	7	Pature land will require more N if CO2 growth increase. More inputs unless mixed with legumes	OK
Ag-158	93	18	Check units	Agree.
Ag-159	96	15	Replace "origen" with "origin"	OK
Ag-160	96	18	Be consistent with units throughout the document	Agree
Ag-161	100	4	Will the general US reader know this term?	OK
Ag-162	103	4	Change to "Effect on Invasive Species"	-
Ag-163	108	9	One potential --what?-- involves grain crops?	OK
Ag-164	109	20 to 21	Change to: "Warmer temperatures likely will lengthen the growing season and affect development rates of individual species, but the effects of warming will vary"	OK
Ag-165	113	18	Work by Owensby, Ham in KS tallgrass related to photosynthetic rate	Work by Owensby et al. is mentioned later. We reference Drake here because it was a review on the subject.
Ag-166	114	18	Replace "tall grass" with "tallgrass"	OK
Ag-167	117	21	Change to "Weltzin and McPherson 2003"	OK

Comment #	Page	Lines	Comment	Author Response
Ag-168	120	1 to 4	How does this fit with Owensby that C4 responded more to CO2 than C3 when water stress. Thus favored the cominant C4 grasses	The preponderance of evidences suggests C3 species respond more strongly to CO2 than C4 species. There is certainly evidence of stronger C4 responses in the literature, certainly the work of Owensby's group. However, in such instances, usually some other issue (such as light interception in Kansas tallgrass prairie, which was greater for the tall C4 grasses compared to the short-stature C3 grasses at that site) is interacting and affecting the CO2 response.
Ag-169	121	23	Should included a discussion of interactions and feedbacks with grazing and fire two major drivers of many grasslands	See Table 2.14 and Sectin 2.9.5. These issues are discussed.
Ag-170	122	14	Figure 12, not figure 14	OK
Ag-171	123	16	Change to "Epstein, et al., 2002"	OK
Ag-172	124	21	Dell and Rice	Need more info.
Ag-173	129	16 to 19	This does not agree with observations of Owensby.	See response to Ag-169
Ag-174	131	23	Change to "altered by climate change"	OK
Ag-175	132	1	Capacity is not changed by economics only the extent that the capacity is realized.	OK
Ag-176	133	13	Change to: Booth and Cox 2006;	OK
Ag-177	140	16 to 17	Italicize Bos taurus. Also 140 line 21, 143 line 10, etc.	OK
Ag-178	146	16	Is accessibility to water a concern. I have not seen this in any discussions but if water is limited for crops this could also be a limitation for livestock?	OK
Ag-179	158	11	However there is some debate about the effect of warmer temperatures on soil oranic matter decomposition rates. While uncertain is should at least be mentioned. Was soil C sequestration mentioned??	-

Comment #	Page	Lines	Comment	Author Response
Ag-180	158	16	As mentioned by other reviewers. Are there tradeoffs extract more C at the expense of soil C and sustainability.	-
Ag-181	n/a	n/a	One of the challenges in framing the report that the lead authors face is to make it very clear how this report fits into the general scheme of things and the boundaries that were placed on the authors in framing and developing their sections. As I understand the framing, and the authors were not to discuss adaptation to climate change at least with respect to managed systems. Thus, they report explores the consequences of observed changes in climate on unmanaged/somewhat managed systems, birds, coral, ... but the focus for the impact on more intensively managed systems such as maize production is impact assuming no adaptation. Since there has been considerable discussion in the climate change literature on adaptation and criticism for estimates of adjustment costs that fail to adequately account for adaptation, the managed systems estimates presumably should be described as upper bound estimates.	The scope of this chapter is according to the charge this writing team was given. The discussion of adaptation is the prerogative of SAP 4.4., although we do not believe that they are looking into agricultural adaptation specifically. It is an important discussion, but it is outside the scope of this report.
Ag-182	n/a	n/a	I was a bit confused in that there is a discussion of adaptation to climate changes in the summary although it does not draw on adaptation literature per se.	OK
Ag-183	n/a	n/a	As I understand the discussions by the lead authors, the recommendations that were discussed in the subcommittees to provide scenarios for the century of pertinent measures from selected GCM's (or, RCMS) as a lead to the discussion to provide a general context … but to focus on why the 30 year rise was chosen for purposes of this report … is indeed the plan.	The time frame for this report is more directly given in the introduction

Comment #	Page	Lines	Comment	Author Response
Ag-184	n/a	n/a	In the context above, it might be useful for the general reader to have a "pull out" box that focuses on the fact that considerable research takes place to adapt cultivars to microclimates and, particularly on the horticultural side, scientists maintain vast collections of cultivars from around the world looking for cultivars with desirable characteristics for particular climates, regions and markets. These kinds of investigations and databases have been one of the sources of information to assess adaptation capability. There are a few references in the report that relate to some of this literature but I didn't run down where they were cited.	The use of pull-out boxes will be determined as the document progresses through the review process, however adaptation is not within the scope of this report.
Ag-185	n/a	n/a	As noted at several points in the general discussion, agriculture including pasture and rangeland is both homogeneous over significant areas but also very heterogeneous in climate and soils. This is even truer of the less managed environment. Those familiar with agriculture readily appreciate the implications of this for the existing structure of agriculture and one gets a sense from the figures that describe the location of different agricultural enterprises. However, the discussion of climate impacts tends to come across as if agriculture existed on a homogeneous "plain". While I grant this is an overdrawn caricature, it does seem to me that it was a general underlying concern/frustration that the group was trying to put their finger on and related to the potential to differential impact of climate change on different regions. Again, perhaps the maps of location might be helpful in tying this part of the story together.	Agriculture exists in a heterogenous environment. Climate change will not occur equally and throughout this chapter we focussed on the responses that are driven by temperature which can be related to a region with some certainty. Agricultural production is a result of complex interactions and those are not well-quantified nor are the regional changes in climate sufficently certain to be able to address for each commodity the certain impact. The information is not available to do the analysis suggested by the reviewer.
Ag-186	n/a	n/a	Having had some experience with the challenges of regional specificity in going from GCM's to more regional impacts, this may be part of the challenge. If so, it would seem to be sensible to be clearer on the point.	The introduction to this report has added clarity to this discussion

Comment #	Page	Lines	Comment	Author Response
Ag-187	n/a	n/a	Also, in this context, the agriculture authors to speak to the issue of variability in both rainfall and temperature and their interaction. It would be helpful to push a bit further, if possible, in the context of other discussions and narratives to speak as definitively as possible to the impact of increased variability if the increase in variability is going to push plants into areas of lower performance. To put this story another way, plugging in average temperature and precipitation overstates plant performance. A related question is most of the focus is on weighted average performance and relatively little discussion in the agricultural section is on whether we should expect a change in the variance of performance or some other measure of dispersion including extreme events.	OK
Ag-188	n/a	n/a	I struggled with the recommendation that follows, namely is it superfluous? Consider a "pull out" box on approaches to estimation of plant response that appears in the manuscript. Many different approaches were involved in reported paramerization.	The use of pull-out boxes will be determined as the document progresses through the review process
Ag-189	n/a	n/a	One of the challenges that were widely discussed is what is left out. We discussed this issue agriculture subcommittee. There are several pieces of research in the report that draw on a statistical method called meta-analysis. One of the challenges this method specifically tries to deal with is publication bias. In some disciplines, if there's no response it may have been be difficult to get a paper published or if the measurements are judged to be sufficiently routine that may appear in research reports which takes us to the "gray" areas of review. I'm not quite sure what to do here one but to at least acknowledge the challenge if it is acknowledged to be a problem and the direction of bias.	While we agree that there may be literature bias, we can only review what is available to us as a scientific community.

Comment #	Page	Lines	Comment	Author Response
Ag-190	n/a	n/a	In the current context, it may be quite clear to those developing the agricultural section but it is not clear to me as to the impact of the current round of maize genetics for this class of issues. My guess is we don't know according to the current ground rules of the review but the authors should not acknowledge that major changes have taken place in recent years. It might also be helpful to have a graph depicts a change in maze yield over the course of the century for Iowa or Illinois. This puts some of the discussion in a more general context and also raises the question as to the potential impact of climate change on the rate of increase in mean maize yields. If I understand the claims being made, the argument is that in the near term the rate of increase will be greater than it has been historically and that the cultivars are more robust to variations in moisture. This would seem to be one of those places that if you do not have knowledge we should acknowledge what has changed the landscape in the upfront that we do not have specific knowledge at this point in time	The graph of corn yields has been removed; however, the discussion of the role of genetics on yiled responses to climate is left in the more basic processes of temperature, CO2 and water responses
Ag-191	n/a	n/a	I am not clear as to what is envisioned for socioeconomic issues in the report. They mostly seem to be statements of gross sales. I would probably drop the graph of corn revenues over time or at the very least converted to constant dollars. I think this story of corn yields is more helpful in the context. If there are measures across time they need to take converted to constant dollars. There are challenges, such as the one in the agricultural graph of sales by "group" that are somewhat misleading in that there is a substantial amount of double counting. These are routinely used and I'm not sure whether the value added is even available. Where it is a challenge for this report in particular is that pasture and rangeland is marketed through livestock. Except for its value in a multiple use sense, it would not show economic value in the sense has been measured here unless it was marketed through livestock.	OK.
Biodiv-1	330	14	Change to: Root (ref) contend that human activities have contributed significantly to temperature	OK
Biodiv-2	330	22	Where did this figure come from?	from cited reference
Biodiv-3	330	22	Change to: the background of climatic and ecological noise from a 0.6° C increase in global mean	agree
Biodiv-4	330	15--	Cite IPCC 2007 findings?	This is done throughout.

Comment #	Page	Lines	Comment	Author Response
Biodiv-5	331	15	and elsewhere. Should distinguish when findings specifically relate to US and where they are derived from other regions	agree
Biodiv-6	332	20	Change to: studies focus on plants. Although most studies tend to separate distributional and	editorial
Biodiv-7	332	3	“tree line had increased previously” explain	editorial
Biodiv-8	333	4 to 5	Change to: Parmesan (ref) describes three types of studies documenting shifts in species ranges: (1) those that measure an entire species range, (2) those that infer large-scale range shifts	editorial
Biodiv-9	333	15	Change to: distributions and/or phenologies over the 20 and 140 year time frame {Parmesan, 2003	editorial
Biodiv-10	333	24	Define if you are going to distinguish	agree
Biodiv-11	333	16	“phenological responses” of what?	editorial
Biodiv-12	335	6	Incomplete thought	editorial
Biodiv-13	335	18 to 19	Ouch!! Individual birds never adapt… Do you mean physiologically acclimate?	agree
Biodiv-14	335	6-8	Something is missing	editorial
Biodiv-15	335	15	“their” ?	editorial
Biodiv-16	336	3 to 5	Change to: species will not be spatially uniform across a species’ range and is thus likely to be highly complex and dependent on species-specific traits, characteristics of local microhabitats, and aspects of local thermal history.	agree
Biodiv-17	336	13	Change to: term consequences might be {Visser, 2005 #7753}.	editorial
Biodiv-18	336	18 to 19	Change to: and egg-laying dates will aid in the understanding of impacts of climate change. There are a suite of responses that facilitate an adaptive phenological shift: a shift in egg-laying	editorial
Biodiv-19	336	22	Change to: that the peak of abundance of their food resource (caterpillars) has advanced in the last	editorial
Biodiv-20	337	8	Change to: constraints and interpreting changes in life-history traits requires a better understanding	editorial

Comment #	Page	Lines	Comment	Author Response
Biodiv-21	337	16-18	Where did this come from	Not clear, but intent was to argue that species that migrate into high latitudes will have as much effect on future phenologies and productivities as the loss of current species. However, statement is unsupported and therefore has been deleted.
Biodiv-22	338	12	Change to: expanded northward, less than 20% had contracted southward, and the remainder were	editorial
Biodiv-23	338	14	Change to: have shifted to the south {Parmesan 1999 #7763}. In North America, butterflies are	editiral
Biodiv-24	338	22	Change to: found that 2-4 ° C warming was driving the northward range expansion over the past 50	editorial
Biodiv-25	338	20	Obviously the habitat was not suitable if they did not survive. Rephrase- to explain better. Eg. they did not survive in spite of adequate food supply or whatever is meant.	agree
Biodiv-26	339	5	Change to: northwards across all species {Hill, 2002 #7865}. A subsequent modeling exercise to	editorial
Biodiv-27	339	17	both species diversity and what?	editorial
Biodiv-28	339	21	Change to: butterfly-host interaction in California led to population extinctions of the checkerspot	editorial
Biodiv-29	339	21	Might be a good place to discuss responses to interannual and decadal climate fluctuations in relation to long term warming trends.	agree
Biodiv-30	340	9	Change to: changes in dispersal were associated with reduced investment in reproduction which	editorial
Biodiv-31	340	16 to 18	I'm not sure what this means- basically, climate change affects mammals indirectly rather than through direct effects on their body temperature…	editorial
Biodiv-32	340	16	Plants of course regulate their physiology. What is talked about here is more about changing behavior.	agree
Biodiv-33	341	n/a	Who did these tests of the many cites that follow.	editorial
Biodiv-34	346	7 to 8	HUH??????!!!!!! Our biggest uncertainty is just how much CO2 will be emitted…	editorial
Biodiv-35	346	17	PDO?? (not defined until later sections)	agree
Biodiv-36	347	13	What is meant by "to be listed" in this context?	agree
Biodiv-37	348	2	What "complex species"? " a complex of species?"	yes

Comment #	Page	Lines	Comment	Author Response
Biodiv-38	348	4	$30 billion value (based on what?)	agree
Biodiv-39	349	1	Change to: irradiance levels (Fitt and Warner 1995, Jokiel and Coles 1990, Lesser *et al.* 1990).	editorial
Biodiv-40	349	18	Change to: Virgin Island National Park surveys. As of yet there are no reports of recovery as	editorial
Biodiv-41	349	21	Change to: degree heating weeks in late August 2005 (NOAA Coral Reef Watch), and some	editorial
Biodiv-42	350	5 to 6	Change to: the world's oceans. It is estimated that half of the CO2 released due to burning fossil fuels was absorbed by the oceans.	editorial
Biodiv-43	350	8 to 9	Change to: soon become too acidic for corals, as well as other species, to product calcium carbonate skeletons (Caldeira & Wickett 2003, Hoegh-Guldberg 2005, Kleypas et al. 1999).	editorial
Biodiv-44	350	14	Change to: it is possible they have also increased the frequency of these intense storms (Mann and	editorial
Biodiv-45	350	20	I recently published a review in Annual Review of Ecology Systemetics and Evolution (2006) that showed that the annual rate of species range shifts in the intertidal zone was 50 km/decade- faster than anything observed on land. However, these data were mostly from Europe. However, it makes the point that the coastal zone is extremely susceptible to climate change, likely much more so than many terrestrial ecosystems.	noted
Biodiv-46	350	22	Change to: 5.8.2 Coastal Seashores	editorial
Biodiv-47	351	17	Change to: Some of this coastal habitat is on remote and barrier islands, where the vulnerability to	editorial
Biodiv-48	352	20	Change to: Range shifts and phenological changes	editorial
Biodiv-49	353	n/a	I got lost here. I thought we were talking about arctic systems but now there is generic information about invasives, relevant to any system, followed by material on tropical systems. The whole of section 5.8 needs some close attention. Too many things mixed together, including bouncing from recent trends to projected trends.	agree
Biodiv-50	363	10 onward	Would be good to link more clearly the relationship of these oscillations to upward trajectories of warming.	Needs to be done in climate context section of the report's introduction.
Biodiv-51	364	11	I understand why this is included in this section, but ENSO is discussed so extensively in the previous section it is a bit strange to have it introduced so late in the document. Same thing with pH.	agree

Comment #	Page	Lines	Comment	Author Response
Biodiv-52	364	19	This has already been discussed in the coral reef section- need to cross reference.	agree
Biodiv-53	366	17	Expand: you mean projections into the future based on our understanding of physics?	editorial
Biodiv-54	366	14	Impacts on what?	agree
Biodiv-55	369	14	Change to: northward shift in the distribution of most pelagic species, and possibly the	editorial
Biodiv-56	369	17	Add: However, there is considerable heterogeneity in factors such as upwelling and climate along coastal regions which can complicates this generalized response for benthic species.	agree
Biodiv-57	371	15	Change to: mammals which relied upon plankton production occurring at the normal time	editorial
Biodiv-58	371	9 and following	Say something about the recent hypoxia occurrences off of the Oregon coast and relationship to upwelling shifts---or whatever is happening there.	partially agree
Biodiv-59	373	8 to 10	Why use direct quotes here?	editorial
Biodiv-60	375	23 to 24	Change to: diverged into the lineage that led to the brown bears found today in the Alexander Archipelago of southeastern Alaska and another that led to the polar bear (*Ursus*	editorial
Biodiv-61	375	Section 5.12.22	This section is interesting but the level of detail is out of balance with other sections.	agree
Biodiv-62	376	20	This section is well-written and very interesting- it just jumps out as very odd in a USDA report, especially given the large amount of space devoted to it. I suspect it is so long because it is a good example of an "early earning species." If this is the case, then spell this out early on in the section. Otherwise, it just seems odd- there are plenty of other more commercially important species that have been hard-hit in recent years but have received little attention simply because they aren't "charismatic megafauna" It's fine to include this, but explain why you are doing so in a USDA report….	dealt with in introduction
Biodiv-63	380	21	also documented for plants.	Agree, but need a reference

Comment #	Page	Lines	Comment	Author Response
Biodiv-64	334-345	n/a	There needs be some discussion of the value these various systems for detecting biodiversity responses to climate change.	agree
Biodiv-65	n/a	n/a	Approach to chapter: 1. Body temperature affects virtually all physiological processes. The relationship between body temperature and processes such as productivity, respiration and stress (both lethal and nonlethal) is often nonlinear and nonmonotonic. 2. The optimal body temperature varies between species, and therefore in any given habitat different species may display varying responses to increases to temperature; i.e., they may be on different trajectories in relation to their "tipping points" both in terms of optimal productivity and the risk of mortality. 3. While body temperature is known to interact with a variety of other environmental factors, including pH, CO2, food supply, etc, the lethal and optimal body temperatures haveen studied for many species. It may therefore be possible to estimate how close to a "tipping point" or other defined threshhold a species may be, given sufficient information about that organism's environment. 4. By measuring and modeling current and future environmental parameters, we may (with appropriate understanding of limits of confidence) predict aspects of an organism's f	This is an intersting framework, but what's the actual comment?
Biodiv-66	n/a	n/a	Jim Smith: Modeling bird ranges using remote sensing data.	citation please
Biodiv-67	n/a	n/a	Explicitly identify (& quantify) areas of uncertainty.	partially agree
Biodiv-68	n/a	n/a	Include text box of long term survey (bird survey)-look at any small window-will not see trend or may miss very important event--need long term.	Agree
Biodiv-69	n/a	n/a	Root: isotherms and bird wintering ranges	Root's work extensively cited already
Biodiv-70	n/a	n/a	Mladenoff: landscape forest simulation modeling, climate and disturbance.	Please see forest chapter of this report.
Biodiv-71	n/a	n/a	Past and Post: forest simulation modeling	Please see forest chapter of this report.
Biodiv-72	n/a	n/a	Holtmeier and Broll 2005 Global Ecology and Biogeography 14 395-410	comment?

Comment #	Page	Lines	Comment	Author Response
Biodiv-73	n/a	n/a	Helmuth et al. 2006 Annual Review of Ecology Evolution and Systematics 37: 373-404. (Reviews ecological forecasting, effects of climate change on coastal ecosystems).	agree
Biodiv-74	n/a	n/a	Price: Modeling bird ranges	comment?
Biodiv-75	n/a	n/a	This chapter contains lots of good material but needs a conceptual framework on which to hang all of this information, such as was used in chapter 3. The various sections are unbalanced in relation to detail. This chapter is not ready for review since many sections are still not complete. Also, how does the recent release of IPCC 2007 support, alter, or contradict this analysis?	agree
GEN-1	16	8	Wrap-up: most uncertainty due to uncertainty in future levels of emissions? Can also refer to recent reports which suggest that we are following “worst case scenario.	Not sure what commenter intended
GEN-2	89	6	need to be consistent in use of subscript throughout report	Agree
GEN-3	n/a	n/a	Need to have the document organized so that general readers can get a good, accurate, non-referenced overview from the executive summary. Body of the document should satisfy the researcher.	Agree
GEN-4	n/a	n/a	Explicitly identify (& quantify) areas of uncertainty.	Partially Agree

Comment #	Page	Lines	Comment	Author Response
GEN-5	189	15-17	Here and throughout the report, the authors need to be more explicit about the linkage between statements of expected responses/impacts and whether or not they are considering the likelihood of additional disturbance impacts and/or threshold-like responses, building on recent findings by IPCC and others. Overall, this report makes good progress on including disturbances and responses, building on recent findings by IPCC and others. Overall, this report makes good progress on including disturbances and thresholds, but should go farther than previous reports in explicitly linking statements of expected responses/impacts to disturbances and thresholds.	Agree. .
GEN-6	194	n/a	Integration is needed among related sections of the report both within the Land resources section and within the overall SAP 4.3. For example, discussion of semiarid woodland and forest die-off from drought and associated bark beetle infestation is included in sections under Land Resources, Forests (p. 194), Land resources, Arid (p. 243), Water resources (p. 322), and biodiversity (p. 332, 355), and is not included in the Agriculture, rangelands section.	Agree
GEN-7	n/a	n/a	In addition to the full printed report, the executive summary should be printed as a separate document.	Agree
GEN-8	n/a	n/a	The current draft has a wealth of information, however the draft is poorly organized and does a poor job on integrating and synthesizing information that makes the material useful for any of the potential user communities.	Partially Agree
GEN-9	n/a	n/a	It would be useful to pull objectives and guidance wording from the Prospectus so that a better understanding of the scope of the chapter is clarified.	Agree

Comment #	Page	Lines	Comment	Author Response
GEN-10	n/a	n/a	The level of writing is unbalanced and many sections are redundant. There is a need for consolidation of key points on climate change effects on critical aspects of ecosystem and biodiversity processes so that repeated materials can be reduced. This will provide a small contribution in reducing the current wordiness of the draft and reduce the report down to a more manageable size.	Agree
GEN-11	n/a	n/a	Would find it useful for the introduction to provide a rationale for the selection and distinction of agriculture, land resources, water resources and biodiversity. What are the distinctions, commonalities, and interactions among these sectors that organize the report.	Partially Agree
GEN-12	n/a	n/a	Where are wetlands and peatlands handled? Given the importance of these ecosystems and rate of observed permafrost thaw affecting the biogeochemical and hydrological feedback to climate and to ecosystem and biodiversity processes in critical environments around North America, it seems like a noteable omission which at least needs some comment why it is not being handled here.	Partially Agree
GEN-13	n/a	n/a	Organization structure does not provide a pathway for a comprehensive evaluation of the scientific assessment of knowledge of climate change effects on ecosystems and biodiversity among agriculture, land resources, water resources, and biodiversity.	Partially Agree
GEN-14	n/a	n/a	The outline as discerned from the table of contents and reading portions of the draft report lends itself for redundancy and potential for conflicting statements of knowledge of effects. It seems that a more synthetic approach on what is know about ecosystem and biodiversity response to climate change be drawn together as an introductory chapter. That is the climate effects (temperature, precip, CO2, N, etc) stuff be pooled into one place. The specific issues related to ag, land, water, and biodiversity can then be dealt with as special aspects of the general case.	Agree

Comment #	Page	Lines	Comment	Author Response
GEN-15	n/a	n/a	Greater emphasis of the develop of our knowledge over the past five to 10 years should be highlighted, in that more is understood about interacting effects, impacts related to multiple stresses, non-linear response of ecosystems and communities that affect ecosystem and biodiversity processes.	Agree
GEN-16	n/a	n/a	In the Agricultural sector, there seems to be a lack of connection between crops, pastures, rangelands, and livestock. Given the integration of systems in food and fiber (and now energy) production, it seems arcane to treat these sectors in a “stove-pipe” manner. In the introduction of this section it would be useful for a more synthetic treatment of the issues, followed by a justification of the 4 sectoral considerations, noting the interconnections and highlighting the rational to treat them distinct from each other.	Partially Agree
GEN-17	n/a	n/a	The section [in the Water Chapter] on drought may benefit from a more comprehensive coverage. In fact, drought is one topic that cuts across almost all of the chapters of 4.3. Some specific areas to consider are: - The work of University of Nebraska and reference to drought monitor - The recent drought studies based on the instrumental records of the past century, in the context of proxy record studies (Tree rings and stable isotope). Overpeck should be a good source for providing some references as well as the Tree Ring center at Univ. of Arizona. - Some coverage of the literature on the economic impacts of recent droughts maybe useful to include.	Agree
GEN-18	n/a	n/a	Another cross cutting topic relates to the impact of changing vegetation cover on the hydrology. Some of the work sponsored by SAHRA STC at the Univ. of Arizona, especially by Eric Small (formerly at NM Tech and now at Univ of Colorado) and the work of USDA ARS in Tucson (Dave Goodrich is a good contact to identify some references) is useful to reference.	Agree

Comment #	Page	Lines	Comment	Author Response
GEN-19	n/a	n/a	**A key point emphasized by the review panel:** Both the drought and land cover change/hydrology, cut across the agriculture, land resources and biodiversity chapters. Whether these topics should be included in the water chapter or in a new section called “cross cut issues”, is up to the authoring team.	Agree
GEN-20	96	18	Be consistent with units throughout the document	Agree
GEN-21	n/a	n/a	One of the widely discussed issues in the general discussion and in the agriculture subcommittee was the use of the report and how we use similar reports if we take ourselves to the representative of one group of users. My understanding, and perspective, was a major need is a document which contains the degree of referencing of the current document that permits the general science reader to obtain an overview and to follow up with more detailed references and authors if appropriate. There was concerned that the document not be edited down to the point that it lost that level of specificity. That calls for a very high quality executive summary or an executive summary and a separate document that captures the substance of the report but does not provide the detailed documentation of "why" and parameterization.	Agree
GEN-22	7-16	n/a	More important here to show or discuss recent trends since 1975 and similarities with AR4 models	Agree
Intro-1	7	18	Change to: "While the U.S. has warmed significantly"	Partially agree

Comment #	Page	Lines	Comment	Author Response
Intro-2	8	6 to 15	Change to: " A range of potential futures envisioned in the Intergovernmental Panel on Climate Change process is shown in Figure 6 and these are only a few of the scenarios developed over the past decade. When scenarios like these are used as input to climate models, the models project increases of from 1-2 to more than 4o C averaged across the US. The range of temperature increases are simulated by the National Center for Atmospheric Research's climate model, the Community Coupled Climate Model (Figure 7). At doubled preindustrial CO2, average temperatures across the US in the last decade of this Century would range from 1-2o to more than 5o (in Alaska) warmer than the present. These are large changes: and Alaska, for example, has already warmed by more than 2o."	Partially agree
Intro-3	16	1 to 7	Change to: 20th Century stabilization shows the results if greenhouse gas concentrations had been stabilized at the end of the 20th Century levels, as a benchmark for comparison. Scenario B1 represents concentrations stabilizing at 550 parts per million (ppm) (of CO2 equivalents) by the end of the 21st Century. Scenario A1B represents concentrations stabilizing at 700 ppm, or roughly doubled preindustrial CO2. Scenario A2, sometimes called a "business-as-usual" scenario represents concentrations continuing to increase beyond the 21st Century	Not applicable
Intro-4	16	18 to 19	Change to: "Results excerpted from a global simulation using NCAR's advanced model show the patterns and variability of simulated warming at the end of this century (Figure 7).", if appropriate	Not applicable
Intro-5	7-16	n/a	Writing in the intro is quite simplistic and below expectations for the level of this document. Example, line 4: "We can't predict what the future will bring."	Agree
Intro-6	7-16	n/a	the introduction has many grammatical errors that need fixing	Agree

Comment #	Page	Lines	Comment	Author Response
Land-1	184	n/a	The opening paragraph should also provide additional quantitative information (e.g., areal extents).	Done for forests in introduction. Will be done for Arid lands but not in time for public review.
Land-2	184	n/a	The Introduction to the section needs a more focused overview of the role of disturbance and ecosystem function, because this will be an important linkage for latter discussion on climate change and ecosystem response (coordinated with more general introductory material fo rSAP 4.3 overall).	Done.
Land-3	184	18-19	To eliminate value judgements, insert "viewed as" before "will be beneficial."	Done - only occurs once in document

Comment #	Page	Lines	Comment	Author Response
Land-4	184	n/a	The report should highlight that although these systems are relatively slow responding systems compared to agriculture, it is still important for management, operations and planning to consider the broader context of disturbance regimes when addressing sisues for a 20-30 year time frame. More specifically, the authors need to include a more explicit discussion of the historical range of variability and to highlight that the distribution will change in the context of climate change. This change will have explicit management consequences.	Done.
Land-5	184	n/a	The authors should explicitly recognize the geographically fixed and legislatively mandated constraints on federal and other land resource managers in adapting to climate change.	We are not sure as to what the reviewers are refering to.
Land-6	184	n/a	Highlight more clearly that loss of woody vegetation can occur rapidly through die-offs or fire but cannot recover quickly, especially in the context of the 20-30 year management time frames.	Included in the broader context added in response to Land-2
Land-7	184	8 to 19	Increase specificity of coverage and ownership information. How many acreas are in in forest and arid lands, east & west? What are the ownership patterns -- and thus the management options -- acrosss the country? Heavy Federalin interior west, NIPF in east, more mixed on along west coast	Done for forests in introduction. Will be done for Arid lands but not in time for public review.

Comment #	Page	Lines	Comment	Author Response
Land-8	184	8 to 19	I suggest including an ecosystem map of U.S. here -- I prefer Baileys, but many others would do. This helps to show the land cover distribution and presets the mind for the strong climate influence on ecosystems	To be determined during public comment. Current Maps outline areas and text provides a description of species. New forest map outlines species groups for forests. We think for many of the readers for which this is intended, the Bailey Ecoregions is not particularly straight-forward or 'mainstream' for arid lands. We think the Sonoran, Mojave, Chihuahuan, Great Basin, etc. designations that we use will be more palatable to most readers. Furthermore, many of the papers we cite use the traditional designations when referring to where the research was conducted. And, Bailey sub-divides arid lands in ways we don't really address or get into in the Arid Land section. So, to present his map would be confusing to many readers we think.
Land-9	184	18 & 19	Wherever value based judgments are used, I suggest inserting "viewed as" --- will be viewed as beneficial --- will be viewed as detrimental	Done - only occurs once in document
Land-10	184	10 to 14	This is a very good statement as to why imapcts on forests are important ---- but then you do not follow-up. Also pg 188 lines 1 to 8.	Effects on ecosystem services are covered in insect and storms sections, and we added a new section on 'How changes in one system affect other systems to discuss hydrology and biodiversity. We deleted page 188 lines 1-8, as our review is broader in scope than productivity, carbon storage, and species.

Comment #	Page	Lines	Comment	Author Response
Land-11	185	n/a	The forest section needs to be more geographically representative. It currently has a strong interior western bias. Specifically consider linkages with invasives beyond fire for other systems besides the forests of the interior west. Be careful with implying that invasives are only driven by a disturbance link and by fire in particular (p. 185, 1. 7).	Added my geographic references to effects of temperature, precipitation, and insects.
Land-12	187	5 to 6	Change to: the carbon released by fossil fuel combustion in the US and will continue to absorb future emmissions (Birdsey et al. 2006).	Sentence revomed in revision, so editorial change not deeded.
Land-13	187	na	should urban encroachment be addressed?	We did not cover land use change for forests, but did for arid lands. We did not include it for forests, because, while it is an important factor, it is difficult to explicitely link with climate.
Land-14	188	12 to 17	Change to: changes enough, species ranges will shift to areas with suitable environmental conditions and will go locally extinct wherever environmental conditions exceed physiological tolerance levels (Woodward 1987). One example of such a species shift is sugar maple in the northeastern U.S.—suitable climate for it may move northward into Canada and the distribution will likely follow (Chuine and Beaubien 2001) , assuming the species is able to disperse propagules rapidly enough to keep pace with the shifting climatic zone.	Done.

Comment #	Page	Lines	Comment	Author Response
Land-15	189	15-17	Here and throughout the report, the authors need to be more explicit about the linkage between statements of expected responses/impacts and whether or not they are considering the likelihood of additional disturbance impacts and/or threshold-like responses, building on recent findings by IPCC and others. Overall, this report makes good progress on including disturbances and responses, building on recent findings by IPCC and others. Overall, this report makes good progress on including disturbances and thresholds, but should go farther than previous reports in explicitly linking statements of expected responses/impacts to disturbances and thresholds.	In the Land Resources Chapter we are explicitly clear about whether we expect disturbances to increas and where. We do not have examples of thresholds for disturbances in forests in the literature. The Arid Lands section as several examples of disturbances causing thresholds--especially the cycle of warming -> more invasive grasses -> loss of native woody and other vegetation.
Land-16	189	19 to 23	Suggest you add a box somewhere in the report to better explain the relationship between weather and climate. For example, the probability of large fires increases when fuels are cured by drought and shorter term climate vairability but big fire events are driven by weather --- and big runs within big fires are mostly driven by wind. One of the big questions about climate change is how the distribution and magnitude of weather within a changed climate will be distributed. Late in the SAP Miller & Schlegel are referenced in regard to Santa Ana winds and fire --- that level of understanding of the climate-weather-disturbance panoply should be displayed in a box	Good idea for the introductory chapter.
Land-17	190	3 to 4	Change to: and 1998 (Hicke et al. 2002b) but the causes of this increase (increases in air and surface temperature, increasing CO2, N deposition, or other factors) are difficult to isolate	Done
Land-18	190	12 to 14	I do not follow the numbering sequence --- is everything that follows literature review?	Entire document has been reorganized and renumbered. There is no explicit 'Literature Review' section any more.
Land-19	191	2	Change to: in temperature is an approximate doubling of respiration with a 10 ºC air (or plant?)	Changed to 'plant temperature'
Land-20	191	8 to 10	No -- climate change will not be superimposed on present interannual temperture variations -- it is not that simple. Interannual variability contained within future climate regimes remains a key question. It is possible that there will be less variability embedded in a warming climate -or ther may be more	Changed dentence to 'It is important to remember that climate warming will be superimposed on interannual temperature variations that already exceed several degrees and may differ in the future.'

Comment #	Page	Lines	Comment	Author Response
Land-21	192	7	what does an "improvement in plant carbon balance" mean.	Changed to"increase in photosynthesis and tree growth"
Land-22	194	n/a	Integration is needed among related sections of the report both within the Land resources section and within the overall SAP 4.3. For example, discussion of semiarid woodland and forest die-off from drought and associated bark beetle infestation is included in sections under Land Resources, Forests (p. 194), Land resources, Arid (p. 243), Water resources (p. 322), and biodiversity (p. 332, 355), and is not included in the Agriculture, rangelands section.	From the viewpoint of Forests and arid lands, the Pinyon dieoff is related to both. Some consider woodlands to be forests and some consider them to be arid lands or the wetter end of arid lands.
Land-23	195	6 to 8	Change to: portions of the eastern US and likely decrease in portions of the western US. However, an increase in drought events will very likely reduce forest productivity wherever these events occur.	Done
Land-24	201	16	Good overall discussion on disturbance and linkage to effects of changes in physical climate and atmospheric chemistry.	Thank you!
Land-25	204	4 to 10	This (M&S 2006) is another example of the danger of too strict adherence to the "30 year" bound.	Our goal and task was to cover the next 30-50 years. We do mention predictions outside of this boundary when credible information is available. We do include Miller and Schlegel (2006) results for the latter part of this century in the sentences following the example mentioned.
Land-26	205	4 to 7	Change to: spruce beetle (*Dendroctonus rufipennis*) in southern Alaska and western Canada (Berg et al. 2006); and >1.2 Mha of pinyon pine (*Pinus edulis*) mortality from extreme drought coupled with an Ips beetle outbreak in the Southwest (Breshears et al. 2005). Ecologically important whitebark pine (*Pinus albicaulis*) is being attacked by mountain	Done.
Land-27	206	6 to 8	Change to: beetle (Logan and Powell 2001) and southern pine beetle (*Dendroctonus frontalis*) (Ungerer et al. 1999). Future range expansion of mountain pine beetle has the potential of invading jack pine (*Pinus banksiana*), a suitable host that extends across the boreal	Done.

Comment #	Page	Lines	Comment	Author Response
Land-28	206	17 to 18	But, it also makes leaves more palatable, doesn't it (less lignified)	Added reference and sentence
Land-29	209	12	Change to: on the grizzly bear (*Ursus arctos* horribilis) (Logan and Powell 2001)). Impacts are	Done.
Land-30	211	23	Change to: conterminous U.S. forests (Birdsey and Lewis 2002, Bragg et al. 2003). Recent analysis	Done.
Land-31	212	15.00	add Stanturf 2007 reference to this section	Done
Land-32	212	24	class 3 should be category 3	Changed.
Land-33	213	1 to 3	Change to: economic factors versus climate change. Try to include some estimate of dollar values of each as well (maybe that's what you mean by "importance"?) and then estimate change to each? I know, that's asking a lot….	We included a reference for timber volume damage in the storm section from which economic losses could be estimated. We added an estimate of economic loss from current disturbance. We could not estimate losses or gains from temperature and precipitation changes.
Land-34	213	22 and on	This needs to be done	We deleted the section on ecosystem services. Potential changes to ecosystem services are well covered in the text, and we do not have any quantitative estimates.
Land-35	214	1	The Land use change section of Land Resources (p. 214-215) should cross reference the related section in Agriculture (p. 94).	We will consider when we see the revised agriculture section.

Comment #	Page	Lines	Comment	Author Response
Land-36	214	20 to 23	This is kind of a weird way to way break things up. I can see the idea behind 2-4 as a means of measuring population and community-level responses to climate change. However, (1) is just one of the mechanisms underlying 2-4. For example direct physiological impacts of climate change, coupled with indirect effects on a species competitive abilities, drive (2); Number 3 is just a manifestation of number 1, etc. Adaptation is not a special response to climate change, it is a normal biological process. It certainly is an important aspect of climate change, but it is not a response. I would suggest saying that several factors need to be considered at several levels of biological organization, including both direct (physiological) and indirect (competition) effects of climate change. These impacts then translate into responses at the population and species level, and result in phonological responses and shifts in species range boundaries.	Changed paragraph
Land-37	215	4 to 6	This section is fairly choopy and needs some editorial work. Yeah, but only to a point, right? This isn't a monotonic response, I assume?	Changed paragraph

Comment #	Page	Lines	Comment	Author Response
Land-38	217	4	This section either needs to be significantly expanded or else eliminated. The key point should be that local **selection** can occur (and not necessarily introduction of new alleles by mutation) can occur which can alter physiological susceptibility to climate change- there are a number of good examples of this. In other words, physiological susceptibility to temperature, etc., is not geographically uniform, and you can't apply the same niche envelope parameters everywhere.	Deleted section
Land-39	217	17	Again, need to expand significantly	Perhaps will be done in the future, or deleted.
Land-40	217	8ff	This section needs re-writing for precision and clarification	Section seems very clear and concise to us.
Land-41	218	21 to 22	Change to: Maintaining continuity of remote sensing observations at appropriate temporal and spatial scales must be a high priority. NASA's Earth Science division cannot support continued	Done.
Land-42	219	21ff	Limit comments to what is needed, rather than how it should be done	Changed wording on the two bullets to describe what is needed, not what should be done.
Land-43	220	16-18	In describing the scientific undersatnding of current and past conditions, the authors should be careful in applying the Degree of LIkelihood scale, which in general should be reserved for predictive aspects of the assesment (here and elsewhere throughout the report).	Done
Land-44	220	14 and on	I strongly suggest that you do not use "very likely" or similar modifers when you are talking about the past or about how we scientifcally understand how the world functions --- except for extremely rare situations. Keep those modifiers for predicted futures	Done

Comment #	Page	Lines	Comment	Author Response
Land-45	230	6	The authors present a useful overview for considering the interacting factors that drive arid land dynamics. However, subsequent statements about the dominance of a given factor (e.g., p. 230, 1.12-15; p. 240, 1.21) seem confusing and potentially conflicting.	We are not sure how to handle this comment without more specific input. The text mentioned on p. 230 of the draft sent to expert reviewers is a very standard, introductory overview of deserts and interactions among temperature, precipitation and precipitation seasonality in the conceptual context of non-climatic factors that may modulate ecosystem response to climate (e.g. fire, CO2, N-deposition, erosion, invasive species). The text beginning on p. 240 subsequently elaborates these points in more detail. We will revisit these sections following receipt of public comments and look for opportunities to clarify or simplify wording.

Comment #	Page	Lines	Comment	Author Response
Land-46	231	n/a	Supporting arid lands examples are focused on Sonoral systems, perhaps due to the larger amount of literature on this desert, but authors should evaluate if additional examples from other deserts can be integrated into the text.	We acknowledge that with the exception of an invasive annual grass example there is a conspicuous shortage of Great Basin cold desert examples. This reflects a general lack of literature on climate change impacts meeting the criteria set forth for SAP 4.3, so there is not much we can do about it. We generally disagree with the comment that the Arid Land section is focused on the Sonoran Desert. Below we give an overview of the deserts from which points are made and examples are drawn; and feel that we have reasonably good coverage of US arid lands: p. 232 – Biogeograhic boundaries. Sonoran Desert – specific example P. 239 – Invasive grasses in Cold Deserts (Sonoran Desert is a Hot Desert) P. 242 – Invasive grasses in Mojave, Great Basin and Sonoran Deserts P. 244 – Drought impacts in Mojave and Sonoran Deserts P. 245- Plant functional group responses in Mojave and Sonoran Deserts P. 247 Charismatic Mega Flora – Sonoran and Mojave Desert P. 248-253. The 'Ecosystem Processes" section is built on citations from the Mojave,

Comment #	Page	Lines	Comment	Author Response
Land-47	231	1 to 2	But, some projections of climate change are an increase in extremes, including an increase in winter freezes??	This comment is in reference to a statement in the Introduction that was simply setting the stage for the more detailed information contained in subsequent sections. Thus, we don't want to get into too much detail at this point in the report re: annual vs. seasonal temperature changes, length of growing season, etc. We talk about extreme climatic events several other places in the Arid Lands section (see for example: p. 232 lines 30-36; p. 233, lines 1-7 and 24-30; p. 239 lines 4-5; p. 247 lines 14-17; page 258 lines 6-18) in the draft sent to expert reviewers.
Land-48	239	11 to 15	Change to: detail. Section 2.2.2 will discuss climate and climate change effects on species distributions and community dynamics and Section 2.2.3 will review the consequences for ecosystem processes. Section 2.2.4 will focus on climate change implications for structure and function of riparian and aquatic ecosystems in arid lands. Implications for wind and water erosion will be reviewed in 2.2.5.	the section numbering will be updated on the next draft after the "Arid Lands" portion is integrated with the "Forests" portion of the "Land Resources" chapter.
Land-49	244	23	Increase clarity on C3 and C4 dichotomies within the Arid Lands section and contrast with related discussion under Agriculture (p. 62, 1.17)	This will be attempted subsequent to receipt of Public Review comments.
Land-50	249	n/a	Arid lands C sequestration conclusion needs more integration with the literature.	We purposely cited few papers in the Findings and Conclusions section. This is because our aim here was to distill what has been elaborated in more detail with supporting references in the main body of the report.

Comment #	Page	Lines	Comment	Author Response
Land-51	263	n/a	Note the importance of long-term repeat photography as an additional monitoring resource	The importance or repeat photography is mentioned in the first paragraph of the “Needs’ section that follows the ‘Monitoring’ section. Additional text has now been developed for the monitoring section.

Comment #	Page	Lines	Comment	Author Response
				Done
Land-52	264	13	The authors should highlight the need for soil moisture as a key monitoring metric and cross reference related text in the Water Reources section (p. 327).	
Land-53	391	3	Change to: Network, and continuous and broad-scale remote sensing	Done

Comment #	Page	Lines	Comment	Author Response
Land-54	190 to 220		This section is quite excellent and complete. I do see the work of Neilson and his colleagues missing and a recent paper by Stanturf: - Stanturf, J.A. et al., Disturbance and coastal forests: A strategic approach to forest management in hurricane impact zones, Forest Ecol. Manage. (2007), doi:10.1016/j.foreco.2007.03.015 - Cary, G.J., R.E. Keane, R.H. Gardner, S. Lavorel, M.D. Flannigan, I.D. Davies, C. Li, J.M. Lenihan, T.S. Rupp, F. Mouillot. 2006. Comparison of the sensitivity of landscape-fire-succession models to variation in terrain, fuel pattern, climate and weather. Landscape Ecology 21:121-137 - Bachelet D., J.M. Lenihan, R. P. Neilson, R.J. Drapek, and T. Kittel. 2005. Simulating the response of natural ecosystems and their fire regimes to climatic variability in Alaska. Canadian Journal of Forest Research 35:2073-2293 - Calkin, D.E., K.M. Gebert, J.G. Jones, and R.P. Neilson. 2005 Forest Service large fire area burned and suppression expenditure trends, 1970 - 2002. Journal of Forestry 103(4): 179-183. - Neilson, R.P., L.F. Pitelka, A.M. Solomon, R. Nathan, G.F. Midgley, J - Marland, G., Pielke, R.A., Apps, M., Avissar,R., Betts, R.A., Davis,K.J	Added New section: 5.8 5.8 Changes in Overstory Species Composition Added Stanturf citation to Hurricane section (see comment under Land-4 and Land-31). Added Calkin ref to the fire section.
Water-1	272		No mention of the Great Lakes? Major oversight. Small lakes and marshes?	Agree
Water-2	289	20ff	Work has been done on the Mississippi basin. References sent by separate message	Agree
Water-3	316	na	Water quality section is focused only on temp. Work has been done on nutrient/sediment loading under climate change. Refs sent separately	Agree

Comment #	Page	Lines	Comment	Author Response
Water-4	321	1,2	not consistent with arid lands section.	this comment refers to reported increases in the number of frost-free days since 1948 in the Water Resources chapter. In the Arid Lands section of the Land Resources chapter, we make no explicit statements regarding length of the frost-free season *per se*. However, we do refer to studies that explore the implications of a lengthening of the frost-free season (e.g., Weiss & Overpeck 2005 and associated text in the 'Bio-Climatic Setting' section and 'Charismatic Mega Flora' section). Thus, we see no inconsistencies with the Water Resources chapter on this point. However, we have added some new text; and have modified the wording of an existing sentence make the connection between the two chapters more direct on this point.
Water-5	321	10	This section is covered elsewhere	That report is not yet available
Water-6	322	4	ditto	This topic wanders too far from the charge. If this were a chapter on the global water cycle, the authors would agree. The authors believe that this topic would be more appropriate elsewhere in this SAP activity, but not in this report specifically.
Water-7	n/a	n/a	Each of the sections may benefit from adding some more references. The recent chapter on water prepared for IPCC, may be a good source.	Agree

Comment #	Page	Lines	Comment	Author Response
Water-8	n/a	n/a	The coverage of the evaporation section is limited to the terrestrial aspect. However, oceanic evaporation (which accounts for over 75% of total global evaporation) plays a critical role in the dynamics of terrestrial water balance and water resources in general. Examples are many such as the winter precipitation in Western US responsible for much of the snow pack etc. The report should cite some of the recent studies such as the work of ***L. Yu and R. A. Weller, 2006, In BAMS***. Other references that may be considered are: ***A. Ohmura and M. Wild, Science, Nov. 15, 2002; Peterson et al., Science 1995; Also Trenberth has a few on this topic.***	Agree
Water-9	n/a	n/a	The section on drought may benefit from a more comprehensive coverage. In fact, drought is one topic that cuts across almost all of the chapters of 4.3. Some specific areas to consider are: - The work of University of Nebraska and reference to drought monitor - The recent drought studies based on the instrumental records of the past century, in the context of proxy record studies (Tree rings and stable isotope). Overpeck should be a good source for providing some references as well as the Tree Ring center at Univ. of Arizona. - Some coverage of the literature on the economic impacts of recent droughts maybe useful to include.	Agree
Water-10	n/a	n/a	Another cross cutting topic relates to the impact of changing vegetation cover on the hydrology. Some of the work sponsored by SAHRA STC at the Univ. of Arizona, especially by Eric Small (formerly at NM Tech and now at Univ of Colorado) and the work of USDA ARS in Tucson (Dave Goodrich is a good contact to identify some references) is useful to reference.	Agree

Comment #	Page	Lines	Comment	Author Response
Water-11	n/a	n/a	The coverage of the water quality sub-section can benefit from the broadening of its scope. In specific and especially relevant to the corn-belt region is the impact of hydrologic variability on water quality (surface and subsurface). Gene had some suggestions for additional references, which have looked at the impact of non-point source impact of Nitrogen and Phosphorus (essentially from fertilizer and feedlots) on water quality.	Agree
Water-12	n/a	n/a	Even though the chapter presents a few of the recent literature about the inadequacy of the stationarity assumption in hydrology, adding some more references may not hurt. In specific, the NRC GCIP report prepared by the GEWEX panel in mid 90s, discusses the issue of the non-stationarity of the hydrologic processes and calls for need for research to address the issue.	This is a bit too out of date, given focus of this report on implications of AR4 scenarios.
Water-13	n/a	n/a	The work of Pagano etal (**Evaluation of official western US seasonal water supply outlooks, 1922-2002 in Journal of Hydrometeorology)** may be useful to build the foundation for a discussion on uncertainties due to lack of sufficient observation and hence the importance of the investment in long term observations.	The reviewer refers to SAP 5.3, Decision support experiments and evaluations using seasonal to interannual forecasts and observational data, with regard to water resources in particular. The reviewer and SAP 4.3 report management have reviewed the available draft, and found that no significant or contradictory overlaps exist.
Water-14	n/a	n/a	The special issue of Water Resources Bulleting in mid 90's on the topic of climate and water may be another useful source to reference.	This is a bit too out of date, given focus of this report on implications of AR4 scenarios.
Water-15	n/a	n/a	The committee is aware of at least anther chapter on water by the NOAA CCSP effort.	Agree. Water is also being coverdin a SAP sponsored by EPA
Water-16	n/a	n/a	Some of the above issues may have already been covered there and no need to duplicate. Coordination may be necessary.	Partially Agree

Changes to Draft
Chapter has been reorganized to include sections on observed changes and responses, extreme events, etc.
This explanitory text has been added to the chapter: "In these analyses a 0.8 ºC temperature increase was assumed to be consistent with projections for the US for the next 30 years as reported in Intergovernmental Panel on Climate Change (IPCC) 2001. There is certainty in this degree of change over the next 30 years, although, regional differences will vary. This value represents one of several potential scenarios for temperature change and characterizes the mid-range of the values. If the temperature increases are less than this value some of the effects will not be realized within the next decades; however, if this value is conservative then the impacts on agriculture will be hastened. "
The verbage was deleted during editing.

Changes to Draft
The passage now reads as follows: "Because of this diversity, changes in climate will likely impact agriculture in many regions of the US. Agriculture within the US is complex: many crops are grown in different climates and soils, and different livestock types are produced in numerous ways."
This explanitory text has been added: "In these analyses a 0.8 ºC temperature increase was assumed to be consistent with projections for the US for the next 30 years as reported in Intergovernmental Panel on Climate Change (IPCC) 2001. There is certainty in this degree of change over the next 30 years, although, regional differences will vary. This value represents one of several potential scenarios for temperature change and characterizes the mid-range of the values. If the temperature increases are less than this value some of the effects will not be realized within the next decades; however, if this value is conservative then the impacts on agriculture will be hastened. "
Language is modified as follows: "As temperature rises, crops will increasingly begin to experience upper failure point temperatures, "
Changed to: "Water availability exerts primary control on productivity and plant species composition of rangelands, each of the global changes, CO2 enrichment, altered precipitation regimes, and higher temperatures affect plant productivity and species composition by altering the water balance."

Changes to Draft
No change.
Changed to: "Roughly, for every 4 mm increase in annual precipitation, the models predict a 1 percent increase in dryland alfalfa yields."
Changed to: "Across the entire United States, percent increase in days to market for swine and beef, and the percent decrease in dairy milk production for the 2040 scenario averaged 1.2 percent, 2.0 percent, and 2.2 percent, respectively, using the CGC model, and 0.9 percent, 0.7 percent, and 2.1 percent, respectively, using the Hadley model."
This section is deleted
This section is deleted
This section is deleted
This section is deleted
This section is deleted

Changes to Draft
Changed to: "Agriculture within the United States is varied and produces a large value ($200 billion in 2002) of production across a wide range of plant and animal production systems. Because of this diversity, changes in climate will likely impact agriculture in many U.S. regions. U.S. agriculture is complex: many crops are grown in different climates and soils, and different livestock types are produced in numerous ways. There are 116 different plant commodity groups listed by the United States Department of Agriculture (USDA) National Agricultural Statistics Service, and four different livestock groupings (i.e., dairy, poultry,specialty livestock, and livestock that contain a variety of different animal types or products derived from animal production, e.g., cheese or eggs). The extensive and intensive nature of U.S. agriculture is best represented in the context of the value of the production of crops and livestock."
Changed as described in Ag-17.
Changed to: "However, orchards are distributed in the Northeast U.S. and intensive areas along the Great Lakes to take advantage of the moderating effect of the lakes. The local microclimate, induced by the regional climate, creates areas in which orchards that have specific requirements for winter chilling create opportunities for these crops as part of the production system."
This section has been deleted.

Changes to Draft
This section has been largely deleted, although in the conclusions, the thought is now summed up in this way: "In regions where vegetation changes are especially counter productive to domestic livestock agriculture, shifts in enterprises will occur. Shifts between rangeland and more intensive agriculture may also occur,"
The discussion has been modified as described in Comment Ag-2. Added more detail to explain that 0.8 is the midpoint and how biological responses to changes would be slowed or hastened by conditions below or above this value.
No change.
Changed to: "Progression of a crop through its life cycle (phenological) phases is accelerated by increasing temperature up to the species dependent optimum temperature beyond which development rate slows"
Changed as noted.
No change.

Changes to Draft
Changed to: "Lobell and Asner (2003) evaluated maize and soybean production relative to climatic variation in the United States, reporting a 17 percent reduction in yield for every 1ºC rise in temperature because of the confounding effect with other yield-limiting factors."
No change.
Changed to: "Baker et al. (1995) summarized many of their experiments from sunlit controlled-environment chambers and concluded the optimum mean temperature for grain formation and grain yield of rice is 25ºC and grain yield is reduced about 10 percent per 1ºC temperature increase above 25ºC until reaching zero yield at 35-36ºC mean temperature, using a 7ºC day/night temperature differential (Baker and Allen, 1993a; Peng et al. 2004)."
Changed to: "Pollen viability and 37 production begins to decline..."
Sentence deleted.
Changed to: "(Craufurd et al., 2003). As air temperature in the southern United States already averages 26.7ºC during the peanut growing season, any temperature increase will reduce seed yields (4.1 percent per 1ºC, or 3.3 percent for a 0.8ºC rise in range of 26-27ºC) using the relationship of Prasad et al. (2003)."
Changed as the reviewer suggested.
Changed as the reviewer suggested.
Changed as the reviewer suggested.
No change.

Changes to Draft
Changed as the reviewer suggested.
Changed as the reviewer suggested.
Changed as the reviewer suggested.
Changed as the reviewer suggested.
Changed to "Ziska and Bunce (1997) reported 2.9 percent biomass increase to CO2 increase from…"
Changed to: "and the small increment of CO2 causes concern about whether these experimental measurements…"
Language has been changed throughout. The reviewer gives no specific sentence, but "4.4 percent increase to doubling or more of CO2." and other similar expressions should meet the request.
Changed to: "In fact, some of the increased yield of crops like soybean currently attributed to technological innovation over the past four to five decades is in fact attributable to the rise in CO2."
No change.
Addition of Section 2.4.2, Plant Response to Temperature. Phrase changed to remove reference.
No change.
Changed to oC
No change.

Changes to Draft
Changed to: "about 0.3 and 0.4 percent per percent change"
Changed to: "Stomatal conductance and leaf area have the same relative effect on ET, increasing ET by 18 0.09 and 0.16 percent for a clear summer day and whole year, respectively."
Changed to "Given the variation in the 3 sizes and baseline irrigation requirements of the basins,"
No change.
Changed to "The slope in Bernacchi Figure 2.4 (p. 4?) shows a 12 percent reduction"
Changed to "Allen et al. (2003) reported that soybean foliage 6 at doubled CO2 averaged 1.3ºC warmer at mid-day."
No change.

Changes to Draft
Added reference: Coakley, S.M., H. Scherm, and S. Chakraborty, 1999: Climate change and plant disease management. Annu Rev Phytopath, 37, 399-426.
No change.
An attempt has been made to make the language consistent throughout.
No change.
The reference has been deleted from this section, but added to sectin 2.7.3-Monitoring Relevant to Rangelands
The report has been and continues to be copy edited for consistent voice.
The discussion of IPM is now contained in 2.7.1.3.
Uncertainty statements have been incorporated into text.
No change.
Changed to "constrained by the -20ºC minimum"
Changed as suggested by reviewer.
No change.
Changed as suggested by reviewer.
Changed as suggested by reviewer and responded to in the comments listed.

Changes to Draft
Section deleted.
Section deleted.
Changed as suggested by reviewer.
An expanded discussion may be found in the revised report under section 2.6.2 "Projections for Weeds."
Changed to "Examples of C3 species grown in the United States exhibiting increased photosynthetic rates under elevated CO2 include Italian ryegrass, orchardgrass, rhizoma peanut, tall fescue, and timothy (Greer et al. 1995; Newman et al. 2001; Wilsey 2001)."
No change.
Information is in the introductory section of the report, but is lengthy and not repeated here.
Discussion of CO2 enrichment may be found in 2.4.4 and 2.4.5.
This section was edited to replace “warming” with more explicit verbiage about changes in ambient air, soil and plant temperatures.
Suggested change made to specify plant temperatures.
Changed as suggested by the reviewer.
The chapter has been wholly restructured. The information has been rewritten, and is now contained in sections 2.4.7 and 2.4.8.

Changes to Draft
No change.
Passage has been completed and will be reworked in copy editing phase to be performed in parallel with public comment period.
No change.
The chapter has been wholly restructured.
Changed to "While most information on these events comes either from short-term (last five years at most) manipulative experiments, modeling exercises, or long-term observations of rangeland vegetation changes (taken during the past 100+ years), the certainty of recent climate and CO2 predictions by the 2007 IPCC, along with an increasingly complete understanding of ecosystem responses to climate change provide a stable background upon which to forecast anticipated changes in U.S. rangelands for the next 30 to 50 years."

Changes to Draft
The section (2.9.5) has been rewritten. The sentence is retained but should be more precise in its meaning in this context.
No change.
Revised (2.7.3).
No change.
No change.
No change.
No change.
Added the assumptions on warming
Changed as suggested by the reviewer.
This section has been deleted.
Section has been rewritten.
The figure has been eliminated from the revised draft.

Changes to Draft
No change.
Section 2.6.4.
This section has been deleted.
No change.
Changed to "Crop water use (requirement) will increase 1.2 percent from a 0.8ºC temperature rise, and reduced 1.4 to 2.1 percent by the rise in CO2 from 380 to 440 ppm, giving a net…"
No change.
This section has been deleted.
No change.
No change.

Changes to Draft
The possibility for modification of these effects through adaptive practices are in specific sections, e.g., "Chronic challenges may require more fundamental responses, such as genetic adaptation and/or alteration."
This is now Table 2.7.
The report has been rewritten with the reviewer's concerns in mind.
Where possible, the discussion has been consolidated (e.g., Table 2.1)
Text added.
No change.
Added: "Animal production systems cover beef, dairy, swine, and poultry as the primary classes of animals. While climate changes affects all of these animals, the literature available predominantly addresses beef, dairy, and swine."
No change.

Changes to Draft
No change.
The chapter has been substantially rewritten to reduce redundancy.
This section has been deleted.
This section has been deleted.
Changed as suggested by the reviewer.
No change.
This section has been deleted.
The distinctive features of each system are now discussed in sections 2.4.7 and 2.4.8.
No change.

Changes to Draft
No change.
The chapter has been substantially rewritten to increase cohesion and improve the presentation of summary points.
Change made as suggested by reviewer.
Change made as suggested by reviewer.
This section has been deleted.
Changed to "$200 billion"
No change.
Changed to: "Agriculture within the United States is varied and produces a large value ($200 billion in 2002) of production across a wide range of plant and animal production systems. Because of this diversity, changes in climate will likely impact agriculture in many U.S. regions."
This sentence has been deleted.
Changed to: "As temperature rises and weather variability and drought periods increase, crops will be more frequently exposed to daily maximum temperatures above 33ºC, a point at which pollination and grain-set processes in most crops began to fail, and quality of horticultural crops can be negatively affected. Grain yield is reduced as a result of decreased grain-set, and shortened duration of grain fill. Regional climate variability will augment variation in crop production between regions during the growing season."

Changes to Draft
No change.
This section has been deleted.
This discussion has been significantly altered.
Changed to "$200 billion"
Changed to: "Distribution of beef cows across the United States is indicative of a livestock commodity produced across a range of climates (Figure 2.4)."
Changed to "Market value of agricultural production within the United States represents a combination of all crops and their distribution (Figure 2.1)."
Changed to "$200 billion"
Changed as suggested by the reviewer.
Changed as suggested by the reviewer.
Copy editing.
Changed to: "The latent energy associated with ET from soybean is 10 to 60 W/m2 less in the FACE plots compared to the control plots at ambient CO2 when the crop had ample water (Figure 2.9 adapted from Bernacchi et al. 2007)."
Changed as suggested by the reviewer.
Changed as suggested by the reviewer.
Copy editing.
Copy editing.
Changed to "The slope in Bernacchi Figure 2.4 (p. 4?) shows a 12 percent reduction over three years. Allen et al. (2003) observed 9 percent reduction in ET..."
Changed to "However, the projected 0.8ºC would increase ET by 1.2 percent, thereby partially negating this water-savings effect of CO2."

Changes to Draft
Changed as suggested by the reviewer.
Changed as suggested by reviewer.
No change.
This statement has been deleted.
Changed to: "...are unlikely to respond strongly...."
Changed to "Another aspect that emerges from this review is the need for comprehensive studies of the impacts of climate change on the pasture ecosystem including grazing regimes, mutualistic relationships (e.g., plant roots-nematodes; N-fixing organisms), as well as C, nutrient and water balances."
This section has been deleted.
Changed as the reviewer suggested.
Units have been made consistent.
Added a note that this is the plural of turf
Section is deleted
Changed to "Recently, scientists have been examining the potential for improved profitability and improved sustainability with a conversion to integrated crop-livestock farming systems (Russelle et al. 2007)."
Changed to "Warmer temperatures likely will lengthen growing seasons and affect development rates of individual species, but effects of warming will vary among species."
No change.
Copy editing.
Copy editing.

Changes to Draft
Owensby 1999 citation has been added.
No change.
Figure 2.11 in the public comment draft.
Changed as suggested by reviewer.
No change.
See response to Ag-169.
Changed to "climate change and CO2 enrichment"
Clause on economics deleted.
Changed as suggested by reviewer.
Changed as suggested by reviewer.
y
This section has been deleted.

Changes to Draft
This section has been deleted.
No change.
The discussion has been reduced essentially to this statement, "This resilience will become increasingly important as a component of farm adaptation to climate change." and the contents of Table 2.15.
No change.

Changes to Draft
No change.
No change.
See report introduction

Changes to Draft
This is now clairified in the synthesis portion of the chapter
No change.
No change.

Changes to Draft
No change.
We have reconstructed the document to focus on the responses and have removed any references to economics other than the overall value of US agriculture.
Change made as suggested by reviewer.
No change.
Change made as suggested by reviewer.
No change.

Changes to Draft
We have made the change suggested by the reviewer and explained that, in some cases, we have used analyses of biodiversity impacts in other regions because equivalent analyses have not been done within the US.
change made
sentence revised to be clearer
done
done
done
sentenced revised
deleted
change made
deleted
clarified sentence
Change made as suggested by reviewer.
Change made as suggested by reviewer.
change made
change made
change made

Changes to Draft
deleted
change made
change made
change made
change made
change made
clarified
change made
that discussion is in introduction and context
change made
rewritten
clarified
clarified
clarified
rewritten
rewritten
Change made as suggested by reviewer.

Changes to Draft
Now more fully explained and refernced in chapter
change made
change made
change made
rewritten
change made
rewritten for clarity
No change.
change made
change made
change made
rewritten
No change in this chapter.
editorial changes for repetitiveness

Changes to Draft
rewritten
rewritten for clarity
rewritten for clarity
change made
change made
change made
This section is now totally revamped in response to all reviewers comments, and we have less space on the Northern California Current. This is an important phenomenon, but there is not sufficient space to discuss it.
change made
change made
Section has been rewritten
No change.
No change.

Changes to Draft
In process, may not be completed for public comment draft but will be done for final.
No specific change, although the chapter has been significantly rewritten and structured.
No change.
We have applied a common lexicon, explained in the exec summary and introduction, to explain authors confidence in major findings. However, this has not been used in all cases because much of the underlying literuature does not quantify uncertainties. We have also tried to better explain and identify uncertainties thorughout.
Section rewritten, also treated in monitoring discussion in exec summary and synthesis chapters
No change.
No change.
No change.
No change.

Changes to Draft
now included
No change.
Entire chapter extensively re-written
We have tried to explain multiple sources of uncertainty, including emissions uncertainty, observationa uncertainty, lack of key observations, and gaps in uderstanding
Too numerous to document individually, please see revised draft.
Executive summary was drafted and reworked several times, and new "synthesis" and "climate and ecological context" chapter were added. Synthesis chapter inlcudes findings and conclusions from more detailed sectoral chapters.
The CCSP lexicon for confidence in findings was applied to the findings and conclusions. A table illustrating the lexicon is included. However, the fact that the report is based on the peer-reviewed literature which does not always include quantification of uncertainty, there are instances where results that do not explicitly identify and quantify uncertainty are described.

Changes to Draft
Many modifications have been made to the discussions of disturbances. We have tried to evaluate the possibility of threshold responses whre we felt that they were well-documented in the literature.
We have tried to provide integrated discussion of some of these issues in the executive summary, synthesis (both new) and the revised introductory sections. However, some issues are still discussed in multiple chapters, where we have tried to ensure that discussion is consistent.
Executive Summary has been reworked, along with a synthesis chapter, and the introduction was reworked as a climate and ecological context section. We plan to publish these as separate, shorter document.
Entire report has been reorganized. Executive summary was drafted and reworked several times, and new "synthesis" and "climate and ecological context" chapter were added. Synthesis chapter includes overarching conclusions and answers to CCSP questions based on the more detailed sectoral chapters.
Language about the scope and guiding questions has been included in the new Executive Summary and Introduction chapters

Changes to Draft
A new climate and ecological context section was added to provide the consolidated overview suggested by the reviewer. The entire document has been re-written and edited to reduce redundancy. In additon the document will undergo additional copy editing before publication.
Topics were chosen by the CCSP agencies. We have tried to explain why these topics are important, and have included the entire prospectus from the CCSP agencies as an appendix.
These issue are discussed in parts of the biodiversity chapter. They could easily be the subject of another SAP.
We have reorganized the report. But organization and contents are somewhat constrained by the prospectus agreed by the CCSP agencies.
A new climate and ecological context section was added to provide the consolidated overview suggested by the reviewer. The entire document has been re-written and edited to reduce redundancy. In additon the document will undergo addtinoal copy editing before publication.

Changes to Draft
We have tried to increases the emphasis on recent results and advances in understanding.
We have tried to better integrate and connect the discussion of these systems. These topics were chosen for us by the CCSP agencies.
Discussion of drought has been significantly expandedin water and othe chapters. We note that the relation of climate change and drought is complex and that many aspects of this remain unexplained.
vegetation cover-hydrology interactions are discussed in water and land resources chapters.

Changes to Draft
The authors believe these topics shoud be addressed both within each chapter and in the introductory sections. The new executive summary that has been added to the report contains synthesis and overarching conclusions sections that include discussion of cross-cutting issues.
Changes too numerous to document individually, please see draft.
Exective summary has been added that includes summary of findings and conclusions, and synthesis. Authors decided to retain much technical discussion in "sector" chapters.
Entire section extensively re-written. Figure referenced by reviewer is no longer included.
Entire section was re-written and expanded. Sentnce now reads ""The US has warmed up significantly, but change varies by region."

Changes to Draft
Entire section has been significantlty re-written. The figure 6 referenced by the reviewer is not longer included. The sentence describing CCSM projections for the US now reads "Below, Figure 8 shows the results of an NCAR CCSM simulatin for IPCC scenario A1B, generally consdiered a mid-range projection. The expected increases in average U.S. temperatures vary from 1-2o C to more than 4o C -- and remember that Alaska, for example, has already warmed by more than 2oC."
Entire section has been re-written. Discussion and description of variation across IPCC scenarios has been removed, since this report is not a scenario-driven analysis, but rather a description of perr-reviwed results which have made use of numerous scenarios.
Entire section re-written. The figure referenced by the reviewer is no longer included.
Entire section has been re-written and will benefit from additional editing as the document goes through the next two stages of review
Enttire section has been re-written.

Changes to Draft
Added: "Forested land occupies about 740 million acres, or about one-third of the US. Forests in the Eastern US cover 380 million acres, with 74% in broadleaf forests, with most of the land in private ownership (83%). The 360 million acres of forest lands in the Western US are mostly conifer forests (78%), and split between public (57%) and private ownership (Source for forest statistics is http://nationalatlas.gov/articles/biology/a_forest.html)."
Added: "Disturbance (such as drought, storms, insect outbreaks, and fire) is part of the ecological history of most ecosystems, and influences ecological communities and landscapes. Climate affects the timing, magnitude, and frequency of many of these disturbances, and a changing climate will bring changes in disturbances to forests and arid lands (Dale et al. 2001). Trees and arid land vegetation can take from decades to centuries to re-establish after a disturbance. Therefore, changes in disturbance regimes caused by climate-change can affect land resources (Dale et al. 2001). Both human-induced and natural disturbances shape ecosystems by influencing species composition, structure, and function (such as productivity, water yield, erosion, carbon storage, and susceptibility to future disturbance). H17 In the past several years, scientists have learned that the magnitude and impact of these disturbances and their response to climate rivals that expected from changes in temperature and precipitation (Dale et al. 2001).
Changed wording to "be viewed as"

Changes to Draft
Added: "Disturbances and changes to the frequency or type of disturbance present challenges to resource managers. Many disturbances command quick action, public attention, and resources. Surprisingly, most resource planning in the US does not consider disturbance, even though disturbances are common, and preliminary information exists on the frequency and areal extent of disturbances (Dale et al. 2001). Disturbances in the future may be larger and more common than those experienced historically, and planning for disturbances should be encouraged (Dale et al. 2001, Stanturf et al. 2007)."
No change.
No change.
Added: "Forested land occupies about 740 million acres, or about one-third of the US. Forests in the Eastern US cover 380 million acres, with 74% in broadleaf forests, with most of the land in private ownership (83%). The 360 million acres of forest lands in the Western US are mostly conifer forests (78%), and split between public (57%) and private ownership (Source for forest statistics is http://nationalatlas.gov/articles/biology/a_forest.html)."

Changes to Draft
No change.
Changed wording to "be viewed as"
Deleted planned ecoststem services table. Added section 7 "7 How Changes in One System Affect Other Systems – Forests"

Changes to Draft
Insects: " and millions of ha affected by southern pine beetle (Dendroctonus frontalis), spruce budworm Choristoneura fumiferana), and western spruce budworm (Choristoneura occidentalis) in recent decades in southeastern, northeastern, and western forests, respectively (USDA Forest Service 2005)." Temperature and preciptation: "If existing trends in precipitation continue, forest productivity will likely decrease in the Interior West, the Southwest, eastern portions of the Southeast, and Alaska. Forest productivity will likely increase in the Northeastern US, the Lake States, and in western portions of the Southeast. "
Sentence deleted.
No change.
Accepted editorial suggestion.

Changes to Draft
No change.
No change.
Accepted editorial suggestion.
Completely reorganized chapter based on mandate from lead authors. Section headings are completely different.
Changed to 'plant temperature'
Changed dentence to 'It is important to remember that climate warming will be superimposed on interannual temperature variations that already exceed several degrees and may differ in the future.'

Changes to Draft
Changed to"increase in photosynthesis and tree growth"
No change.
Accepted editorial suggestion.
No change.
No change.
Accepted editorial suggestion.
Accepted editorial suggestion.

Changes to Draft
Added: "Drought stress, resulting from decreased precipitation and/or warming, reduces the ability of a tree to mount a defense against insect attack (Carroll et al. 2004, Breshears et al. 2005), though this stress may also cause some host species to become more palatable to some types of insects (Koricheva et al. 1998). "
Accepted editorial suggestion.
Accepted editorial suggestion.
Added: "For example, hurricanes Rita and Katrina together damaged a total of 2200 ha and 63 million m3 of timber volume (Stanturf et al. 2007)." and "Disturbances in the future may be larger and more common than those experienced historically, and planning for disturbances should be encouraged (Dale et al. 2001, Stanturf et al. 2007)."
Changed to category 3
Added: "In forests, more than 55 million acres are currently impacted by disturbance, with the largest being insects and pathogens (Dale et al. 2001). These disturbances cause an estimated economic loss of 3.7 billion dollars (Dale et al. 2001). "
Deleted planned ecoststem services table. Added section 7 "7 How Changes in One System Affect Other Systems – Forests"
Future action.

Changes to Draft
Changed paragraph to: "The species that comprise communities respond both physiologically and competitively to climate change. One scheme for assessing the impacts of climate change on species and communities is to assess the effects on (1) the physiology of photosynthesis, respiration, and growth; (2) species distributions; and (3) phenology, particularly life cycle events such as timing of leaf opening. There may also be effects on functions of ecosystems such as hydrologic processes."
Changed paragraph to "Net primary productivity (NPP) is closely related to indices of “greenness” and can be detected by satellite over large regions (Hicke et al. 2002b). Net ecosystem productivity (NEP) can be measured on the ground as changes in carbon stocks in vegetation and soil (Boisvenue and Running 2006). Root respiration and turnover are sensitive to climate variability and may be good indicators of climate change if measured over long enough time periods (Atkin et al. 2000, Gill and Jackson 2000). Gradient studies show variable responses of growth to precipitation changes along elevational gradients (Fagre et al. 2003). Climate effects on growth patterns of individual trees is confounded by other factors such increasing CO2 and N deposition, so response of tree growth is difficult to interpret without good knowledge of the exposure to many possible causal variables. For example, interannual variability in NPP, which can mask long-term trends, can be summarized from long-term ecosystem studies and seems to be related to interactions between precipitation gradients and growth potential of vegetation

Changes to Draft
Deleted section.
No change.
No change.
Accepted editorial suggestion.
Changed sentences to" "o A national climate observation system should be able to identify early indicators of climate effects on ecosystem processes and observations of structural and species changes. o Large scale experimental manipulations of climate, CO2 and N have supplied the most useful information on separating the effects of climate from site and other effects. Experimental manipulations of precipitation and water availability are rare, but supply critical information on long-term responses of different species."
Removed 'liklihood language' from statements about ecological knowledge and reserved it for predictions of the future.
Removed 'liklihood language' from statements about ecological knowledge and reserved it for predictions of the future.

Changes to Draft
none at this point.

Changes to Draft
none at this point.

Changes to Draft
none at this point.
see last paragraph of the ‘Systems Perspective’ section of the Arid Lands report.for nue section numbering
none at this point.
we have added the following text and supporting citations to “Ecosystem Processes” section of the “Findings and Conclusions – Arid Lands” section in the in the new draft: "Arid soils contain relatively little soil organic matter and collectively make only a small contribution to the global pool of carbon in soils (Schlesinger 1977, Jobbagy and Jackson 2002)."

Changes to Draft

The following text has been added to section “Indicators and Observing Systems – Arid Lands” (last entry in that section in the Revised manuscript): Repeat Photography

Repeat photography is a valuable tool for documenting changes in vegetation and erosion. Hart and Laycock (1996) present a bibliography listing 175 publications using repeat photography and information on the ecosystems photographed, where they are located, number of photographs, and dates when the photographs were taken. More recent publications have added to this list (e.g., Webb 1996, McClaran 2003, Webb et al. 2007) and Hall (2002) has published a handbook of procedures. Time-series aerial photographs dating back to the 1930s and 1940s are also a useful source for quantifying landscape-scale changes in land cover (e.g., Archer 1996, Asner 2003). These early aerial photographs, often commissioned by federal and state agencies, are a valuable source of synoptic, spatially explicit depictions of vegetation cover

Changes to Draft
The following text has been added to the “Needs” section of the revised manuscript (after paragraph 1): Soil moisture is a key indicator and integrator of ecological and hydrological processes. However, as noted in the Water Resources Chapter (Chapter 4, this volume), there is a dearth of information on the long-term patterns and trends in this important variable. Even on well-instrumented watersheds in arid lands (e.g., Lane and Kidwell 2003, NWRC 2007, SWRC 2007) soil moisture records are only erratically collected over time and are limited in their spatial coverage and depth. Thus, there is a pressing need for a distributed network of soil moisture sensors in arid lands. Ideally, such a network would also include collection of plant, soil and precipitation samples for determination of the stable isotope composition of C, O and H. Such isotope data would provide important clues regarding when and where plants were obtaining soil moisture and how primary production and water use efficiency are being affected by environmental conditions (e.g., Boutton et al. 1999, Roden et al. 2000, Williams and Ehleringer 2000)
Accepted editorial suggestion.

Changes to Draft
Added new section:5.8 Changes in Overstory Species Composition Several approaches can predict changes in biomes (major vegetation assemblages such as conifer forests, and savanna/woodland) and changes in species composition or overstory species communities (Hansen et al. 2001a). These approaches use either rules that define the water balance, temperature, seasonality, etc. required for a particular biome, or statistically link species distributions or community composition with climate envelopes. These efforts have mostly focused on equilibrium responses to climate changes over the next century (Hansen et al. 2001a), so predictions for the next several decades are unavailable. Bachelet et al (2001) used the MAPPS model with the climate predictions generated by seven different global circulation models to predict how biome distributions would change with a doubling of CO2 by 2100. Mean annual temperature of the US increased from 3.3 to 5.8 °C for the climate predictions. Predicted forest cover in 2100 declined by an average of 11% (range for all climate models was +23% to -45%). The MAPPS model
NRC (1988) reference has been added.
Pagano and Garen (2005) reference has been added.
References added

Changes to Draft
We have added this sentence to paragraph 2 of the Arid Lands 'Bio-Climatic Setting' section: "The vegetation growing season, as defined by continuous frost-free air temperatures, has increased by on average about two days/decade since 1948 in the conterminous U.S. with the largest changes occurring in the West (Easterling 2002, Feng and Hu 2004)." The sentence following this addition has been modified to read: "A recent analysis of climate trends in the Sonoran Desert (1960-2000) also shows a decrease in the frequency of freezing temperatures…." (the word 'also' was added).
No change has been made.
No change has been made.
Woodhouse and Overpeck (1998) reference has been added.

Changes to Draft
The following text and reference on pre-instrumental droughts has been added: "Prior to the instrumental record of roughly 100 years, there is evidence that much more severe droughts have occurred in North America. For instance, Woodhouse and Overpeck (1998), using paleo indicators (primarily tree rings) find that many droughts over the last 2000 years have eclipsed the major U.S. droughts of the 1930s and 1950s, with much more severe droughts occurring as recently as the 1600s. Although the nature of future drought stress remains unclear, for those areas where climate models suggest drying, such as the Southwest (see e.g., Seager et al, 2007), droughts more severe than those encountered in the instrumental record may be increasingly likely."
Suggested references have been added. But even they are vague on water quality impacts, there is not a lot written on this.
NRC (1988) reference has been added to the background section.

Changes to Draft
Pagano and Garen (2005) reference has been added, to discussion of Central US.
No change has been made.
No change has been made.
No change made.
No change
We agree that avoiding duplication is a worhtwhile goal. However, each SAP also needs to be a complete, stand-alone document. Given the differing sponsors, and management of each SAP effort, and the widley varying schedules, the task of coordination was beyond what could be accomplished by the author team alone.