

Draft Minutes for:

**The Human Impacts of Climate Change
Advisory Committee Meeting**

**January 14, 2008
12:00-2:00 pm Eastern Time**

Participation by Teleconference Only

Prepared for:

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NOTICE

This document was prepared by Versar, Inc., an EPA contractor (Contract No. EP-C-07-025, Task Order No. 07), as a summary of the discussion held via conference call by the *Human Impacts of Climate Change Advisory Committee (HICCAC)* on January 14, 2008. This report captures the main points and highlights of the meeting. It is not a complete record of all detailed discussion, nor does it embellish, interpret, or enlarge upon matters that were incomplete or unclear. Statements represent the individual views of each participant.

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PREFACE

The U. S. Environmental Protection Agency's (EPA) Global Change Research Program (GCRP) is an assessment-oriented program within the Office of Research and Development that focuses on analyzing how potential climate change and other global environmental changes may affect water quality, air quality, aquatic ecosystems, and human health in the United States.

The GCRP is a member of the U.S. Climate Change Science Program (CCSP) and is therefore responsible for helping to implement their *Strategic Plan* and to fulfill the requirements of the Global Change Research Act of 1990 to conduct periodic assessments of climate change and variability. Hence, the GCRP is conducting an assessment for the CCSP draft report entitled *Synthesis and Assessment Product (SAP) 4.6: Analyses of the Effects of Global Change on Human Health and Welfare and Human Systems*. A Federal Advisory Committee, Human Impacts of Climate Change Advisory Committee (HICCAC), was established to conduct an external peer review of the draft SAP 4.6.

1. INTRODUCTION

A public teleconference was held by the *Human Impacts of Climate Change Advisory Committee (HICCAC)* on January 14, 2008. The teleconference was held to address EPA's response to the post panel meeting comments from the HICCAC meeting that was held on October 15-16, 2007 at the Hilton Alexandria Old Town Hotel, Alexandria, VA. The minutes of the teleconference are captured below. The Appendices are as follows: Appendix A - List of Attendees; Appendix B – FACA Panel Individual Comments on the SAP 4.6; and Appendix C – Response to the Comments of the Human Impacts of Climate Change Advisory Committee (HICCAC).

2. WELCOME AND ADMINISTRATIVE PROCEDURES

Joanna Foellmer, the Designated Federal Official (DFO), began the teleconference by taking a roll call and reminding the committee members to please identify themselves before speaking so that accurate notes could be recorded. She officially opened the meeting by reading the Federal Advisory Committee Act (FACA) statement and announcing that time for public comments would be at 1pm. She also welcomed the panel and stated that the purpose of the teleconference was for EPA to inform the committee of their disposition of the committee's advice.

Dr. Thomas Dietz, committee co-chair, thanked the committee and the authoring team for their hard work and the significant restructuring of this report that has taken place. He feels that it is now a substantially better report that will be easier for the readers to follow and will be very influential.

Dr. Janet Gamble thanked the committee for their comments on the documents, adding that the authors have responded to those comments as well as approximately 1,000 others from the public and the government. It was a real challenge, and the result was some major restructuring of the report in response to these comments. Specifically, an additional chapter has been to discuss the common themes across chapters and provide research recommendations. Chapter Two has been significantly changed and merged into Chapter One (the introductory chapter), therefore, Section 1.2 is the new location for most of Chapter Two. The boxes holding climate change adaptation examples were moved around and in many cases permanently deleted. The one box remaining appears in Chapter One and looks at the increase in depth of Lake Meade in the last 50 years. The other boxes that were lost still contain material that the authors would like to retain, and they are asking again for the committee's advice on this issue. The Executive Summary was also reviewed and changed extensively based on the committee's recommendations. Comments on these changes were also requested. Chapter Four has been revised to include a discussion of welfare that distinguishes wellbeing and quality of life. She adds that there is still no discussion of mitigation and policy in this report, as the SAPs were called out not to pursue this topic.

Dr. Dietz thanked *Dr. Gamble* for an excellent summary of the major changes that were made and suggested that the committee first share comments on the overall report (the big picture items).

Dr. Barbara Entwisle also thanked *Dr. Gamble* of the summary and agreed that big picture items should be addressed here first. She also thanks the authors for making such gratifying changes.

3. DISSCUSION OF THE DRAFT REPORT

3.1 Text Boxes

Dr. Jonathan Patz began the discussion with the boxes that are now almost entirely absent from the report, asserting that they were valuable in their previous locations and should be brought back in.

Dr. Gamble suggested that the boxes were at a lower level of detail than should be included in the report, to which *Dr. Patz* agreed. *Dr. Gamble* went on to recount the entire list of boxes that appeared in the previous draft of the report.

Dr. Dietz spoke in favor of adding the boxes back in, as he believes that specific examples can be beneficial to the reader.

Dr. Peter Frumkin spoke in favor of restating some or all of the boxes, with the bottom line being the need to communicate effectively with regards to climate change to both the public and scientists. He believes that the stores and examples that the boxes provide help people to connect to the document.

Dr. Gamble agreed that they would help people connect on a personal level to the climate changes that researchers are anticipating.

Dr. Dietz took a look at the one surviving box (Lake Meade) and commented that it was really more like a picture with a long description than a concise story with a punch line. He suggested that the boxes be made more concise and added back in.

Dr. Gamble agreed that this could be down with a little rewriting.

Dr. Entwisle suggested that the problem is not the boxes themselves but that they are too wordy. She supports reinstatement with revision.

Dr. Dietz suggested that the authors focus on making them figures to illustrate points already in the text, rather than being a separate assessment or analysis.

Dr. Gamble assured the committee that the boxes would be revised and reinstated.

3.2 The Issue of Mitigation

Dr. Dietz acknowledged that mitigation was beyond the scope of the report, but added that this is an issue he finds troubling because he believes that mitigation and adaptation should go hand in hand.

Dr. Frumkin first admitted that he did not know the actual SAP rules surrounding this issue, but then suggested that if climate change were to result in a particular mitigation strategy that affected human welfare, then perhaps that strategy can be viewed as an indirect pathway to the affects of climate change on welfare, and not solely a form of mitigation. In this way, the authors would not comment on mitigation directly, but rather would comment on its direct and indirect effects on health and wellbeing.

Dr. Patz agreed with *Dr. Frumkin*, and stressed the need for connectors in this report between adaptation and mitigation so that society does not move forward blindly with a cure that could possibly be worst than the cause. He suggested adding a section to allude to these possibilities; specifically that policy can be connected to negative repercussions for human health.

Dr. Entwisle agreed with *Dr. Patz*, further suggesting that these comments should be made in the report because mitigation strategies have their own cost and benefits to human health, welfare and wellbeing.

Dr. Michael Slimak, being involved in the origin of the SAP, offered some insight on the group's decision not to get involved in mitigation in any of their Products. He stated that *Dr. Entwisle's* comments should be added to the report in the context of what should or could be done in a future assessment. He also suggested adding more recommendations in the final chapter of the report that urge more work in the areas of mitigation and techniques that could be employed for this purpose. He admitted that he, too, would like to see mitigation discussed outright in the report, but in that case the report would not get through the Climate Science Program review process. Unfortunately, it would likely do nothing more than cost the authors and the committee a good deal.

Dr. Dietz pointed to page four and page 13 as places where *Dr. Entwisle's* suggestions stemmed from. *Dr. Frumkin* suggested the addition of a paragraph that might read "further discussion of mitigation is beyond the scope of this report, but since mitigation efforts do have an impact on human health and wellbeing, they should be considered."

Dr. Ann Gamsch agreed with *Dr. Patz's* comments on the cure possibly being worst than the disease. She suggested pulling this concept forward to give it more prominence. She suggested that this could be done with very few words.

Dr. Entwisle suggested a sentence or two defending the scope of the report since it focuses is almost entirely on adaptive responses in the US. These responses should be considered in a global context, yet this is outside the scope of the report. This should be

clearly stated. *Dr. Gamble* offered to walk through the report and find areas where these ideas could be incorporated into the discussion.

3.3 Chapter One

Dr. Entwisle expressed her desire to see a discussion the Introduction Chapter on how the SAPs are interconnected. *Dr. Dietz* agreed, and asked if, during the final stages of report revision, the authors would be able to give updates on the work of the other SAPs.

Dr. Slimak replied that this is doubtful because the Products are all on about the same schedule, and this SAP only has two weeks until submittal.

There were no comments other specific comments from the committee on Chapter One Sections One or Two.

Dr. Frumkin stated that, in regards to Sections Three and Four, this Chapter began to get too heavy on demographic information, reflecting the expertise of the committee, and was much more thing on other non-climate factors such as water scarcity and peak petroleum (which goes completely unmentioned in the report). He noted that of course, with this tight time frame he did not expect rewrites to be done, but perhaps the authors could elaborate more with the bullet list they already have. Even more non-climate factors to include would be socioeconomic factors, water, changes in urban patterns of growth due to real estate availability, and technology.

Dr. Dietz offered the list on the top of page 12 as reasonably complete and balanced listing of a subset of these. The authors should make clear that the report only deals with a subset because those are the ones that are most practical to get at, not necessarily more important than others that are not elaborated on.

Dr. Gamble agreed to take this advice and make any headway she could.

Dr. Frumkin asked, with regards to Chapter One, Section Four, the authors meant when they said that population trends and migration patterns “develop the Nation’s landscape.” *Dr. Gamble* replied that the authors were referring to buildings on the ground and what these cities and neighborhoods actually look like. *Dr. Frumkin* liked this topic and suggested it be called Urbanization Pattern.

Dr. Entwisle pointed out that in Chapter One, Section Three, the first few sentences on page 11 did not follow logically from what precedes it, and these is confusion here on if qualitative statements can even be made about climate effects on wellbeing through the interactions of other factors. *Dr. Frumkin* suggested that the language be changed to saw that climate variability in the US operates with other issues and is seldom the only issue affecting human wellbeing. *Dr. Dietz* concurred with this suggestion. *Dr. Patz* added that something could also be written on how climate change cuts across so many pathways that in itself it can not define variability and risk. This would require adding something with regards to the breath of exposure.

Dr. Gamble asked the committee to help her by providing something on this issue in writing. *Dr. Patz* simplified this request by emphasizing *Dr. Entwisle's* suggestion to get rid of the language "are seldom the most important" because a heat wave or a hurricane are always important.

It was agreed upon that the sentence in question would be removed from the final version of the report.

It now being 1pm, *Ms. Foellmer* asked if anyone was on the line who would like to make a public comment. No comments were made.

3.4 Chapter Two

Dr. Patz began the discussion on Chapter Two by stating that he found it to be very comprehensive, with a good historical context, and overall very well done.

Dr. Frumkin added that she thought that the health impacts included in the chapter were well done and strongly supported. However, there were several missing that she feels are important. These include mental health, allergens, food productions and others.

Dr. Kristie Ebi answered that it was a challenge to balance what is known in first principle public health with what is in the knowledge base. The knowledge base was what was considered for inclusion of a specific health impact in this report.

Dr. Frumkin stressed the inclusion of extremely important mental health impacts even if they did not have as much supporting information as some of the ones that were included. *Dr. Patz* agreed, and suggested that allergens be included in the section on air quality. *Dr. Ebi* responded that she did include a few sentences on aeroallergens, but only with hesitation because the literature base of this health impact is only coming out of one research group. *Dr. Patz* asked for some notes or a redirect so that readers would know that aeroallergens would be discussed later.

Dr. Frumkin suggested that, given that it is a granular chapter, one more disease be added.

Dr. Frumkin asked if there would be a table of contents for this chapter. *Dr. Gamble* responded that this aspect would be handled by the formatting team at the end of the month. There were no specific comments with regards to Chapter Two, Section One.

Dr. Entwisle asked about the use of 'highly likely' in Chapter 2, Section 2 and if it is in agreement with the language used in Table 2 of the same section. *Dr. Ebi* explained that some of this discrepancy comes back to the issue of first principles versus what can be supported by evidence. She agreed to go back and take better looks at the two uses in question.

Dr. Patz offered to send *Dr. Ebi* a paper on climate change affects on PM2.5. This sparked the question of what the literature cut-off date is for the report. *Dr. Gamble* stated that the committee had decided on 2001-2007.

There were no other specific comments with regards to Chapter Two, Section Three.

Dr. Frumkin pointed out that in Chapter Two, Section Four, there was a vulnerable population that was over looked; specifically, people living in geographically vulnerable areas. *Dr. Ebi* said that this could easily be added.

Dr. Frumkin suggested that Table 5 of this Chapter be deepened to more thoroughly mention national and state agency public health functions. *Dr. Ebi* agreed that this was also an issue that she cared deeply about, but that due to the page limit things were often done in a shorthand way. She agreed to more information into this table.

Dr. Frumkin stated his concern with the size of the arrows in Chapter Two, Section Seven - Figure 11. He did not like how the arrow for heat related mortality was only slightly bigger than the arrow for cold-related benefits. He believes that this figure ducts the issue of quantization the two phenomena. *Dr. Ebi* replied that, based on current impacts, we know that heat is more important that cold in terms of mortality. *Dr. Frumkin* added that this style of figure is undesirable because it dangerously denotes that we have more precision in this area than we really do. *Dr. Patz* agreed. *Dr. Ebi* decided that if something suitable can not be figured out then the figure will be dropped from the report.

Dr. Dietz stated that the authors and the committee need to be cautious of the process by which the priority of research needs verses research gaps are identified. He stresses that it need to be more of a community-wide process than is possible for this document. That is, the report has not been an engagement with the research community, and thus should not set research priorities. He asked that the authors focus only on what they, as a skilled group of authors, can do.

Dr. Ebi agreed with *Dr. Dietz*, but also cited the fact that they took on over 1,000 public comments. So, in a sense, they were engaging a larger community. *Dr. Dietz* stressed the lack of a formal call for research priorities from the community and recommended the removal of 'priority' from several places in the report.

3.5 Chapter Three

Both *Dr. Dietz* and *Dr. Entwisle* agreed that Chapter Three was in great shape following the author's recent revisions. There were no specific comments on Chapter Three, Section 3.1. *Dr. Entwisle* stated that, with regards to Section 3.2, she had an issue the verbiage "one person, one vote (page 18)." *Dr. Gamble* will have this deleted from the report.

Dr. Frumkin raised an issue with regards to Section 3.3. He believes that the authors should take the opportunity in this section to flag appropriate co-benefits and to get into the adaptation/mitigation issue. He suggests listing adaptation strategies that are also mitigation strategies, such as buildings that will consume less energy. He stressed that this section is probably the most promising place in the document in which to highlight co-benefits and adaptation plans that are also mitigation plans. He added that the box in this Chapter does not specifically call these things co-benefits, yet they should.

Dr. Patz added that the Chapter also needs a diagram to better communicate these co-benefits. He suggests the Center for Disease Control (CDC) bar graph of the ten leading causes of death in the United States. He states that there are no visuals in this well-written chapter.

Dr. Frumkin highlighted what he sees as a very important set of opportunities at the intersection of climate change policy and urban change policy. He wants to call out in the report the factors that are driving adaptation changes other than climate changes (such as walking more and driving less for health, rather than solely climate change). He believes that, in this context, there is a bigger story out there than is being told in this report, and he feels that it needs to come through in the conclusion section of this Chapter.

Dr. Dietz suggested that the authors make the point of a variety of factors converging to produce co-benefits before their conclusion section in this Chapter. He suggests they pick a community and talk about how these things all play out together, in addition to the box on mitigation.

3.6 Chapter Four

Dr. Entwisle applauded the authors for the substantial amount of work that was done' on Chapter Four in response to the committee's recommendations. She believes that it is a much more effective chapter in its present form. *Dr. Dietz* agreed.

Dr. Entwisle stated that Table 2, Chapter 4 was somewhat useful in showing direct versus indirect effects of climate change on fishery resources. However, she highlighted a few concerns. Specifically, she suggested that the authors expand out the reasoning behind choosing these possible metrics and how they might hold up in an analysis. She suggested that, for example, if those who do get jobs leave the community than the population is likely to become poorer. Also, as more people need help, there may be more community activities and interventions available to them. She noted that a lack of evidence would be reason to drop this table from the report all together.

Dr. Dietz agreed with *Dr. Entwisle* on both metric observations. He added that there is a literature on booms and busts, and what happens in these situations is pretty mixed (although busts are often cyclical).

Together, *Dr. Sussman* and *Dr. Dietz* decided that the first point would be handled by talking about selective outmigration and the second point will be assessed by dropping this metric from the table.

Dr. Entwisle commented that Chapter 4, Section 4.3 was much stronger in its economic evaluation than the previous version. There were no comments on Chapter 4, Section 4.4.

3.7 Chapter Five

Dr. Dietz stated that his comments on how to structure the end of the report chapters also applied to Chapter Five. Overall, he was pleased with this chapter, but did remind the authors to play to their strengths. Here, that would include the ability to clearly point out literature gaps, but not to make research priorities. *Dr. Frumkin* agreed with *Dr. Dietz*.

Dr. Patz added that the theme of co-benefits is still somewhat missing in Chapter Five. He sighted the bottom of page five where the cost and capacity of adaptation was discussed without mention of smart growth and co-benefits. *Dr. Frumkin* agreed with *Dr. Patz*, and also cited page nine, where he believes that a bullet point needs to be add that deals with mitigation.

Dr. Frumkin cited lines 30 and 31 on page nine, asking for the literature reference. *Dr. Gamble* believes that the wording could be safely changes to ‘can often not be affective’ and no citation would be needed. *Dr. Dietz* added that there is a good basis in the natural hazard literature on what can be deemed successful and unsuccessful.

Dr. Ebi stated that she thinks it important to differentiae between the physical signals of a heat wave as opposed to the effectiveness of a response plan.

Dr. Fumkin believes that the bullet point in question makes a sweeping empirical claim that it does not back up, suggesting that a more nuanced claim would be more appropriate. *Dr. Gamble* will make changes accordingly.

Dr. Dietz pointed out that Chapter Five, Section Two discusses scenarios and so should be compared against the SAP that is out regarding scenarios to make sure they are in accordance. He also noted that the consistent and clear differentiation between welfare and wellbeing in the report up until this point may have broken down in this chapter. *Dr. Gamble* agreed to take a look at both of these issues.

4. NEXT STEPS AND ACTION ITEMS

Dr. Frumkin pointed out that *Dr. Dietz* and *Dr. Entwisle* were excellent leaders of this committee and that the authors were wonderfully profession and non-defensive. He acknowledged a great job done by everyone. His sentiments were echoed by *Dr. Dietz* and the rest of the committee.

Dr. Dietz also stated that this report would be an excellent piece of literature to be cited by others in the field and to inspire work by graduate students in the future.

Dr. Gamble announced that the final version of the report would be finished and sent for formatting by the end of January. She added that nothing more was required from the committee members, and thanked them for meeting all of their responsibilities.

APPENDIX A
LIST OF ATTENDEES

Human Impacts of Climate Change Advisory Committee Meeting (HICCAC)

Members in Attendance:

Dr. Tom Dietz, Chair – Michigan State University
Dr. Barbara Entwisle, Co-Chair – UNC Chapel Hill
Dr. Howard Fumkin – CDC, Emory
Dr. Jonothan Patz – University of Wisconsin, NCAR

Members Not in Attendance:

Dr. Kristen Shrader Frechette – University of Notre Dame
Dr. Robert Pulwarty – NOAA
Dr. Peter Gleick – Pacific Institution, NAS
Dr. Eugene A. Rosa – Washington State University
Dr. Susan C. Stonich – UC Santa Barbara

Other Attending:

Dr. Janet Gamble - EPA
Ms. Joanna Foellmer - EPA
Dr. Michael Slimak – EPA
Dr. Ann Grambsch - EPA
Dr. Kristie Ebi – ESS, LCC
Dr. Frances Sussman - EEC

APPENDIX B

**RESPONSE TO COMMENTS OF THE
HUMAN IMPACTS OF CLIMATE CHANGE ADVISORY COMMITTEE
(HICCAC)**

Climate Change Science Program
Synthesis and Assessment Product 4.6
Analyses of the Effects of Global Change on Human Health and
Welfare and Human Systems

Response to Comments of the
Human Impacts of Climate Change Advisory Committee (HICCCAC)

1. Treatment of human dimensions as a separate theme rather than providing an integrated assessment. The CCSP SAP has decided to produce 21 separate assessment products. This is a departure from the strategy of most previous assessment efforts in the U.S. and globally where the necessity of integrating across assessment questions has been seen as vitally important. In particular, the separation of SAP 4.6 from the other SAPs addressing CCSP Goal 4 has made it very difficult to address the issues framed for SAP 4.6 because of the strong causal linkages between human and ecosystem processes. We urge that other Goal 4 SAPs be reflected in the revision SAP 4.6 to the greatest extent possible. Where other Goal 4 SAPs would provide critical information but are not available, that should be acknowledged.

RESPONSE

We agree that the SAP 4.6 needs to include language to describe the Climate Change Science Program's Goal 4 SAPs and their interrelated topics. Early in the introductory chapter, the report addresses how the Goal 4 SAPs are intended to examine the sensitivity and adaptability of different natural and managed ecosystems and human systems to climate and related global changes. Throughout the report (including the three topic chapters --- health, welfare, and settlements), the interconnected Synthesis and Assessment Products are highlighted, including the SAP 4.1 analysis of sea level rise impacts, the SAP 4.2 ecosystem changes, the SAP 4.3 agricultural production, the SAP 4.4 adaptive options for climate sensitive ecosystems, the SAP 4.5 energy use, and the SAP 4.7 transportation system impacts along the Gulf Coast.

2. Effective communication about climate change. Effective communication about climate change is important in informing the public and policymakers, and in affecting how people will respond to climate change. Messages about climate change might evoke fear and denial, or they might inspire informed, constructive choices that help protect health and promote well-being. This is a researchable topic; there is an extensive literature on risk communication, and an emerging literature that applies key communication principles to climate change (Moser and Dilling, 2007). While this topic is not part of the overall outline as currently framed, it is inherent in discussion of either adaptation or mitigation strategies. The committee recommends that the report address the importance of communicating climate change, discuss principles of effective communication, and identify key research needs.

RESPONSE

The report is being revised to include a separate chapter (Chapter 5) on research recommendations and data needs. The importance of risk communication in the response to climate change is addressed in that chapter. Specifically, the report encourages the implementation of adaptation measures to address the near and long-term responses to climate change, engaging regional and local stakeholders in the development of effective, responsive, and timely adaptation policies. Stakeholders should be full partners in research that addresses their decision support needs. Local, state, and federal governments can be instrumental in employing stakeholders in developing and deploying well-conceived and suitable adaptation strategies.

Furthermore, as Chapter 2 points out, adaptation to climate change is basically a risk management issue. Adaptation and mitigation are the primary responses to manage current and projected risks. Specifically, adaptation policies should address both projected risks and the regions and populations that currently are not well adapted to climate-related health risks. Obviously, the extent to which effective proactive adaptations are developed and deployed will be a key determinant of future morbidity and mortality attributable to climate change.

3. Executive Summary: To state the obvious, a variety of changes the committee has suggested for the separate chapters should be incorporated into the ES. It is suggested that a “concise articulation of research gaps and needs” be presented in a concluding chapter. That suggestion also implies, but does not elaborate, on the importance of the “difficulties of implementing adaptation strategies.” Left unaddressed, however, is the need for research that arrays the variety of reasonable adaptation strategies and then judges the degree to which each strategy has been grounded in empirical evaluation. As pointed out by Roger Pulwarty, remarkably few of the proposed adaptation strategies could stand up to the empirical test. In view of the committee discussions, but especially in view of the purpose of the SAP Reports as valuable support documents for decision makers, I would recommend the structure of the ES be something like:

A. What Do We Know?

1. Summary of basic research findings
2. Literature driven list of expected adaptation strategies

B. What Do We Need to Know?

1. Research gaps in basic and use-inspired knowledge
2. Gaps in understanding the success of different configurations of adaptation

C. What Do We Need to Address the Gaps?

1. New and more complete forms of data
2. Increases in capacity building, especially in the social sciences

RESPONSE

The Executive Summary is being edited to incorporate portions of the suggested organization in the revision. In addition, a concluding chapter is added to discuss research recommendations and data gaps. NOTE: the welfare chapter (the new Chapter 4) adds some discussion of additional research needs, particularly with regard to

quantification of mortality effects in health, and effects of disaster in the community section. The revised Executive Summary includes an Abstract, a Survey of Findings across the three topic chapters, and a table summarizing impacts of climate variability and change on health, settlements, and welfare. Finally, the Executive Summary includes a table that tracks Census Bureau projections for population change out to 2030 along with a notation of the historic climate-related impacts experienced by region over the past half century.

4. Uncertainty. A key question shaping the organization and content of the report is: “How well does it handle uncertainty?” Appropriately the committee recommends that the EPA SAP adopt language that is consistent with the international climate and global environmental change community, in particular the 4th Assessment of the IPCC, Working Group II. (See p. 4, “Introduction to the Report.”) <http://www.ipcc.ch/activity/uncertaintyguidancenote.pdf>. There and elsewhere are useful taxonomies for describing the likelihood of certain outcomes (a seven-point scale from Virtually Certain to Exceptionally Unlikely) and the degree of confidence in major conclusions. This summary was taken from an earlier document: *Guidance Notes for Lead Authors of the IPCC Fourth Assessment Report on Addressing Uncertainties*, 2005.

However, it is both ironic and troubling that nowhere could I find with a moderate amount of digging a definition of uncertainty in the IPCC 4th Assessment. The CCSP offers a definition in its glossary (2003, p. 199), where uncertainty is defined in terms of “An expression of the degree to which a value (e.g. the future state of the climate system) is unknown. The terms “uncertainty” and “unknown” are synonyms, not a good starting point for a clear, unambiguous definition. A definition should be stated in terms other than what is being defined. The NRC/NAS metrics report (*Thinking Strategically: The Appropriate Use of Metrics for the Climate Change Science Program*, Washington, DC: National Academy Presses, 2005) addresses the issue of uncertainty most directly in its effort to provide a metric for assessing the increase or decrease in scientific uncertainty. Nevertheless, its discussion of the topic quickly shifts to the need for characterizing the degree of uncertainty in climate and related assessments—a proscription consistent with the treatment of the IPCC.

Perhaps it belabors the point, and offers wisdom too late in a process that nears completion. Nevertheless, the point seems relevant to the CCSP itself and to the SAP’s it generates. Here is one approach to defining uncertainty.

Uncertainty is a feature of knowledge where there is an indeterminacy between cause and effect in the world. Uncertainty, defined in this way, can be traced to a variety of sources: (1) a misspecification of the cause(s), such as the omission of a causal factor resulting in spurious correlations; (2) mischaracterization of the effect(s), such as a model that predicts cooling rather than warming; (3) absence of or imprecise measurement or calibration (such as devices that fail to detect minute causal agents); (4) fundamental stochastic (chance) processes in the world; (5) ambiguity over the temporal ordering of cause and effect, such as whether thought precedes language or vice versa; (6) time

delays in cause and effect, such as the occurrence of some cancers, (7) complexity where cause and effect between certain factors are camouflaged by a context with multiple causes and effects, feedback loops, and considerable noise.

It is our view that a covering definition of what is meant by uncertainty, whether the one we offer above or some other, would add to the committee noted missing conceptual framework of the report.

RESPONSE

The report now adopts the language on uncertainty that is consistent with the IPCC Fourth Assessment Report, WG II. The report acknowledges that this section in Chapter 1 will also utilize the uncertainty definition provided in this comment: Specifically: “Uncertainty is a feature of knowledge where there is an indeterminance between cause and effect in the world. Uncertainty, defined in this way, can be traced to a variety of sources: (1) a misspecification of the cause(s), such as the omission of a causal factor resulting in spurious correlations; (2) mischaracterization of the effect(s), such as a model that predicts cooling rather than warming; (3) absence of or imprecise measurement or calibration (such as devices that fail to detect minute causal agents); (4) fundamental stochastic (chance) processes in the world; (5) ambiguity over the temporal ordering of cause and effect, such as whether thought precedes language or vice versa; (6) time delays in cause and effect, such as the occurrence of some cancers, (7) complexity where cause and effect between certain factors are camouflaged by a context with multiple causes and effects, feedback loops, and considerable noise”

Throughout the document wherever words such as “likely” appear the statement is evidence-based, and does not represent an informal usage of the word. The word “likely” is used in discussions of science/physical effects and does not appear in discussions of well-being or economics. For instance, Table 2 in Chapter 2 describes possible influences of climate change on climate susceptible pathogens and/or diseases that report the confidence of change and a basis for the assessment of that confidence.

5. Balance and tone. In chapters 1 and 2 in particular, the report often makes statements about the importance of climate change relative to other factors that influence change, or compares negative and positive impacts of climate change, or asserts that, as an affluent nation, it will be easy for the U.S. to adapt. The panel has serious concerns with the tone of these comments especially given the lack of any analysis in the report to support them. The impacts of climate change will of course always be location specific and have more impacts on some groups (those by definition more vulnerable) than others. The report never aggregates across all these groups, yet such aggregation might show that a substantial portion of the US population might be impacted. The point is not that the report should do such an analysis, but that absent such an analysis it’s not appropriate to “scale” the impact of climate change relative to other factors. Or, put differently, the report sometimes says that climate change is not as important as other factors in driving particular impacts. But analyses that partial out causal effects of climate change versus other drivers are not cited, and probably are not available. The report should note this

limitation in current research and note that absent such analyses we cannot dismiss the effects of climate change—rather we can see pathways, regions, groups, and sectors where the impacts may be substantial and very troubling and places where it will be less worrisome. The discussion of ease of adaptation likewise needs to be grounded in evidence or acknowledge that we don't know how easy it will be to adapt. While one can imagine paths along which society will move in which, for example, changes in infrastructure and effective public health policies and programs will mitigate change, we also have historical examples where this has not happened. Further, the report should note that many of the systems that would provide adaptation to climate change, e.g. public infrastructure, the public health system, are already under substantial strain. The overall point is that the conclusions about the severity of climate change impacts, the primacy of climate change as a driver and the ability of the US to cope by adaptation needs to be grounded in published analyses, and lacking those analyses, the gaps in knowledge and the need to fill those gaps should be noted.

RESPONSE

We agree. Language is being incorporated to address this concern in the new Chapter 5 Research Recommendations and Data Gaps. Limitations in current research are highlighted and note is made that absent such analyses we cannot dismiss the effects of climate change—rather we can see pathways, regions, groups, and sectors where the impacts may be substantial and very troubling and places where it will be less worrisome. In the “Complex Linkages” section of Chapter 1, the report concludes that climate change impacts spread from directly impacted areas and sectors to other areas and sectors through extensive and complex linkages: including demographic changes, region-specific vulnerabilities; social, political and cultural contexts; human and social capital; economic conditions; available natural and budgetary resources, available technologies and barriers; conditions of the built environment; transportation and communication innovations; land use change and available public health and social services infrastructure

6. Treatment of uncertainty. The panel lauds the effort to use consistent language about uncertainty in the report. However, several steps need to be taken to improve the treatment of uncertainty. First, we suggest the use of the categories and language from the IPCC WG II rather than WG I, as that is more appropriate for the content of the report. Second, we suggest that a careful editing insure that the terms used for treatment of uncertainty be reserved for use with the precision intended and not be deployed informally as part of the prose of the report. This may imply that these terms are used only in tables, bullet lists, etc. Third, we suggest that whenever possible, not only uncertainty but strength of evidence and perhaps magnitude of impact be included in this assessment. Fourth, it is very important that the authors indicate the process by which they developed estimates of uncertainty. There are well developed methods for systematic elicitation of views from experts. While some of these are quite elaborate, others are straightforward and could be deployed even within the time constraints of the current deadlines. The authors might consider using these. In any event, the way in which the estimates of uncertainty were developed should be described clearly.

RESPONSE

Estimates of uncertainty and mechanisms for deriving are more clearly described in Chapter 1. We have changed the scales to coincide with those utilized by IPCC Fourth Assessment Report, Working Group II. We have also revised the statement of knowledge diagram per the WG2 guidelines. These estimates of uncertainty appear in a number of sections in the report. Where applied, they have been applied based upon the available science and the expert judgment of the lead and contributing authors. For instance, see Table 2 in Chapter 2 (Human Health impacts).

7. Under-represented voices. The impacts of climate change vary across groups (by stakeholders, social categories, etc.) While several groups of relevant stakeholders are identified and discussed in the report, several other significant groups are not identified. The most important of these include differential impacts across racial, ethnic, gender, and class categories. This is not simply a concern for social and demographic representation, but a recognition that vulnerability and resiliency will vary by these social and individual categories.

RESPONSE

Language is added to the section on vulnerable populations in Chapter 1. We have added a text box in Chapter 4 on vulnerabilities and communities, with a number of new citations. We have also added paragraphs of text in Chapter 4 to the discussion of indicators that generally describes differential vulnerability and local/regional effects, along with appropriate citations.

8. Analysis and deliberation. Because public, participatory, deliberative approaches were not included in the process of generating SAP 4.6, we recommend that the report be limited to identifying major research gaps/needs and not include recommending broad adaptive strategies. The report should not ignore the large body of health literature that follows deliberative approaches and makes specific recommendations. However, we do believe that specific adaptive strategies with some evidence of effectiveness should be used as examples where appropriate throughout the document.

RESPONSE

Specific adaptive strategies, where some evidence of effectiveness is available, are used where appropriate. For instance, in the new Chapter 5 (research recommendations and data gaps) there is a discussion of the cost and capacity for adaptation. In Chapter 2 (human health), Table 2.5 surveys the actors and their roles and responsibilities for adaptation to climate change health risks. In Chapter 3 (settlements), a section of the chapter discusses the major categories of adaptation options for human settlements and current considerations of adaptation strategies. Finally, in Chapter 4 (welfare) the chapter includes discussions of vulnerability and adaptation at a community level, concluding that the goal of successful adaptation to climate impacts is to maintain the long-term sustainability and survival of the community. .

9. Global aspects of problem. Although the panel realizes that the impacts of climate change on/in the U.S. are the focus of SAP 4.6, we urge that the report more thoroughly consider these national impacts within a broader global context. Many of the most significant impacts in the U.S. are part of global processes and phenomena that are linked to climate change outside the U.S. Some of the most importance of these include: the emergence, spread, and expansion of infectious diseases; the introduction of invasive and exotic species; changes in terrestrial and aquatic food production systems, declining outputs, and associated human food security; declines in livelihoods and accelerated international migration in search of work; and the continued growth of global tourism. These transnational, international, and global processes significantly influence the U.S.

RESPONSE

We have added a section in the extensively revised Chapter 1 on transnational climate impacts that significantly influence the U.S. We conclude that in-migration is an important response to climate change outside of U.S. borders (section 1.4). The movement of people into the U.S. will affect the structure and composition of communities throughout the country and their related impacts.

10. Immigrants. The draft report makes some mention of immigrants, but more needs to be said. First, immigration may represent a response to climate change outside of US boundaries. The movement of these people to the US will affect the structure and composition of communities throughout the country. Second, immigrants (especially recent immigrants and those not yet fluent in English) should be considered a vulnerable group with respect to potential heat waves, hurricanes, etc. within the U.S. Third, immigration, tourism and trade are all examples of international flows relevant to the spread of disease. The current draft of the report recognizes the first but in isolation from the others. All should be mentioned.

While difficult to predict there is also the possibility of out migration of firms and individuals in certain types of business. For example, one predicted outcome of global warming is the shift in the most productive agricultural areas further north, extending into Canada. Agricultural producers and workers could potentially move to more productive areas in Canada.

RESPONSE

See prior comment. Much of this language has been moved verbatim to this section in Chapter 1.

11. Definitions and consistent use of terminology: We recommend that the report provide a glossary of key terms, covering climate science, human impacts, well-being, health outcomes, and so on. This would be useful as a table in the introductory chapter. It is important that the language then be used consistently throughout the report

RESPONSE

A glossary has been prepared based on the IPCC Third Assessment WG 2, the Fourth Assessment WG 2, the Millennium Ecosystem Assessment, and the American Heritage Dictionary. The Glossary has been reviewed for inclusiveness and accuracy by two independent reviewers and by the lead authors.

12. Emphasize co-benefits. The issue of co-benefits is central to the discussion of climate change and well-being. For example, a shift from motor vehicle use to walking and bicycling will not only reduce greenhouse gas emissions, it will bring health benefits from physical activity, reduced air pollution, reduced risk of motor vehicle injuries, and perhaps enhanced social capital. This issue also bridges the gap between mitigation and adaptation; certain activities offer co-benefits in that they achieve *both* mitigation and adaptation. We recommend developing the discussion of co-benefits, with appropriate citations (Haines et al., 2000; Higgins, 2005).

RESPONSE

A discussion of co-benefits is added to Chapter 1. It appears that a portfolio of adaptation and mitigation options can address the risks of climate change. Yet, even given the most extensive mitigation efforts, further impacts of climate change are expected to continue. Win-win responses to climate change will be realized as “co-benefits.” Language reflecting this conclusion is included in the revised Chapter 1.

13. Balanced discussion of negative and positive impacts. The overall tone of the health discussion is at points a bit too reassuring, bringing to mind Okrent’s Law (“the pursuit of balance can create imbalance, because sometimes something is true”). Several examples are illustrative:

- Chap 2, p 8, on Table 2.1: “Climate change will have negative and positive health impacts in the U.S.,” a statement that is designated as “very likely.” The probability of negative impacts so outweighs the probability of positive impacts, that this statement is misleading as it stands.
- Figure 6 in Chapter 3 (p 31) shows a small arrow indicating negative health impacts for vector-borne diseases, and a much larger arrow showing positive health impacts from reduced cold-related mortality—a relative weighing of consequences that is difficult to justify.
- Chap 2, p 14, lines 24-26: “While we anticipate that many Americans will be only marginally affected by climate change in the next 50 years, we conclude that some portion of the population and some places where people live and work will be seriously and disproportionately impacted.” A very sanguine statement, also difficult to justify.
- Chap 2, p 11, lines 23-28: The bulleted summary of human welfare impacts includes relatively trivial concerns (less skiing, erosion of beaches) while omitting far more profound concerns, such as the sorrow accompanying the loss of the concept of nature (described by Bill McKibben in his landmark book *The End of*

Nature), the stress of living with chronic water scarcity in regions that depend on snowmelt, and the destabilizing influence of population shifts from coastal areas. The document needs a careful check for such statements, more proportionality, and appropriate relative emphasis on positive and negative outcomes

RESPONSE

We agree. The document needs a careful check for statements that are not balanced and proportional with respect to relative emphasis on positive and negative impacts. Chapter 2 has been extensively revised and “folded into” Chapter 1. The new chapter 1 looks to balance the overall tone of the document and concludes that overall negative impacts are generally more prominent than overall positive impacts for health, settlements, and welfare endpoints.

14. Discussion of concurrent drivers of health and well-being. It is important to note that climate change is not the only determinant of health and well-being. The draft report does this, but often in a potentially misleading manner that may unintentionally minimize the importance of climate change. For example, Table 2.1 (Chapter 2, p 8) includes the statement that “Climate change will seldom be the primary factor affecting the burden of climate-related injuries, illness, and death in a population.” Careful rewording of such statements is recommended. On the other hand, the report would benefit from a more robust discussion of concurrent trends that will interact with climate change to affect health and well-being. Demographic trends are one example, and these are discussed at Chapter 1, pp 8-13, although not all relevant trends are addressed (e.g., increases in one-person households are not discussed). Other trends that deserve attention include urbanization, transportation and communication innovations, depletion of some water tables, globalization, and peak petroleum. The committee did not agree on whether these other trends should be given equal treatment, or not. A good example of a diagram (box) to illustrate the overall framing of climate to well-being and health impacts is Figure 9.1, page 96 of the CCSP. Also, it would be useful to distinguish between direct and indirect effects to well-being and health

RESPONSE

Concurrent non-climate factors that operate alongside climate change are discussed at length in the new Chapter 1. Additions made to the original Chapter 2 are folded into the new Chapter 1.

15. Interconnections to IPCC and other Reports. The IPCC and Millennium Ecosystem Assessment offer several organizing conceptual models and figures outlining health, ecosystem, well-being and interactions that may be used in the document. This would save text on revisiting theoretical and other frameworks provide clarity and continuity and offer a more accessible and readable report. In addition the report would benefit from overlap of citations in both of these assessments that would provide continuity. Chapter 3 does a good job of this but cross-referencing the global assessment. This needs to be more consistent throughout the report.

RESPONSE

Chapter 2-4 have language describing IPCC and Millennium Ecosystem Assessment commonalities. The MA was reviewed, together with other sources, for the welfare chapter, and contributed to the conceptual basis for a number of discussions, including the framework presented in Table 4.1 and the discussion of ecosystem services. Additional citations to IPCC and MA have been added to welfare chapter.

16. Issues in conceptualizing and measuring welfare. The term “welfare” is one of the more nebulous terms to describe the conditions determining life chances and experiences of individuals. Furthermore, the term often conflates the background or parametric conditions of those experiences with the subjective experiences themselves. To surmount these definitional difficulties it is suggested that the term “well-being” be used to refer to the background and related conditions of life chances and experiences. Well-being is not only used synonymously with welfare in many instances, but it is also the terminology adopted in the Millennium Assessment—thereby maintaining a connection and symmetry with the larger literature. It is further suggested that the term “quality of life” be adopted to represent the subjective experience of individuals. Not only would this make an appropriate analytic distinction between background conditions and the experience of those conditions this terminology would be consistent with the sociological literature.

RESPONSE

Clarification of discussion of welfare has been incorporated in the new Chapter 4: Welfare Impacts. Terminology in the Welfare chapter has been changed to distinguish welfare (economic welfare) from well-being and quality of life. As discussed in the panel comments, these latter two terms are still being used interchangeably, because they are so closely linked in a number of literatures.

17. Adaptation and vulnerability. The panel has two concerns about the use of the concept of adaptation in the report. First, at a theoretical level, the report seems to draw most extensively on the natural hazards tradition in discussions of adaptation. In particular, the report often invokes physical and social dimensions of vulnerability. While this is a venerable approach, there have been a number of extensions, elaborations and critiques of this (McLaughlin and Dietz forthcoming). These approaches are part of the IPCC and MA discussions and deserve to be mentioned. Some, such as the “livelihood” approach may offer important additions to the approach currently used and should be noted so they become part of the agenda for further work.

Second, the report uses the vulnerability-response-adaptation (VRA) logic throughout. However, this neglects adequate consideration of mitigation. In considering societal actions to deal with climate change, logic requires that the costs, risk, benefits, and feasibility of VRA always be compared with, and indeed integrated with, responses that emphasize mitigation. In some cases adaptation may be a superior strategy, in some cases mitigation, in many cases some mix, are likely to be the best policy approaches.

RESPONSE

Mitigation is not included in the report. The guidance from the CCSP on the SAPs is to strictly limit discussion of public policies associated with mitigation.

18. Data needs

The Committee recommends that the report affirm the need for data covering multiple social, spatial, and temporal scales for monitoring as well as research purposes. Fine-grained data on the population are needed in order to assess and track vulnerability at very local scales, where the impacts of climate change and variability are most likely to be felt and also where prevention and response are most likely to be organized. The decennial census and the American Community Survey currently serve as excellent sources of such data and should be specifically mentioned in the report

RESPONSE

Chapter 5: Research Recommendations and Data Gaps addresses this point

19. Integration in language. Chapters 3-5 need to be better integrated, terms and language used consistently, and redundancies reduced and possibly eliminated. Currently, the chapters appear to be ordered in terms of the size and weight of the research record behind them. The Committee believes that other orderings might make more sense conceptually. One member suggested that Chapter 5, changed to emphasize wellbeing as opposed to welfare, logically comes first and that Chapters 3 and 4 should follow. Another member suggested that Chapter 4, on settlement, logically comes first. Settlement structures exposure to climatic events as well as itself being a possible response to them. If, as seems likely, the authors of the report do not have the time to restructure the chapters, the Committee recommends more framing discussion at the beginning of each one to better explain its relationship to the others.

RESPONSE

Chapters 1 and 2 have been merged and harmonized. Once that is accomplished, Chapters 2-4 (new numbering) will be updated to improve the overall harmony of the entire report.

20 Audience and Usability. As it is presented the report does not yet offer clear concise articulation of research gaps and needs. These should be collated and presented within a conclusions chapter in the document. As importantly, adaptation while discussed is not grounded in a clear elaboration of key examples mentioned. As a result potential public users of the documents may not be able to draw clear insights for practice. That being said the difficulties of implementing adaptation strategies are not discussed (technical, financial, cognitive) but are assumed to occur once the adaptation strategy/technology is identified. Outline the problems involved in developing and implementing adaptation strategies in the context of health. One such area is that of early warning systems when

the need is identified but mechanisms of how to include climate change information into these systems is not well defined.

From a usability standpoint, it is unclear as to how early warning would function or be modified across times scales from extremes to change, and how the responses to early warning may be embedded in a larger prevention framework. This issue has been recognized for quite some time in the disasters and policy literature and does not require completely precise knowledge about the future (as noted for many adaptation strategies, identified in the IPCC). This discussion would strengthen the health chapter within the report.

RESPONSE

Chapter 5 is being included to focus on research recommendations and data gaps.

21. Resiliency. Resiliency, a central concept, in assessing the vulnerability and adaptability of regions, communities, and individuals will depend not only on physical infrastructure, but also social infrastructure as well. Social infrastructure includes factors such as human capital (e.g. formal education), cultural capital (e.g. breadth of linguistic mastery), and social capital (e.g. ties to social networks), and each of these assets vary from community to community and from individual to individual. This collection of non-economic capitals provide both assets and buffers for communities and individuals. It would, therefore, be important to consider these forms of capital, however brief, in the assessment of vulnerability, resiliency, and capacity for adaptation. Furthermore, mitigation efforts will also decrease vulnerability, thereby increasing the capacity for adaptive response.

RESPONSE

A discussion of resiliency is being added in Chapter 2 to merge into the new Chapter 1 and to the adaptation section in the new Chapter 5.

22. Mitigation. The idea of adaptation is embedded in a three-part framing of vulnerability, resiliency, and adaptation (V-R-A). The implied consequence of this framing is that the impacts of climate change are seen as unalterably *fait accompli*. This overlooks mitigation efforts to reduce the precursors of climate change directly (such as restructuring the transportation infrastructure) or indirectly, resulting from the co-benefits of actions taken to address other issues (reduction of ground level urban ozone to reduce public health risks). Adding mitigation results in the four-part framing: mitigation, vulnerability, resiliency, and adaptation (M-V-R-S). Furthermore, certain mitigation efforts will also decrease vulnerability, thereby increasing the capacity for adaptive response

RESPONSE

This report does not address mitigation policies.

23. Rates of change. Throughout the document change is treated as a discrete jump in mean conditions. Given committed change within the climate system, adaptive responses require an evolutionary approach to learning and incorporation into practice (IPCC). A key question concerns the adaptability of institutions and practice in the context increasing rates of change at present and in the near future, i.e. not just a change in base states by 2050 or otherwise.

RESPONSE

The need for near-term adaptation is addressed in Chapter 1.

24. Introduction. We recommend a single opening chapter instead of the two that now appear. This chapter would frame the entire report and set the stage for the content area chapter that follow. It would include the following components (most of which appear in draft chapters 1 and 2):

- Basic aspects of climate science, climate change, and variability as relevant to health and well-being
- An overview of human impacts, defining well-being and its component concepts, indicating that some of these (agriculture, transportation, energy) are discussed in other SAPS (4-3, 4-7, 4-5 respectively) while others (health, settlements) are addressed in this report.
- A discussion of concurrent forces that also affect health and well-being in addition to climate change, such as demographic change, urbanization, transportation and communication innovations, depletion of some water tables, globalization, and peak petroleum. This discussion would contextualize climate change.
- Introduction of key cross-cutting concepts such as mitigation and adaptation, vulnerability and resiliency.
- A discussion of certainty and uncertainty, and how they are assessed and expressed throughout the report.
- A glossary of key terms used throughout the report.

RESPONSE

Chapters 1 and 2 are being merged to include the following topics:

Basic aspects of climate science, climate change, and variability as relevant to health and well-being. Overview of human impacts, defining well-being and its component concepts, indicating that some of these (agriculture, transportation, energy) are discussed in other SAPS (4-3, 4-7, 4-5 respectively) while others (health, settlements) are addressed in this report. A discussion of concurrent forces that also affect health and well-being in addition to climate change, such as demographic change, urbanization, transportation and communication innovations, depletion of some water tables, globalization, and peak petroleum. This discussion would contextualize climate change. The introduction includes key cross-cutting concepts such as adaptation, vulnerability and resiliency. Finally, the report includes a discussion of certainty and uncertainty, and

how they are assessed and expressed throughout the report. A glossary of key terms used throughout the report is included as an Appendix to the report.

APPENDIX C

FACA PANEL INDIVIDUAL COMMENTS ON THE SAP 4.6

Reviewer Name	Affiliation	Chapter	Page	Line	Comment	Authors' Response to Comments
Barbara Entwisle	UNC-Chapel Hill	General	General	General	The distribution of the population within and between places determines settlement. Settlement is crucial to an understanding of the impact of climate variability and change because it defines exposure to a set of place-specific risks. Place-specific risks change as a result of climate change, and when they do, aggregate risk changes as well. Although the possibility of positive as well as negative changes in aggregate risk is noted at several points through the assessment, few examples are given. Most relevant research has focused on negative impacts, and in my opinion, this should be clearly stated. Social characteristics of the population may interact with its spatial distribution, and if so, the aggregation of risk may be nonlinear. This latter possibility is not addressed in the SAP. It should at least be mentioned.	We agree. Social characteristics of the population may interact with its spatial distribution, and if so, the aggregation of risk may be nonlinear. This will be addressed.
Barbara Entwisle	UNC-Chapel Hill	General	General	General	The distribution of the population within and between places responds to fundamental demographic processes. Given low fertility and mortality, migration and residential mobility are key, both as demographic backdrop and as response. Regarding the first, shifts of the population south and west, and to coastal areas are mentioned repeatedly through the SAP as increasing potential exposure to some of the negatives of climate variability and change. Immigration trends and their consequences are mentioned only in passing, however, and their implications are not explored. It is possible that climate variability and change will affect the rate of immigration (see below) and patterns of immigrant settlement. Mitigation and adaptation strategies will need to take into account the changing ethnic makeup of communities, including in the languages spoken.	We agree. Discussion of immigration trends and implications for adaptation will be better addressed.
Barbara Entwisle	UNC-Chapel Hill	General	General	General	Increases in the number of households and changes in their size distribution is another demographic trend of potential importance for the SAP. U.S. census data show that the number of households more than doubled between 1960 and 2006, faster than for the population as a whole, and the	The importance of one-person households will be addressed, especially as it relates to the implications of social isolation

Reviewer Name	Affiliation	Chapter	Page	Line	Comment	Authors' Response to Comments
					number of one-person households tripled. One-person households as a fraction of all households rose from 13.1% in 1960 to 22.7% in 1980, 25.5% in 2000, and 26.6% in 2005. This trend has implications for energy consumption in response to global warming. As a reflection of social isolation, it also has implications for responses to events such as hurricanes and heat waves.	
Barbara Entwisle	UNC-Chapel Hill	General	General	General	Migration and residential mobility are also key in terms of potential responses to climate variability and change. Environmental factors may act as “push factors,” contributing to a decision to move out of a particular area. They may also serve as “pull factors,” shaping the desirability of particular locales as potential destinations. One of the “truisms” about migration is that it is selective. Barring a full-scale disaster, migrants are positively selected from places of origin. Those leaving particular areas are generally better off than those staying. So long as those places of origin have positive qualities, those leaving will be replaced by other in-migrants. However, if those places of origin are undesirable as potential destinations for other migrants, they will become increasingly disadvantaged as out-migration continues. I was surprised not to see a clear call for more research on migration dynamics in relation to environmental factors in the SAP. The scenario I just sketched was assembled from disparate pieces of research and needs to be updated and verified at multiple social, spatial, and temporal scales.	<p>The importance of environmental factors as “push” or “pull” factors will be addressed.</p> <p>The research recommendation re: migration dynamics is well taken.</p>
Barbara Entwisle	UNC-Chapel Hill	General	General	General	As a related point, immigration into the U.S. may be stimulated directly and indirectly by climate variability and change elsewhere. Environmental refugees are mentioned at various points in the SAP, and illustrate a direct impact, but indirect impacts are likely to be even more important. Given the size and persistence of migration streams from Mexico and other parts of Central and South America, for instance, it is important to consider the possibility that climate variability and change in these regions may further increase immigration pressures. A global perspective on	The report is designed to address issues in the U.S., not international contexts. Nevertheless, environmental refugees are discussed in Chapter 1.

Reviewer Name	Affiliation	Chapter	Page	Line	Comment	Authors' Response to Comments
					climate variability and change is necessary even if ultimately, the concern is with impacts within the borders of the U.S. This is true not only with respect to issues of human settlement, but also with respect to health and welfare. While appropriate to focus on U.S. social systems, it is important to recognize that climate variability and change are global phenomena and that impacts outside of the U.S. may have direct consequences for social systems within the U.S. The scope of the SAP is defined too narrowly.	
Barbara Entwisle	UNC-Chapel Hill	General	General	General	An understanding of the human dimensions of climate variability and change requires high-quality data on the location and characteristics of the population at fine spatial and temporal scales. Earlier this year (2007), the NRC published a report entitled <i>Tools and Methods for Estimating Populations at Risk from Natural Disasters and Complex Humanitarian Crises</i> which made these points. Compared to many parts of the world, the U.S. has a wealth of census and survey data. That said, it is important to reaffirm the need for this data, both for the decennial census (which provides very fine spatial detail, but starting with 2010, not much social detail) and for the American Community Survey (which complements the census in providing better temporal and social detail but at not quite the same spatial detail). This should be a clear recommendation of the committee.	Chapter 5 on research recommendations is being added to the report.
Barbara Entwisle	UNC-Chapel Hill	General	General	General	Finally, in the study of settlements, it is important to recognize that communities are more than aggregative sums of their parts. Quite apart from their own characteristics, residents of communities that are better off social and economically, and better integrated and cohesive, often do better on a variety of health measures (the literature is voluminous and somewhat mixed, but this is the clear tendency among the results). The literature relating response to heat waves (Browning et al. 2006), etc. to community characteristics is very slim and should be expanded.	Settlements and Welfare chapters will address these issues.

Reviewer Name	Affiliation	Chapter	Page	Line	Comment	Authors' Response to Comments
Howard Frumkin	CDC, Emory	General	General	General	While certain health outcomes are well covered, others receive far too little attention. The four that receive most attention are water- and foodborne diseases, vector and zoonotic diseases, air quality, and extreme weather events. Three that are neglected are mental health, allergic disease, and food insecurity. <i>Mental health</i> is a key outcome (for example, arguably the major health impact of Hurricane Katrina) and one of the leading causes of DALYs worldwide. The draft does mention it (chapter 2, Box 2, on p 9; chapter 3, p 26, lines 21-24) but inexplicably fails to consider it in any depth. Two principal domains need attention: the anxiety, depression, and hopelessness that may accompany long-term climate-related changes, and the post-traumatic stress that may follow acute events such as hurricanes and floods. <i>Allergic disease</i> is mentioned in passing during the discussions of air pollution, but these discussions focus almost exclusively on ozone. An emerging literature discusses the growth of allergenic plants such as ragweed (e.g. Breton et al. 2006, Ziska et al. 2003, Wayne et al. 2002) and poison ivy (Mohan et al. 2006) and this needs to be cited and discussed. Finally <i>food insecurity</i> may threaten the health of poor people, as agricultural production is threatened by climate change (especially when concurrent trends—depletion of key aquifers such as the Ogallala and Floridan, depletion of soil, and petroleum scarcity—are taken into account).	Thank you. The Health chapter (2) will address these issues.
Howard Frumkin	CDC, Emory	General	General	General	The overall tone of the health discussion is at points a bit too reassuring, bringing to mind Okrent's Law ("the pursuit of balance can create imbalance, because sometimes something is true") For example, in Chap 2, p 8, on Table 2.1, we read that "Climate change will have negative and positive health impacts in the U.S.," a statement that is designated as "very likely." The probability of mutative impacts so outweighs the probability of positive impacts, that this statement is misleading as it stands. The document needs a careful check for such statements.	Statements of impacts have been carefully reviewed to insure consistency in tone and interpretation of effect.

Reviewer Name	Affiliation	Chapter	Page	Line	Comment	Authors' Response to Comments
Howard Frumkin	CDC, Emory	General	General	General	A similar concern arises in the summary of human welfare impacts in chapter 2, page 11. The bulleted list includes relatively trivial concerns (less skiing, erosion of beaches) while omitting far more profound concerns, such as the sorrow accompanying the loss of the concept of nature (described by Bill McKibben in his landmark book), the stress of living with chronic water scarcity in regions that depend on snowmelt, and the destabilizing influence of population shifts from coastal areas. The document needs a broader view and more proportionality.	The original chapter 2 discussion has been folded into the new chapter 1.
Howard Frumkin	CDC, Emory	General	General	General	An important dimension of climate change is mitigation—and mitigation will have impacts on health and well-being. For example, a shift to walking and bicycling will bring health benefits from physical activity, a shift to biofuels will raise the price of corn, and a shift to nuclear energy will increase the risks associated with nuclear waste. The document would benefit from a discussion of the health and well-being consequences of various mitigation strategies.	The report does not include discussion re: mitigation.
Howard Frumkin	CDC, Emory	General	General	General	Concurrent trends during the coming century will operate together with climate change to affect health and well-being. At present when these issues are mentioned it is usually in passing (e.g. chap 3, p 16, lines 25-29), resulting in an incomplete consideration of key issues. The document would benefit from an explicit discussion such trends as population growth, aging and other demographic changes, depletion of groundwater and soil resources, and decreasing availability of petroleum (Frumkin et al. 2007).	The health chapter has been revised to include this material.
Howard Frumkin	CDC, Emory	General	General	General	The conclusion of the health chapter includes a discussion of organizational arrangements for adaptation, and offers two suggestions—an independent agency (based on the UK Climate Impacts Programme) and the model of the NOAA Regional Integrated Sciences and Assessments (RISA) program. If this discuss is to remain, it needs considerably more depth. In particular there is only one national public health agency whose mandate includes precisely the health protection activities recommended on Chapter 3, pp 43-45: the CDC. Why is this not discussed?	This report is purposefully not policy proscriptive.

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Peter Gleick	Pacific Institution, NAS	General	General	General	In general, new and more up-to-date detail is needed, such as the IPCC new report; information about San Francisco's efforts to include climate change in new stormwater system planning and design (ask Gleick for citation); the failure to include climate change in the rebuilding efforts in New Orleans should be clearly described...	No scientific evidence appears to support this assertion though the popular press suggests that it's true.
Peter Gleick	Pacific Institution, NAS	General	General	General	Overall, update with new IPCC results.	Yes.
Eugene A. Rosa	Washington State University	General	General	General	<i>The Strategic Plan for the U.S. Climate Change Science Program, CCSP</i> (reviewed by a committee of the NRC/NAS on which I was a member) specified the preparation of 21 synthesis and assessment products (SAPs) for the 13 participating agencies, but only adumbrated the tasks of each SAP, not the specific charges to the respective agencies. Hence, despite the background information provided to the HICCAC, there is no clear trail connecting the broad mandate of the CCSP to the charge to the EPA. As a reviewer I would find a description of that trail useful and I believe readers would, too. Perhaps it is in the memorandum by William Brennan where he mentions, in passing, a prospectus: "It is important that the authors adhere closely to the terms and the product described in the prospectus." I don't recall seeing such a prospectus. (New paragraph) The more direct operational reason to see a delineation of this trail is to provide a general criterion to the HICCAC for performing its assessment and evaluation task. After all, the key basis of judging whether the report has met its charge is to examine it in the light of the specific expectations laid out for it. For example, how did the broad CCSP Goal 4 ("Understand the sensitivity and adaptability of different natural and managed ecosystems and human systems to climate and related global change.") get translated into an assessment of the more narrow effects of climate on human health, on settlement patterns, and on human welfare? Furthermore, the "Charge Questions" for the HICCAC states: "...the U.S. is called to develop and	The process for report preparation is covered in the new Chapter 1.

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					<p>deploy strategies for mitigating greenhouse gases and for adapting to individual and collective impacts.” Similarly, the abstract to the Executive Summary states: “...the United States is expected to develop strategies for mitigating greenhouse gases...” (ES, 2.9). But nowhere in the three short chapters I have read is there any mention whatsoever of mitigation strategies, a point to be developed a little further below. Nor is there a discussion of how mitigation strategies might reduce vulnerability or, conversely, increase resiliency. (New paragraph) I think it would improve the report if there was an introduction that gave a summary of its connection to Goal 4 of the CSSP and how that goal was translated into the specific issues addressed in the report: affects on human health, human welfare, and human systems.</p>	
Kristen Shrader Frechette	University of Notre Dame	General	General	General	<p>Although the report is much needed, important, generally clear, and well done, at least in ch. 2 (and perhaps elsewhere) scientific citations are needed after virtually every other sentence. As it is, the report makes many claims with which I happen to agree, but these claims are not documented, and many are very controversial. This lack of scientific citation makes the report vulnerable to serious criticism.</p>	<p>This concerned is addressed in the original version of Chapter 2 which has been revised extensively and included in the new Chapter 1.</p>
Kristen Shrader Frechette	University of Notre Dame	General	General	General	<p>Although the report makes hundreds of important claims and will do much good, there is a persistent conceptual ambiguity -- at least throughout the executive summary and chapter 2. This ambiguity is that the report repeatedly makes claims that appear to presuppose that many or most impacts of climate change can be ameliorated. This presupposition has at least 4 problems. First, it implicitly (and with subtlety) invites the reader to draw the conclusion that climate change is OK, since it can be ameliorated. Second, the presumption seems factually false or at least uncertain. Third, the reliability of the presupposition is dependent on "how much" climate change nations are able to avert, through their policies. Fourth, the presupposition (because of its ambiguity and its failure to discuss the issue of</p>	<p>These issues have been addressed in the merging of chapters 1 and 2.</p>

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					prevention adequately) invites the reader to ignore the benefits of preventing additional climate change -- although prevention is one of the best ameliorating strategies.	
Kristen Shrader Frechette	University of Notre Dame	General	General	General	Despite the strengths of the report, the frequent use of qualitative language such as "likely," "extremely likely," and so on, detracts from its scientific respectability; it would be better to replace these terms with citations to specific levels of uncertainty, scientific consensus, and so on, associated with each particular claim where these terms are used.	This language used to define uncertainty is applied based on expert scientific opinion. The use of the word likely has been confined to its formal usage. Every effort is made to be consistent across and within chapters.
Kristen Shrader Frechette	University of Notre Dame	General	General	General	Repeatedly the report reveals inconsistencies in its use of hyphens with compound adjectives.	Necessary changes made.
Kristen Shrader Frechette	University of Notre Dame	General	General	General	Repeatedly the report falls into grammar problems with agreement, misuse of colons before giving a list, and comma faults.	Necessary changes made
Susan C. Stonich	UC-Santa Barbara	General	General	General	Lack of an overarching framework: The entire document suffers significantly from the lack of comprehensive (integrative) conceptual, methodological, and analytical frameworks. As a result, the separate chapters (3-5) read as distinct, disarticulated pieces each organized differently, focused at various scales, using different categorizations of the impacts of climate change, and with different themes covered (or not). I find the conceptual organization of the SAP 4.6 to be incomprehensible: human health, human settlement, and human welfare are not comparable concepts – i.e., at the same level of abstraction. To me, human welfare is a much more inclusive concept than the other two and includes health and settlement as well as other dimensions. Yet human welfare is the final chapter of the report. I don't understand this, and in fact, not surprisingly,	Chapters 1 and 2 are being combined, the old chapters 3-5 will move to new chapters 2-4 and a chapter on research recommendations is being prepared. Every effort is being made to harmonize the chapters. The redundancy in chapter 4 (welfare) with the health chapter and, to a lesser extent, the settlements chapter, is intentional. The discussions of physical effects in the sectors of health, ecosystems, recreation, and

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					there is significant redundancy in Chapter 5 in terms of discussions of health and aspects of human settlement.	amenities (in the welfare chapter) are intended to provide the reader with the information necessary to read the subsequent discussions of economic welfare. The expectation is that some readers may be interested in these pieces who have not read the health chapter in its entirety, or the SAP on ecosystems.
Susan C. Stonich	UC-Santa Barbara	General	General	General	<p>Absence of clear definitions of key terms: Associated with lack of overall frameworks is the absence of (conceptual and operational) definitions of key terms in the introductory chapters (1 & 2) that are then used in all or in some of the following chapters. I believe the most important of these terms include: climate change, vulnerability and adaptation/adaptive capacity although there are several others (e.g., resilience, welfare/well-being/quality of life, sustainability, etc.) that are used throughout the document. There are so many perspectives of the concepts of vulnerability, adaptation/adaptive capacity, and resilience (as well as huge literatures and academic/ policy networks of individuals and institutions) that it is essential to establish specifically how those concepts are used in this document. The basic discussions of vulnerability (4.2) and adaptation (4.3) in Chapter 4 (Human Settlements) is very good and could easily be broadened beyond applications to human settlements to include health and human welfare as well. The application of the concept of vulnerability in terms of impacts on health (Chapter 5 Health) to specific human groups that are especially vulnerable to climate change also is excellent and should also be applied in Chapters 3 and 5 – to human settlement and welfare. Adequately defining these terms (as used in this document) in the introductory chapters would do a lot to integrate the entire document as well as reduce contradictions and redundancies in the rest of the document.</p>	A glossary is included in the report to address these issues and every effort is being made to insure that key terms are defined.

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Susan C. Stonich	UC-Santa Barbara	General	General	General	<p>Under-citing statements/claims and inadequate integration of important recent international efforts on the human dimensions of climate change: To me, a great many of the statements and claims made in Chapters 1 and 2 require citations, many of which are not included. This includes making claims about controversial and contested issues. My copy of those chapters is littered with specific instances of this and are too numerous to include here. I will leave my copy of these chapters with the co-chairs after the meeting. Glaringly absent from the document are references to the 2007 IPCC Working Group II and III reports and summaries for policy makers, although these are available online. Although the IPCC WGI SPM is referred to in Chapter 1, IPCC WG II and III reports are much more relevant to SAP 4.2. These could provide not only some guidance on framing, organizing, and structuring the SAP 4.6, but would also provide a more global context in which to place the U.S. case. Similarly, I would like to see some reference to several documents in the Millennium Ecosystem Assessment: Ecosystem and Human Well-Being, including the framework for assessment, as the complex relationships between ecosystems and human well-being are not treated sufficiently in SAP 4.6.</p> <p>To indicate the likelihood of outcomes or results, the SAP 4.6 does make use of the terms in the Likert-like scale in the IPCC WG I Summary for Policy Makers and report: i.e., a 10 point scale varying from “Virtually likely” (>99% probability of occurrence) to “Exceptionally unlikely” (<1% probability). However, I consider the use of this particular scale problematic and would prefer the use of the 7 point scale in IPCC II and IPCC III for a couple of reasons grounded in social science methodology (I can provide citations for this if necessary). Likert-like scales (and there are hundreds if not thousands) are normally composed of 3, 5, or 7 items, with the middle choice indicating some degree of neutrality. Further, human minds apparently have a</p>	<p>We are tightening the presentation of the science with appropriate citations.</p> <p>In addition, the discussion of uncertainty has been edited to include a seven category scale as provided in the IPCC WG2 AR4.</p>

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					difficult time conceptually differentiating scales with more than 7 elements. While I support the decision to use a scale system that was used in the IPCC reports because it makes the findings/conclusions of SAP more comparable with those of the IPCC, I believe that the use of the 7 point scale by IPCC WGII be employed. If finer resolutions are required (or known) then specific probabilities can be used in the document. (I believe, but do not know, the IPCC WG I used a 10 point scale in order to indicate increased precision. In any case, as a social scientist this is my position.	
Susan C. Stonich	UC-Santa Barbara	General	General	General	<p>Painting too positive a picture of climate change: In total, the introductory chapters and especially Chapter 5 overly emphasize the positive impacts of climate change and down play, overlook, or trivialize the negative ones – especially the effects of climate change on vulnerable populations who also have the least adaptive capacity/resilience. A glaring example of this is in the summary of impacts on human welfare (Ch 2, p. 11, Lines 21-33), in which the first impact listed is “disruption of recreation and outdoor activities” and the second is “limit on some snow-related recreational activities.” With the memory of Hurricane Katrina and the high probability of more intense and more frequent extreme weather events, sea level rise, and temperature increase, the disruption of recreation and outdoor activities and snow related activities does not seem crucial. (Although the impacts of climate change on the tourism industry, a major economic sector in the U.S. certainly is important).</p> <p>This overall emphasis also tends to trivialize some findings, e.g., in Table 2.3 (Chapter 2, p. 12), where one of the impacts of climate change on human welfare, “climate change will have positive and negative non-market effects on health, recreation, amenities, and communities” is judged as “very likely.” No surprise there.</p> <p>I realize that to a great extent, the somewhat biased positive</p>	<p>Greater attention has been paid to the political economic aspects of climate change impacts.</p> <p>This perspective would help balance the conclusions of the SAP4.6 by including issues such as inequity related to the impacts of climate change, environmental justice, social justice, and other related issues.</p> <p>Chapters have been reviewed for tone and balance, and edits made.</p> <p>Note: The Welfare chapter is not intended to be a review of all aspects of human welfare. Its purpose is to provide evidence of a well-being framework that could be used for climate change, and to review the economic welfare literature that is not present elsewhere.</p>

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					assessment of SAP 4.6 is the result of the limited theoretical and political perspective of the agencies requiring and supporting the SAPs, however, I believe some attention needs to be paid to more political economic (and other) perspectives of climate change. These perspectives would help balance the conclusions of the SAP4.6 by including issues such as inequity related to the impacts of climate change, environmental justice, social justice, and other related issues.	
Susan C. Stonich	UC-Santa Barbara	General	General	General	Treating the U.S. as an isolated case: In this era of globalization, the U.S. does not operate in an isolated vacuum, yet the relationship of the U.S. to the rest of the world in terms of climate change is hardly mentioned in the SAP 4.6. The impacts of climate change do not stay within the U.S. nor is the U.S. immune to impacts of climate change from outside the U.S. Human migration, trade, food security, and many other forces and impacts in the U.S. cannot be considered without contextualizing the U.S. in the global setting.	An effort is being made to better characterize the context of the U.S. in the global scene with respect to migration, trade, food security and other impacts that are influenced by the global setting.
Susan C. Stonich	UC-Santa Barbara	General	General	General	Speaking of food security: I do not understand the absence of “food security” in the SAP 4.6. Food production (in the U.S. as well as elsewhere given our growing reliance on imported food), nutritional impacts, food security (including access, distributional, sustainability, and food safety aspects), and the relationship between nutritional status and human health, are crucial human dimension issues. It may be that these are included in other SAPs but even if they are they deserve some treatment in SAP 4.6., both in the introductory and summary chapters as well as in Chapters 3 and 5.	SAP 4.2 is the “home” of agricultural impacts.

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Susan C. Stonich	UC-Santa Barbara	General	General	General	Some additional concerns: (1) The use of diverse and varied scales (levels of analysis) in each chapter (geopolitical, social, spatial, temporal, ecosystem), (2) The homogenization of the concept of “community” given that a huge literature exists on the heterogeneity of communities in terms of social/cultural categories that are relevant to understanding the differential impacts of climate change (especially in terms of vulnerability and adaptive capacity/resilience), (3) The superficial treatment of mitigation (see IPCC WG III), (4) An unsubstantiated dependence on technological innovation and/or insurance to deal with the impacts of climate change, (5) Direct and forthright discussion of the trends that are likely to make the development of strategies to deal with climate change more difficult such as: Continued development in coastal zones, Increasing demand for freshwater resources, (6) The cumulative effect of climate change and other driving forces (7) Globalization – the connections with the rest of the world	<p>Thank you. We have addressed these issues in the new Chapter 1.</p> <p>The discussion of communities in the welfare chapter recognizes that communities consist of individuals and groups with varying degrees of vulnerability and adaptive capacity. Additional material on vulnerability of different groups has been added in a text box.</p>
Susan C. Stonich	UC-Santa Barbara	General	General	General	Comments specific to Chapter 5: (1) Narrow focus in the entire chapter on a particular kind of economic approach to human welfare and the impacts of climate change to human welfare, (2) Conceptually this chapter seems out of sync with the other chapters and introduces a number of new concepts and approaches that do not appear in other chapters (e.g., economic valuation, social capital, ...), (3) Much of this chapter is a text/justification of valuation methods in economics – in this case to assess the impacts of climate change – and does not directly address the mandate/questions of the SAP, (4) I am uncomfortable with the interchangeable use of the terms “well-being,” “welfare,” and “quality of life.” Human welfare may be an elusive concept as stated by the authors, but I want to know specifically how the concept is defined and used in this report, (5) This chapter would benefit considerably by the use of the concepts of vulnerability and adaptation as laid out in Chapter 4 and applied in Chapter 3. This could also	<p>See the new Chapter 4 (Welfare)</p> <p>Two sentences were added and a footnote to the paragraph on non-market effects in the framework section. The added text and footnote include seven new citations, including one to Boyce piece. However, the political economics perspective, as typified by Boyce's work, is focused more on issues of ownership and equity, and is not central to the main purpose of the chapter. It is therefore mentioned in the footnote.</p> <p>The work of ecological economists,</p>

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					be a means to better integrate this chapter with the others. (6) If an economic approach to human welfare is essential in this chapter, I recommend integrating other economic approaches, especially those of ecological economists and political economists. Here the efforts of James Boyce and colleagues at the Political Economic Research Institute at U MA could be a starting point, but there are many ecological economists	as typified by Costanza's attempt to generate a comprehensive measure, is summarized in a new sentence (the original introductory sentence actually referred to the method used in his work which is now cited). Two critiques of Costanza's work are also referenced, as is an NAS/NRC publication on ecological valuation that appears relevant and represents a balanced discussion. Work by Jim Boyd on Green GDP and non-economic indicators of ecological health is also cited.
Roger Pulwarty	NOAA	General	General	General	There is significant overlap between this SAP and 3.3 (Extremes and 4.3 Land and Water resources (e.g. Box 4 Ch1 p15, Ch 3 Fig. 2 p. 6. The degree of overlap may have to be minimized or coordinated.	The other Goal 4 SAPs are described in the Chapter 1.
Roger Pulwarty	NOAA	General	General	General	The summary and impacts sections should be concrete on the data limitations especially for reconstructing epidemiological histories, local climates records for understanding climate-health linkages, linking local data to scenarios,	Data limitations will be discussed in the new Chapter 5 on research recommendations and data gaps.
Roger Pulwarty	NOAA	General	General	General	The SAP mixes units of analyses throughout (communities, landscapes). Some consistency is needed when different units are used.	Point well made.
Roger Pulwarty	NOAA	General	General	General	The SAP does explicitly recognize the distinction between primary, secondary and tertiary impacts. As such the complexity of indirect ecologically mediated effects via indirect pathways receive little attention (even to acknowledge limits in understanding). The study appears to assume a cause-effect (dose-response) relationship between climate change and health.	We agree. A discussion of this distinction is made in Chapter 5

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Roger Pulwarty	NOAA	General	General	General	The use of early warning systems in the context of present extremes and ENSO variability should be outlined (with clear examples given (e.g. for West Nile, Dust, flu) This would be help place greater confidence in this recommendation as a viable learning and adaptation mechanism for addressing response in spite of confounding factors in climate-health relationships.	See language in the New Chapter 2: Human health
Roger Pulwarty	NOAA	General	General	General	While it may be problematic to actively disaggregate the information as presented, the literature (1) contains several examples of gender bias in health care, (2) migrants populations, and (3) identifies differential roles in disaster mitigation especially as related to nutrition (see Enarson, Peacock, Hearn Morrow and others. Gender issues are relevant to each of the chapters	Point well made.
Tom Dietz	Michigan State University	General	General	General	<u>Conclusions without comparative analysis.</u> There is a tendency throughout the report to assume that adaptation is relatively easy, or that climate change is not “primary,” or to adopt other language that minimizes the assessed impacts of climate change without any analysis or references to literature to justify it. In some places, e.g. Chapter 2, the report seems to contradict itself by saying climate change will be marginal on average then giving a series of analyses that contradict this. Some assessment of orders of magnitude are needed for comparisons before such judgments can be made. And if such analyses haven’t been done or are not feasible, that should be clearly identified as a weaknesses in the state of knowledge that badly needs correcting.	A better sense of proportionately is being applied to the newly merged chapters 1 and 2
Tom Dietz	Michigan State University	General	General	General	<u>Language about uncertainty.</u> The use of the Moss/Schneider derived guidance is appropriate and admirable. But it is not deployed consistently in the chapters. At a minimum the report might say that this language will be used only in specific tables, which seems usually to be the case. Better, the language throughout should be cleaned up, and this section should note the colloquial terms used if that is deemed necessary to carry the prose. Assigning certainty/ uncertainty assessments to policy and research issues is an	Topic chapters are being reviewed for consistent use of uncertainty language.

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					excellent approach. It should be done consistently throughout the report.	
Tom Dietz	Michigan State University	General	General	General	<u>Adaptation but not mitigation.</u> It is unbalanced to discuss adaptation strategies to reduce vulnerability without also considering mitigation. A logical analysis would consider the costs, benefits and risks of both mitigation and adaptation strategy and search for an optimal mix of the two. Even if the state of the science does not allow this it should be noted as what is required as a logical analytic base for policy discussions and that the science needs to be in place to do this.	Mitigation policies are not the province of this report.
Tom Dietz	Michigan State University	General	General	General	<u>The capacity for adaptation.</u> While the idea that the U.S. is affluent and can adapt is raised repeatedly in the report, how carefully has the adaptive capacity been assessed? For example, both there are well respected analyses that indicate that the public health system and the engineered infrastructure of the country have deteriorated because of a lack of public investment. It is not accurate to suggest that adaptation is easy when key elements of the adaptive systems are already having difficulty sustaining their capacity. This raises the institutional questions as well. Arguably, no society in history has been as affluent as the U.S. during the last half of the 20 th century. Yet we witnessed a catastrophic failure of adaptive capacity during Hurricane Katrina. Any argument for being sanguine about our adaptive capacity has to argue why that failure of adaptation at the end of a period of 50 years of affluence is not the appropriate model for the next 50 years. One can think of many other examples of failure in adaptation, this is merely the most dramatic. The point is that if the report is going to argue that adaptation will be successful, that argument should be based on analysis and not just hopes.	The limitations of adaptation strategies in the US is being better addressed in the new chapter 1/2

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Tom Dietz	Michigan State University	General	General	General	What climate changes? What scenarios and what GCM outputs are guiding this analysis. It appears that unlike the National Assessment, there are not specific GCM projections that undergird this analysis. This is a weakness and if it is a necessary weakness given the constraints of the assessment, that should be noted explicitly and its implications, positive and negative, discussed.	No specific GCMs are being utilized in this assessment. That statement is clear in the Chapter 1 discussion.
Tom Dietz	Michigan State University	General	General	General	Who is the audience for the report? A recent NRC analysis of global change assessments argues that the best assessments, inter alia, : 1-have an audience asking for them, and 2-engage a broad range of stakeholders (U.S. National Research Council. Committee on the Analysis of Global Change Assessments. (2007). Analysis of Global Change Assessments: Lessons Learned. Washington, D.C.: National Academy Press). The report should identify clearly who is asking for this assessment, and what decisions it will inform.	We agree. Language is being prepared to address this issue in the Chapter 1.
Tom Dietz	Michigan State University	General	General	General	What stakeholder engagement supported the report? The report should also discuss what stakeholder engagement underpins the assessment, what the limitations of that engagement have been, and what the implications are for “getting the right science and getting the science right”) Stern, P. C., & Fineberg, H. (Eds.). (1996). Understanding Risk: Informing Decisions in a Democratic Society. Washington, D.C.: National Academy Press).	Stakeholder engagement has been limited to public comments on the prospectus and on the actual report. A widespread dissemination of the report included resource managers, public health officials, city and county planning officials, etc.
Tom Dietz	Michigan State University	General	General	General	Coordination across chapters. The biggest problem is bringing chapters 1 and 2 into better alignment in tone and judgment with chapter 3-5. However, these latter chapters, while in better shape overall, need a bit more cross-referencing and checking for consistency, e.g. the discussion of heat health effects and urban heat islands.	Chapters 1 and 2 are being combined and harmonized. Chapters 2-4 will then be updated to insure consistency across and within chapters
Tom Dietz	Michigan State University	General	General	General	Consistency with MA and IPCC. As much as possible the report should use the accepted language, framework, concepts, etc. developed by the IPCC and the MA. The use of the MA approach to ecosystem services, for example,	As mentioned in collective comments, the MA greatly informed the discussion in the welfare chapter. Additional

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					allows easier understanding than would result from an ad hoc approach. This also argues for discussion welfare as a particular approach to well-being rather than as a framing concept.	citations to the MA and material/citations to the IPCC Fourth Assessment have been added in the chapter.
Tom Dietz	Michigan State University	Exec. Summary	2	2	“demographics” is colloquial/ business in usage not social scientific.	Point well made
Peter Gleick	Pacific Institution, NAS	Exec. Summary	2	1-16	Replace Abstract with the following edited Abstract: Climate change, interacting with changes in land use and demographics, will affect important human dimensions in the United States, especially related to human health, settlements and welfare. The challenges presented by population growth, an aging population, migration patterns, and urban and coastal development will be compounded by changes in temperature, precipitation, and extreme climate-related events. Climate change will affect where people choose to live, work, and play. Among the most likely climate changes are changes in the intensity and frequency of precipitation, more frequent heat waves, more persistent and extreme drought conditions and associated water shortages, changes in minimum and maximum temperatures, potential increases in the intensity and frequency of extreme tropical storms, measurable sea-level rise and increases in the occurrence of coastal and riverine flooding. In response to these anticipated changes, the United States will be required to both develop and deploy strategies for mitigating greenhouse gases and for adapting to unavoidable individual and collective impacts of climate change. This report – the Synthesis and Assessment Product 4.6 (SAP 4.6) – focuses on impacts of global climate change, especially impacts on three broad dimensions of the human condition: human health, human settlements, and human welfare. The SAP 4.6 has been prepared by a team of experts from academia, government, and the private sector in response to the mandate of the U.S. Climate Change Science Program’s Strategic Plan (2003). The assessment examines potential impacts of climate change on human	Thank you. This abstract has been exchanged.

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					society, opportunities for adaptation, and associated recommendations for addressing data gaps and near- and long-term research goals.	
Eugene A. Rosa	Washington State University	Exec. Summary	2		The discussion plunges too quickly into the summary table (itself quite useful); there needs to be a better connection to the table and a smoother transition to its presentation	Some language has been added to smooth this transition
Peter Gleick	Pacific Institution, NAS	Exec. Summary	3	Table ES-1	Change “Increase in Precipitation” to “Changes in Precipitation” [Under Climate Factor column]	Change made as suggested
Eugene A. Rosa	Washington State University	Exec. Summary	3		In the adaptation strategies for air pollution here, and elsewhere, there is a conflating of mitigation actions versus adaptive actions. The use of alternative fuels would contribute first to the reduction of CO ₂ , one key mitigation practice, before it would add to the adaptation capabilities of communities or regions. I don’t think mitigation and adaptation are the same and, accordingly, should be treated so.	We agree. Appropriate language is provided to address this point.
Tom Dietz	Michigan State University	Exec. Summary	4	1	What about energy efficiency?	Language added
Tom Dietz	Michigan State University	Exec. Summary	4	6	Not in south and southwest?	Language added
Tom Dietz	Michigan State University	Exec. Summary	4	7	“Engage in alternatives” ignores regional and local economic impacts—the alternatives my lead to substantial economic disruption in some areas. And what of northern New England and the upper Great Lakes where skiing and snowmobiling, respectively, are economically significant. On the latter see http://www.pileus.msu.edu/tourism/ and well as Hamilton, L. (2003). Warming winters and New Hampshire’s lost ski areas: An Integrated Case Study	Language added.

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					International Journal of Sociology and Social Policy, 23(10), 52-73.	
Peter Gleick	Pacific Institution, NAS	Exec. Summary	4	Table	Under “Drought” add in “Adaptation Strategies” column: “Reallocate water among current users; develop water markets to encourage more efficient allocation.”	Addition made.
Peter Gleick	Pacific Institution, NAS	Exec. Summary	4	Table	Under “Late snow fall and early snow melt” add in “Adaptation Strategies” column: “Modify operation of existing infrastructure to account for changes in hydrology.”	Addition made
Eugene A. Rosa	Washington State University	Exec. Summary	4		It is difficult to imagine significant climate change without serious impacts—positive and negative—to economic activity and, consequently, human welfare. Positive benefits, for example, might include the expansion of jobs in the old port cities, and in newly emerged port cities on the West coast of the U.S. if arctic melting leads to new shipping channels in the northern Pacific ocean. Conversely, additional expenses incurred by industry and business could squeeze profits resulting in lowered wages or fewer jobs.	Thank you for the comment. No change / addition has been made.
Eugene A. Rosa	Washington State University	Exec. Summary	5	16	I can see no ostensible reason to provide a cover statement for the report that compares the U.S. with the poorer nations of the world. While the claim of our advantaged position is not necessarily false, it potentially leads to the belief that there is little to worry about in the U.S. I doubt that such a belief could attract widespread consensus among climate and policy experts—or even the informed public.	Paragraph has been extensively rewritten to address this concern.
Eugene A. Rosa	Washington State University	Exec. Summary	6	7-8	I do not understand this sentence: “Nonetheless, climate change will seldom be the primary factor affecting the burden of climate-related injuries, illness, and death.” If climate is not causing “climate-related” outcomes, what is?	Change made to clarify this point.
Tom Dietz	Michigan State University	Exec. Summary	6	7-8	Not sure what this sentence means.	Language clarified

Reviewer Name	Affiliation	Chapter	Page	Line	Comment	Authors' Response to Comments
Roger Pulwarty	NOAA	Exec. Summary	6	16-20	Unclear as to the distinction between West Coast vs. Western precipitation declines. Both regions (at least at high elevation sites) are projected to experience declines.	Change made to clarify this point.
Eugene A. Rosa	Washington State University	Exec. Summary	6	33-36	Overlooked in the delineation of impacts from changes in precipitation patterns is the consequence of reduced snowmelt on certain regions of the country, especially the Pacific Northwest. That region, and perhaps others, has an electricity base dominated by hydropower that is directly dependent upon the water flows from snowmelt. Reduced hydropower would mean the need for supplemental electricity sources, resulting in a wide variety of negative ripple effects to the economy and to human welfare.	Language added to bolster this point.
Tom Dietz	Michigan State University	Exec. Summary	7	15-22	And substantial equity effects will be entrained as the need increases prices rise and those with low income are increasingly stressed by it and least able to adapt to it.	Language included to make this point.
Tom Dietz	Michigan State University	Exec. Summary	7	23 et seq.	I agree but the comments on recreation seem to contradict what is said on p. 4 row 7 where it implies just a shift in kinds of recreation without considering local/ sectoral disruptions.	Addition made to clarify this point.
Jonothan Patz	Univ. of Wisc., NCAR	Exec. Summary	8	11	the para is about issues related to sea level rise. While I know that Great Lakes are often grouped with coastal issues, the issue of 'low lying' counties seems out of place. If anything, the Great Lakes are projected to drop.	We agree.
Roger Pulwarty	NOAA	Exec. Summary	8	12-16	It is unclear as to how physical vulnerability is weighted against adaptive capacity to produce the index mapped in Fig ES 1. This Figure may have to be removed if the weighting and types of hazards are not identified.	Will consider removing this map ... it does not clearly express the point it makes.
Eugene A. Rosa	Washington State University	Exec. Summary	8	24-25	The report appropriately recognizes the amorphous conceptualization in several literatures of the term "human welfare," despite the frequent and effective use of that term. It then shifts terminology to "quality of life," a complement to human welfare, but a similarly amorphous concept. However, these two concepts are not equivalent in the sociological literature; welfare often refers to structural features of a society (later referred to as "individual and group life conditions") and aggregated measures of those	In response to several comments on the terminology, we have opted in the Welfare Chapter to confine the use of the term human welfare to economic welfare (an approach that is consistent with definitions in the IPCC). The concepts of well-being and quality of life are used interchangeably in the chapter to

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					features while quality of life typically refers to the subjective experience of citizens. Hence, for consistency and because of the six dimensions chosen to measure the concept (none measuring subjective experiences), the report would be well served by dropping the quality of life terminology.	describe the conditions of place/life that enable pursuit of individual preferences and states of psychological satisfaction. The decision to use the concepts of well-being and life quality interchangeably reflects the synonymous use of the concepts in medical, sociological, psychological, and urban planning literatures.
Peter Gleick	Pacific Institution, NAS	Exec. Summary	8	Figure	I don't understand the units in the legend. This must be explained.	Figure is deleted
Jonothan Patz	Univ. of Wisc., NCAR	Exec. Summary	8	Figure ES 1	What are the units of the legend?	Figure is deleted
Tom Dietz	Michigan State University	Exec. Summary	8	Figure ES 1	The labels could be much clearer. This is presumably based on a factor score, which is unfortunate because the negative scores are hard for the average reader to interpret.	Figure is deleted
Jonothan Patz	Univ. of Wisc., NCAR	Exec. Summary	9	41	with regards to beaches, however, for inland beaches, heavier runoff causing beach contamination (coupled with more beach goers) could lead to more people exposed to unhealthy contaminants in recreational waters	We agree.
Eugene A. Rosa	Washington State University	Exec. Summary	9	1-2	(same comment as exec. summary, page 8, line 24-25) The report appropriately recognizes the amorphous conceptualization in several literatures of the term "human welfare," despite the frequent and effective use of that term. It then shifts terminology to "quality of life," a complement to human welfare, but a similarly amorphous concept. However, these two concepts are not equivalent in the sociological literature; welfare often refers to structural features of a society (later referred to as "individual and group life conditions") and aggregated measures of those features while quality of life typically refers to the subjective experience of citizens. Hence, for consistency and because of the six dimensions chosen to measure the	We are making every effort to clarify this use of terminology in both the executive summary and in the topic chapter 4

Reviewer Name	Affiliation	Chapter	Page	Line	Comment	Authors' Response to Comments
					concept (none measuring subjective experiences), the report would be well served by dropping the quality of life terminology.	
Tom Dietz	Michigan State University	Exec. Summary	9	2-8	This is not the same as the Millennium Assessment or Our Common Journey, and in the text I hope some effort is made to justify the particular dimensions used, and the use of the term welfare rather than well-being. It's particularly telling in light of t	Thank you for the suggestion
Tom Dietz	Michigan State University	Exec. Summary	9	20-29	This appears to use the MA typology and that is good but then the labeling should be consistent, not just invoking support and cultural services.	Thank you for the suggestion
Tom Dietz	Michigan State University	Exec. Summary	9	31-41	Can this argument be sustained? Most growth is in the sunbelt (see Table ES.2), and there increased high temperatures, reductions in water availability, etc. may contravene the effects of higher temperatures in the coldest seasons, which is not a severe	Point well made.
Peter Gleick	Pacific Institution, NAS	Exec. Summary	10	ES-2	Where does this Table come from? The check marks seem completely random and not based on science. For example, why is heat waves not checked for the New England, even though research has been done on heat wave frequency and intensity for this region, for example?? Why is there no column for Sea Level rise or Coastal Impacts?? These have been identified throughout the report as a key, critical regional/urban impact.	The table has been extensively modified and included in the Executive Summary.
Eugene A. Rosa	Washington State University	Exec. Summary	10	Table ES.2	The ease of reading the table is confounded by the misalignment between the icons within the table and the icon key at the bottom of the table. It would make simple sense, and be more reader friendly, if the icons in the key followed the same order as they are presented in the table: degraded summer air quality, urban heat islands, etc.	Point well made. Change made to both the icons and to the assignment of importance across and between regions.
Tom Dietz	Michigan State University	Exec. Summary	10	Table Es.2	What is the basis for the presence and absence of check marks? What I see is not intuitively obvious.	See comment above.

Reviewer Name	Affiliation	Chapter	Page	Line	Comment	Authors' Response to Comments
Eugene A. Rosa	Washington State University	Exec. Summary	Table ES.1		Here and elsewhere whenever an assessment is presented it would be reader friendly (and contribute to consistency) to include, in parentheses, the adopted numerical probability connected to each verbal probability (e.g. >90% for very likely, >66% for likely, etc.).	There is not adequate space to include this information for every entry.
Tom Dietz	Michigan State University	1	2	21	Does this list reflect current thinking on vulnerability and resilience, adaptive management and environmental/ecosystem governance? And should not mitigation be taken into consideration along with adaptation, since analyses are likely to indicate some impacts that are not within the adaptive range we can anticipate but might be avoided by mitigation.	Discussion of mitigation policies is not included in this report.
Tom Dietz	Michigan State University	1	2	23	Presumably it's not where it was published but the area analyzed that was the scoping constraint.	Yes.
Tom Dietz	Michigan State University	1	2	8-9	This sentence is hard to follow.	We agree.
Tom Dietz	Michigan State University	1	2	12-14	What of ecosystem change that may come from climate change, human management practices, invasive species, changes in biogeochemical processes and their interactions? It seems not to include this in the scope of what is considered.	Ecosystem change is not included in the SAP 4.6. The SAP 4.4 explicitly examines impacts related to ecosystem services, invasives, etc.
Tom Dietz	Michigan State University	1	2	23-35	Does the audience not include the research community who would advance our knowledge on these issues?	Addition made to paragraph
Tom Dietz	Michigan State University	1	2	38-39	The amount of exposure matters but so does the degree of vulnerability.	Change made as suggested
Eugene A. Rosa	Washington State University	1	2	40-42	It appears that the report, following a growing practice in the global environmental change community, has adopted a vulnerability-resiliency-adaptation (v-r-a) based framing that excludes the idea that even if climate change is inevitable—now the consensus in the scientific community—there remains the opportunity to lessen its impacts. In short, the opportunity to mitigate the causes of	Mitigation is not included in this report.

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					climate change (which have proximate benefits on their own) is preempted with the v-r-a framing. Yet, mitigation seems embedded in some of the recommendations for addressing the multitude of risks associated with climate change. For example, goal (i), “To avoid maladaptive responses,” and goal (ii) “To manage significant risks proactively when possible,” could both be interpreted as mitigation actions. They are apparently not termed “mitigation” because the v-r-a framing excludes that possibility <i>a priori</i> .	
Tom Dietz	Michigan State University	1	3	5	Does this list reflect current thinking on vulnerability and resilience, adaptive management and environmental/ ecosystem governance? And should not mitigation be taken into consideration along with adaptation, since analyses are likely to indicate some impacts that are not within the adaptive range we can anticipate but might be avoided by mitigation.	Mitigation is not included in this report
Jonothan Patz	Univ. of Wisc., NCAR	1	3	29	Should add 4 th , so reads, “The IPCC Third and Fourth Assessment Reports (IPCC, 2001; 2007) conclude....	Change made
Eugene A. Rosa	Washington State University	1	3	29-30	It is unclear why the third IPCC assessment is cited here regarding human settlements, while the fourth assessment is cited elsewhere. Is it because the former addressed human settlements while the latter did not?	Both the 3 rd and the 4 th IPCC reports are now cited.
Tom Dietz	Michigan State University	1	4	1-3	This makes it seem as if institutions and other social factors don't influence vulnerability when the vulnerability literature emphasizes their importance.	Suggested change is made.
Eugene A. Rosa	Washington State University	1	4	6-9	Why is health, often the most important welfare issue to people, omitted from the list of welfare components?	Health is added to the list.
Tom Dietz	Michigan State University	1	4	8-9	Economic “power” seems a strange term to use. And what of freedom and political power, arguments embedded in Sen's and Nussbaum's arguments, e.g. in Sen, A. (1999). Development as Freedom. New York: Random House. And there are pretty well accepted indicators on the international scene: life expectancy, the HDI and PQLI. These should at	Suggested change is made.

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					least be mentioned.	
Eugene A. Rosa	Washington State University	1	4	13-15	Stated here is an important conclusion that points to a literature that is inappropriately left uncited.	No change.
Eugene A. Rosa	Washington State University	1	4	34-37	Here the scope of the report—a fully appropriate step—is described. However, again I raise the issue of the appropriateness of the v-r-a framing that defines the scope, raising the issue of whether it is broad enough to affectively address the goals of the report.	The issue of mitigation is not addressed by this report.
Jonothan Patz	Univ. of Wisc., NCAR	1	4	section 1.2	Excellent primer!	Thank you.
Tom Dietz	Michigan State University	1	5	5	“see” level should be “sea” level	Change made.
Eugene A. Rosa	Washington State University	1	5		The presentation of the impacts and adaptations of the most recent IPCC report, the fourth assessment, is a useful prelude to examining the human impacts of the projected changes. However, these general findings, I believe, are for the globe as a whole, meaning there will be variation in impacts in different regions of the world. It may be the case that the models and other analyses producing these findings still await downscaling to account for such variation. Nevertheless, it would still be appropriate to alert readers to the fact that the impacts identified by the IPCC will not be the same in all regions of the globe, nor specific countries, equally.	Point well made. Clarifying language has been added to this section to acknowledge that there will be variation in impacts in different regions of the world
Tom Dietz	Michigan State University	1	6	16,18	Degree needs to be superscript	Change made
Tom Dietz	Michigan State University	1	7	34-36	Sentence unclear to general reader for whom this is intended.	Clarification made
Tom Dietz	Michigan	1	8	36	No colon in mid sentence	Change made

Reviewer Name	Affiliation	Chapter	Page	Line	Comment	Authors' Response to Comments
	State University					
Tom Dietz	Michigan State University	1	8	25-30	This list of questions should be shaped by climate change issues not by general demographic change. The first two questions make sense. Other than an influence on overall population growth in some communities, why is immigration singled out? I also am not clear why rural/urban transitions for counties is an issue listed. On the last question the issue seems to be not retirees but rather where the vulnerable elderly will live. The same may be asked about other vulnerable groups—the poor, the very young, those with particular health problems.	No change made.
Tom Dietz	Michigan State University	1	9	4-5	What is a “rigorous” scenario?	Change made as suggested
Tom Dietz	Michigan State University	1	10	1-2	I think you mean population projections, most professionals don’t refer to these as forecasts. This sentence is hard to follow.	Change made as suggested
Tom Dietz	Michigan State University	1	10	Box	“While” and “However” seem awkward	Change made as suggested
Tom Dietz	Michigan State University	1	11	10	Gateway not defined	Definition added.
Tom Dietz	Michigan State University	1	11	3-6	This seems to imply that these patterns are not a result of policy decisions. Many argue that a critical factor was the degradation of mass transit systems of the late 19 th and first half of the 20 th century, along with policies intended to facilitate such growth.	No change needed.
Eugene A. Rosa	Washington State University	1	11	6-10	Central cities are not always global cities, and a nontrivial amount of population migration will be to non-global cities.	Wording changed to clarify this point.
Tom Dietz	Michigan State University	1	11	20-22	This seems to imply that suburban sprawl is a good policy for adapting to climate change. Is that what is intended?	Wording changed to clarify this point.

Reviewer Name	Affiliation	Chapter	Page	Line	Comment	Authors' Response to Comments
Eugene A. Rosa	Washington State University	1	12	4	Despite laying out six dimensions of human welfare and mapping them onto appropriate measures, the discussion here shifts to “quality of life” as a subjective concept—as I pointed out above. This is potentially confusing. My suggestion is to make a distinction between human welfare and quality of life at the outset, indicate that the emphasis will be on the former but that the latter is important for certain factors impinging on welfare.	Wording changed to clarify this point.
Eugene A. Rosa	Washington State University	1	12	13-14	What about recreational activities or aesthetics?	Addition made to text.
Tom Dietz	Michigan State University	1	12	13-23	This needs editing for clarity. It assumes that climate is important in migration and then qualifies that statement. It would make more sense to also evidence of the importance of climate in migration and at least speculate about whether and how climate change might influence that. For example, if the destination areas become hot and dry while the origin areas today become warmer and stay wet, might the projections be off? This is addressed in the next paragraph. But the flow is awkward.	Paragraph edited to improve clarity.
Eugene A. Rosa	Washington State University	1	12	24+	A reference should be made here to Figure 1.2 as an example of one of the perception factors that influence migration patterns. Also, I would recommend that footnote 3 be included with Figure 1.2.	Suggested addition is made.
Eugene A. Rosa	Washington State University	1	14	27	Just about anything can be described with an estimated probability. The key issue, unaddressed, is from whence does the probability come?	Better description of the process of assessing probabilities are included.
Eugene A. Rosa	Washington State University	1	14		It is very useful to have an explicated relationship between verbal and mathematical expressions of levels of certainty and to have it applied consistently. And the report’s delineation of this relationship is reasonable. It is also important that the difference between the terms “likelihood” and “level of confidence” be stated, and the report does this well. As for “level of confidence,” an open question is whether it could use a similar pairing between terminology and numerical representation. If so, as pointed out by Tom Dietz, there is a now widely adopted taxonomy for	Improvements have been made to better describe levels of uncertainty and insure consistent use across the document.

Reviewer Name	Affiliation	Chapter	Page	Line	Comment	Authors' Response to Comments
					expressing confidence by Moss and Schneider (2000) that may be useful here.	
Eugene A. Rosa	Washington State University	1	15	4-5	It is not clear whether this 2 X 2 table really means, “state of knowledge” or “state of confidence.” It would be more consistent with the text if it were re-labeled the latter. Furthermore, this table (adapted but uncited from Moss and Schneider, 2000) was developed in the context of M&S’s discussion of levels of confidence, not knowledge.	Table is being relabeled to read “qualitative level of understanding”
Eugene A. Rosa	Washington State University	1	7-8		There is a shifting back and forth between global and national scales (occasionally regions within the U.S.) that seems undisciplined and is somewhat confusing to follow. One approach would be to introduce a point with the global evidence (most likely from the IPCC and related literatures), followed by the evidence available from the U.S. In those instances where U.S. data is unavailable this could serve to identify future research needs. And in the absence of data reasonable judgments could be made of the applicability of global patterns to the U.S.	No change made.
Eugene A. Rosa	Washington State University	1	16-20		For the most part the list of references seems appropriate and thorough.	No change made.
Eugene A. Rosa	Washington State University	1	Section 1.3		Population Trends, etc. The patterns of population growth, migration, and composition will, no doubt, shape the risks of climate change. However, it is likely that the capability of dealing with increased risks will, at least, in part depend upon intervening social factors. For example, the level of adaptability to risks will depend, not only on resilient infrastructures (e.g. effective levees), but also on such assets as social capital—comprising community commitment, networks of support, incidence of volunteerism, etc.—and community organization. Hence, an important question is: What are the effects of the variety of population trends on these social assets?	This discussion point is included in Chapter 1 section on vulnerable populations.

Reviewer Name	Affiliation	Chapter	Page	Line	Comment	Authors' Response to Comments
Tom Dietz	Michigan State University	1			Language about uncertainty. The use of the Moss/Schneider derived guidance is appropriate and admirable. But it is not deployed consistently in the chapters. At a minimum the report might say that this language will be used only in specific tables, which seems usually to be the case. Better, the language throughout should be cleaned up, and this section should note the colloquial terms used if that is deemed necessary to carry the prose.	The section on uncertainty in Chapter 1 is being revised and guidance given to the three topic chapters.
Tom Dietz	Michigan State University	1			Overall, the whole section on demographic change needs a stronger introduction to motivate it.	This section has been updated.
Eugene A. Rosa	Washington State University	2	1		This title is fully inappropriate for the contents of the chapter. The chapter is neither addressed to human dimensions, in the full meaning of that term, nor to global change, as that term is used in the relevant research and policy communities. The term “human dimensions” refers to both the drivers of environmental change (unaddressed in this report) and the impacts, not simply the latter. A more appropriate title would be something like: “Projected Human Impacts from Climate Change in the United States.”	Chapter 2 is being merged with Chapter 1.
Eugene A. Rosa	Washington State University	2	2	27	It would improve the presentation considerably if a Box, with a diagram, accompanied the Outline of the expected changes in the U.S. Figure 9.1, page 96 of the CCSP is a useful example and suitable model for such a diagram. Also, it would be useful to separate direct effects from indirect ones.	No change made.
Peter Gleick	Pacific Institution, NAS	2	3	1	Replace “Coping with the consequences of decreased precipitation and increasing temperatures... With: “Copying with the consequences of altered precipitation frequency and intensity and rising temperatures...” [Comment: there will be regional differences in how precipitation changes: it will not always “decrease”...]	Change made as suggested.
Eugene A. Rosa	Washington State University	2	3	7 et passim	As pointed out above, the melting of the Arctic permafrost and ice sheet are very likely to have impacts on economic structure and activity and migration patterns.	Suggested addition made.

Reviewer Name	Affiliation	Chapter	Page	Line	Comment	Authors' Response to Comments
Peter Gleick	Pacific Institution, NAS	2	4	22	Update Lake Mead levels from the 2003 reference. More than four years have passed.	Updated photo retrieved and additional language produced to better describe the issue of water table decrease in the West.
Peter Gleick	Pacific Institution, NAS	2	4	32	Update SLR projections from new IPCC results	Update made.
Eugene A. Rosa	Washington State University	2	4	8 et passim	As pointed out above, the impact of snowmelt to hydroelectric power needs to be recognized, especially since alternative ways of generating electricity could contribute to further greenhouse gas buildups.	Suggested addition made.
Eugene A. Rosa	Washington State University	2	5	30	It would be reader friendly to say that PM 2.5 means fine particles 2.5 micrometers or less in diameter.	Suggested change made.
Eugene A. Rosa	Washington State University	2	5	36	We now find a switch in terminology to “well-being” a concept related in some way to human welfare and quality of life. But, given the ambiguity surrounding all these terms it would seem to be prudent to select core concepts (e.g. conditions=welfare, affect=quality of life) and stick to these without raising the possibility of more confusion with the introduction of another term.	Chapter 4 provides clear delineation of these concepts.
Jonathan Patz	Univ. of Wisc., NCAR	2	5	section 2.1.2	Very glad to see this section “Role of non climate factors”	Thank you.
Peter Gleick	Pacific Institution, NAS	2	6	16	Replace: While non-climate stressors are currently more pronounced than climate impacts, one cannot assume that this trend will persist. With: “While non-climate stressors are currently more pronounced in some places than climatic factors, overall future stress will increasingly depend on combinations of the two.”	No change made for new Chapter 1.
Tom Dietz	Michigan State University	2	6	6-8	These two situations of increased vulnerability don’t seem very parallel, one can be addressed by infrastructure improvement the other is a societal trend.	Point well made.
Eugene A. Rosa	Washington State University	2	6	11-12	Scenarios are not the only, or necessarily best ways to uncover these linkages. Other possibilities include the downscaling of socioeconomic models, such as the	We agree.

Reviewer Name	Affiliation	Chapter	Page	Line	Comment	Authors' Response to Comments
					STIRPAT model (see <stirpat.org>) to regional and sub-regional desegregations.	
Tom Dietz	Michigan State University	2	6	11-12	I don't think that the existence of these developments automatically means scenarios are the way to go. The justification of scenario methodology, which is always prone to be ad hoc, needs more careful justification if that is what is intended.	We agree.
Eugene A. Rosa	Washington State University	2	6	16-17	Here and elsewhere there are conclusions that other non-climate stressors have greater effects than climate. It is likely that a full delineation of those other factors is beyond our current knowledge. Nevertheless, it would be helpful if a few examples were given.	No change made.
Tom Dietz	Michigan State University	2	6	21-23	I don't agree that directness drives importance. One has direct effects and indirect effects and the sum of the indirect effects can easily be greater than the direct effects.	We agree.
Tom Dietz	Michigan State University	2	7	1	Surely there is a demographic dimension here—the poor and the immobile, including the elderly, are at greater risk.	We agree.
Peter Gleick	Pacific Institution, NAS	2	7	Table 1	In “Extreme Rainfall” line, replace “Increased vulnerability in storm prone coastal zones;” With “Increased vulnerability in storm-prone coastal zones and riverine floodplains;”	Change made as requested.
Eugene A. Rosa	Washington State University	2	7		Yet again a Table appears from on high with no transition discussion or any indication that it is about to appear or where.	Table is being deleted.
Eugene A. Rosa	Washington State University	2	8	4	Same issue as above about using the term well-being here. If this is what the report is really about, then the human welfare framing in the introduction should be revised.	Chapter 4 provides the definitive framing of the well-being issue.
Tom Dietz	Michigan State University	2	8	23	Health impacts “are likely to be protected by”? is “populations vulnerable to”. And is “likely” being used in the sense of the direction given in C 1?	No change made.
Jonathan Patz	Univ. of Wisc., NCAR	2	8	25	Change “most” to “many”. Based on the next few sentences about Katrina. The word “most” in this context is quite misleading and will lead to misinterpretation of the findings	We agree. A change has been made.

Reviewer Name	Affiliation	Chapter	Page	Line	Comment	Authors' Response to Comments
Eugene A. Rosa	Washington State University	2	8	9-16	This listing of health and well-being impacts commingles causes and effects. For example, extreme heat is a cause. A vector-borne disease is an effect. Missing, too, is any connection to mental health.	Point well made. Language added to address this issue.
Eugene A. Rosa	Washington State University	2	8	22-23	If it is expected that health impacts of climate (including, supposedly, “extreme heat” since it is in the list of exposures) are likely protected by public health and medical care systems, then how do we account for the 600 deaths in Chicago alone during the 1995 heat wave?	Point well made
Jonothan Patz	Univ. of Wisc., NCAR	2	8	table 2.1	This summary of likelihood will undergo much scrutiny. In my general comments I shared concern about how well the literature review supported the final assessment language. I recognize that this is essentially an exercise in “expert judgment” however the general reader will want to know a bit more about this process. Some transparent explanation of protocol to arrive at the concluding states is warranted.	A description of the process of eliciting expert judgment will be included in the new Chapter 1.
Eugene A. Rosa	Washington State University	2	8	Table 2.1	Chapter 1, of course, provided a table connecting verbal and mathematical representations of likelihood. Again it would be useful to provide numerical values in parentheses after the verbal description throughout the report—e.g. More likely than not (>75% probability). Yet again, the third item in the table makes the claim that the burden of climate-related injuries and illnesses will be tied more directly with non-climate factors; what are examples of these factors? Finally, to say that it is “likely” that climate change will increase health outcomes related to air pollution seems to be too low a probability estimate.	There will invariably be a range of likelihoods across a range of reviewers. The author team have come to their conclusions based on their best understanding of the scientific literature.
Tom Dietz	Michigan State University	2	8	Table 2.1, row 3	What does “primary factor” mean? How would you explicate this in terms of heat related deaths? Does this mean it always has gotten hot so climate change is not “primary?” Does this mean that poverty, poor health, limited social contacts, make people vulnerable.	This table is being removed
Tom Dietz	Michigan State University	2	8	Table 2.1, row 8	Almost anything has negative and positive effects. One can imagine quantifying each in DALYs or QALYs or the like. What are the relative magnitudes of each? The real substance comes in the next few lines so this could be dropped as empty of content	This table is being removed

Reviewer Name	Affiliation	Chapter	Page	Line	Comment	Authors' Response to Comments
Tom Dietz	Michigan State University	2	9	15	“hard” and “soft” are always troubling terms. One could just as easily say “brittle” (infrastructure) and “adaptive” (policy and institutions) which puts different connotations into play. Why not just say infrastructure and policy, or show the range.	We agree.
Eugene A. Rosa	Washington State University	2	9	Box 2	I do not think it good form to cite a general magazine as a source in a science-based document, such as this.	We agree. Changes have been made to address these issues in the new Chapter 1.
Tom Dietz	Michigan State University	2	9	Box 2	This needs cites to primary lit not just to <i>Time</i> .	We agree. Changes have been made to address these issues in the new Chapter 1.
Tom Dietz	Michigan State University	2	10	Box 2.2	I like the idea of assigning certainty/ uncertainty assessments to policy and research issues. But this should be done consistently throughout the report.	We agree. Changes have been made to address these issues in the new Chapter 1.
Tom Dietz	Michigan State University	2	10	Box 2.2, r. 1	But if we attribute sunbelt migration to climate and dustbowl migration to climate change, does this stand? And if not, then the analysis needs to explain away these other two phenomena.	We agree. Changes have been made to address these issues in the new Chapter 1.
Eugene A. Rosa	Washington State University	2	10	Table 2.2	Again, I suggest adding the numerical descriptions of the probabilities, too.	Thank you.
Eugene A. Rosa	Washington State University	2	11	21	Now the prose shifts back to “human welfare.” This adds the further complication to the fact that welfare cum quality of life includes health as one their dimensions, and health impacts have already been covered in section 2.1.3.	We agree.
Eugene A. Rosa	Washington State University	2	11	23-28	Again, I cannot imagine the absence of impacts, positive and negative, to economic activity.	We agree.
Tom Dietz	Michigan State University	2	11	32-34	Not a sentence.	Thank you
Eugene A. Rosa	Washington State University	2	11	Box 3	The box seems to come out of nowhere, making it unclear as to where it fits into the discussion.	Thank you
Tom Dietz	Michigan State	2	12	7	“of most? Many?” Throughout the report the role of poverty in exacerbating vulnerability is emphasized so it	Yes. We agree

Reviewer Name	Affiliation	Chapter	Page	Line	Comment	Authors' Response to Comments
	University				shouldn't be ignored here.	
Peter Gleick	Pacific Institution, NAS	2	12	31	Change "some Americans, in some locations, will be vulnerable..." to, "some Americans, in some locations, will be highly vulnerable..."	No change made.
Eugene A. Rosa	Washington State University	2	12	7-8	Once again this comparison to poor nations seems misplaced and, at best, only tangentially relevant.	No change made.
Tom Dietz	Michigan State University	2	12	7-17	Without at least rough quantification this argument seems to contradict itself. I would suggest saying that while in many parts of the world there are limited resources for adaptation, here large segments of the population have that capacity. But then it would be useful to quantify vulnerabilities or failing that at least indicate how they could be quantified. For example, there are studies of who is vulnerable to urban heat extremes and they could be used to extrapolate nationally. If this hasn't been done, then one could at least indicate that this is important research. The same with coastal areas, dry areas, etc. I suspect that once those numbers are added the proportion of the US pop "invulnerable" to climate change is smaller than the opening of this paragraph would make one think.	Point well made.
Tom Dietz	Michigan State University	2	12	19-29	What about the problems in regions of the world impacted by climate change that engage important U.S. interests? It is not just a matter of refugees.	Point well made. Will be addressed in new chapter 1 and 2 combined
Tom Dietz	Michigan State University	2	12	Section 2.2	Not sure why one is directed to 1.3.	Thank you
Tom Dietz	Michigan State University	2	12	Table 2.3, row 1	These two statements are logically independent and should be separated. The first one is definitional and it's hard to see how it can be assigned a degree of uncertainty.	Table is being deleted.
Tom Dietz	Michigan State University	2	12	Table 2.3, row 2	Nearly all changes have positive and negative effects. This statement is pretty empty unless one can get some sense of the balance. Is the implication that they are roughly equal? Is there analysis to support it?	Table is being deleted
Tom Dietz	Michigan State	2	12	Table 2.3, row 3	Is this consistent with SAP 4-2, 4-3, 4-4? They have the same due date as 4.6 in the last schedule I saw, so can they	Table is being deleted.

Reviewer Name	Affiliation	Chapter	Page	Line	Comment	Authors' Response to Comments
	University				be referenced here?	
Tom Dietz	Michigan State University	2	12	Table 2.3, row 5	I'm not sure I understand what this intends. On both the (economic?) sectors and non-market or on the link between them?	Table is being deleted.
Eugene A. Rosa	Washington State University	2	12		There might also be indirect impacts to ecosystems. For example, lowered transportation costs due to newly opened seaways might lead to lower prices, higher consumption, and increased demand for nature's capital and services.	Point well made.
Tom Dietz	Michigan State University	2	13	26	It is fairly well established that it is best to make these kinds of comparisons on a common base: 4 out of 100 versus about 12 in 100.	We agree.
Peter Gleick	Pacific Institution, NAS	2	13	46	"micropolitan"???? is that a real word??	Yes, that is a real word.
Tom Dietz	Michigan State University	2	13	47	Most readers won't know what "core statistical areas" are.	Neither did we. We have provided a definition.
Tom Dietz	Michigan State University	2	13	24-35	Labeling the logic of vulnerability "conventional logic" degrades what I think is rather well established in the literature. This argument minimizes vulnerability unless the magnitude of the "voluntary" and "involuntary" stayers can be assessed at least	We agree.
Eugene A. Rosa	Washington State University	2	13	36 et. Passim	A useful list is provided that would seem to frame the rest of the discussion. Yet, we find the paragraphs that follow don't align well with the list. Furthermore, there is no discussion of arctic consequences, even though it is item (4) in the list.	This list has been significantly "beefed" up to better frame the discussion
Eugene A. Rosa	Washington State University	2	14	12	Refer to and insert Box 4.	Change made as suggested
Eugene A. Rosa	Washington State University	2	14	24-26	Does the claimed anticipation that many Americans will remain unaffected by climate change include the multiple pathways of indirect effects? It seems unlikely.	Change made to reflect this point.
Eugene A. Rosa	Washington State University	2	15	1	The discussion seems to include not only adaptation strategies, but also mitigation actions. Furthermore, the latter would be consistent with abstract summarizing the	Mitigation policies are purposefully not included in this report.

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					entire report when it states: "...the United States is expected to develop and deploy strategies for mitigating greenhouse gases, etc..."	
Eugene A. Rosa	Washington State University	2	15	5-7	What about proactive strategies for increasing the resilience of communities?	Unclear what strategies are being suggested.
Tom Dietz	Michigan State University	2	15	Box 4	Last line: Does this Water Plan take account of the climate change projections? It seems unlikely given the dates. Thus does the Texas plan badly underestimate the infrastructure needs and overestimate the water supply? The logic of the recent EPA report on municipal water infrastructure should be noted here: Billions in infrastructure investment may be spent very inefficiently unless climate change is incorporated into infrastructure planning.	This is an interesting question. We have reviewed the Texas plan and believe that it has not adequately addressed infrastructure needs and overestimates water supplies in the coming century. There is only a limited discussion of the drought in the early 1950s and no projections going forward.
Eugene A. Rosa	Washington State University	2	16	16	Couldn't urban planning be considered a prevention or mitigation strategy just as well as an adaptation one?	We agree.
Tom Dietz	Michigan State University	2	16	44	"Success" by what standards? It has been very successful at some things and problematic at best by other criteria.	Sentence deleted.
Tom Dietz	Michigan State University	2	16	28-33	This ignores the policies that facilitated, some would say, induced, these changes. These include underinvestment in public transportation, subsidization of private home ownership via the mortgage deduction as well as loan guarantees (as I understand it)	We agree. Additional language has been added.
Tom Dietz	Michigan State University	2	17	33	The idea that people have always adapted to "prevailing climate conditions" doesn't seem useful. People have sometimes adjusted, and sometimes failed to adjust successfully, to "excursions" in climate, such as the dust bowl, the little ice age, etc.	Change made.
Tom Dietz	Michigan State University	2	17	1-2	If this is to be evenhanded, then there needs to be a sentence or two that begins "The failures of the post WWII pattern of development..." Here we can think of increased segregation, declining inner cities, social isolation, environmental costs of a variety of types, etc. Or better	Change made.

Reviewer Name	Affiliation	Chapter	Page	Line	Comment	Authors' Response to Comments
					perhaps, the report should discuss changes and not try to weigh success and failure.	
Eugene A. Rosa	Washington State University	2	17	17-19	Shouldn't resilience include such social assets and buffers, such as social capital?	Yes.
Tom Dietz	Michigan State University	2	17	17-19	Are there examples of resilient communities?	Discussion includes examples.
Tom Dietz	Michigan State University	2	17	21-27	Is there evidence that we are moving in this direction or is this an admonition that we should or a prediction that we will?	Not clear what this comments refers to...
Eugene A. Rosa	Washington State University	2	17	Section 2.3.3	As elsewhere, there appears to be a conflation of mitigation and adaptation strategies when these are arguably different types of actions.	We have rephrased this language to clarify this issue.
Eugene A. Rosa	Washington State University	2	18	6	An ostensibly clear "no regrets" action would seem to include efforts to decrease energy use causing ground level pollutants, such as ozone and particulates, that have direct effects on health. Taking these "no regrets" actions to reduce health effects would also result in the reduction of greenhouse gases.	We agree.
Tom Dietz	Michigan State University	2	18	1-9	I have a sense that both the civil engineering and the public health communities are issuing warnings that the infrastructure in these two critical areas for coping with climate change are deteriorating and adequate investments to maintain even current capacity...	We agree.
Tom Dietz	Michigan State University	2	18		I am not a land policy expert or attorney but I have a sense that recent court decisions have shaped the ability of government to influence development. This is key to the kinds of strategies mentioned here and there should be some reference to these issues	Some language has been added to address this issue.
Eugene A. Rosa	Washington State University	2	19	5	The idea of "no regrets" may be a good and applicable one, but it is neither well defined here, nor illustrated with a useful example.	No-regrets is better defined in this section and an example is provided.
Eugene A. Rosa	Washington State University	2	19	11	Can any examples of "co-benefits" be provided?	An example of co-benefits is provided and a better definition included.

Reviewer Name	Affiliation	Chapter	Page	Line	Comment	Authors' Response to Comments
Eugene A. Rosa	Washington State University	2	20	9	It would seem to be the case that the potential affects of climate change, described as marginal for many Americans, is fully dependent on the time frame of assessment. What is meant by the “near term,” the next year, next five years, next ten, twenty, or what?	Near term is within the present generation --- approximately the next 20 years.
Eugene A. Rosa	Washington State University	2	21		On the surface of the matter the list of references seems thin. However, since this is a synthesis chapter it may be the case that the full listing of appropriate references is contained in the detailed, substantive chapters.	A glossary has been included as an Appendix to the report.
Tom Dietz	Michigan State University	2	24	24-26	This claim of “marginal impact” should be based on at least semi-quantitative analysis and accompanied by an uncertainty assessment. The very next page has a box headed: “Perpetual Drought in the Southwest: Water Supply at Risk”—this highlight the con	We agree.
Tom Dietz	Michigan State University	2	2-5		The literature on which each subsection is based should be cited. It would also be useful to note in each subsection discussed trends and projection and effects in a parallel structure as much as possible. In this section is the uncertainty language des	Citations are being much more developed throughout the chapter.
Roger Pulwarty	NOAA	2	18-19	10-	Need to tie these strategies for adaptation more clearly to U.S.-based responses. Use examples of adaptation but several need to be tested and evaluated over time.	We agree.
Roger Pulwarty	NOAA	3	2	33-37	The role of regulation is mentioned here but not explored further (including tradeoffs in command and control), use of models in regulation etc.	Regulation is discussed in the adaptation section. This is a summary of the 2000 assessment and therefore not appropriate to change.
Jonothan Patz	Univ. of Wisc., NCAR	3	2	bullets	These seem more random than I recall. Why not just take the conclusions from the synthesis document of the 2001 assessment.	These are summary statements from individual chapters.
Jonothan Patz	Univ. of Wisc., NCAR	3	2	last bullet	hardly the most salient conclusion from the report	This is stated as key in the executive summary.
Tom Dietz	Michigan State University	3	5	7-9	Why? This hangs begging for explanation.	Added

Reviewer Name	Affiliation	Chapter	Page	Line	Comment	Authors' Response to Comments
Tom Dietz	Michigan State University	3	5	Figure 1	It seems odd that the upper bound of the analysis is around 80°F. This seems to be a substantial limit of this study and should be noted. Without this caveat, one would get the impression that anticipated warming will tend to reduce mortality because of	Changed
Tom Dietz	Michigan State University	3	5		This seems to say that the risk from cold is about three times the risk from heat. If this is an artifact of the truncated high temperatures, that should be noted. Also, it would seem that the most vulnerable populations can somewhat limit exposure to c	Actually the reference is 2006 but is based on 2002 data – this was the most recent I could find.
Jonathan Patz	Univ. of Wisc., NCAR	3	7	28	missing key WNV reference – Reisen et al 2006 (refer to N. American chapter of the 2007 IPCC report)	I located a 2002 reference that gives an updated estimate of 375 million, for diarrhea cases only (text updated). Mead 1999 gives the latest estimates for hospitalizations and deaths.
Tom Dietz	Michigan State University	3	7	1-10	Is there evidence regarding air quality impacts of wildfires?	This was meant to highlight the differing trends between food/waterborne outbreaks and sporadic cases. Language has been changed in the text to better capture this.
Jonathan Patz	Univ. of Wisc., NCAR	3	7	39-41	much too aggregated statement	This phrase comes up several times in searches on Lepto (including CDC's fact sheet on the disease). I added an additional reference from WHO's Weekly Epi Record (1999) that shows the results of the first international survey of occurrence. "Most widespread" is due to occurrence across the globe in human illness, wide range of pathogenic species, and wide range of hosts. Additional language was added to clarify.
Jonathan Patz	Univ. of Wisc.,	3	8	5	2002 – no newer ref?	This was the only published figure synthesizing the results of the

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	NCAR					study.
Jonathan Patz	Univ. of Wisc., NCAR	3	8	23	Need to update Mead et al 1999. There are new national estimates (2006) – I'll find and send ref.	Most of the studies cited are based on modeling of prior data or collection of samples ('real time'). I know of no specific projections based on climate models. That was one of the goals of this table, to take known trends and apply that to possible outcomes (projections) of climate change.
Jonathan Patz	Univ. of Wisc., NCAR	3	8	26-28	Can authors explain the difference? Unclear.	Disagree
Jonathan Patz	Univ. of Wisc., NCAR	3	9	31	"...most widespread" meaning what? Certainly not most prevalent... or is there suggestive data?	Added
Jonathan Patz	Univ. of Wisc., NCAR	3	12	figure 3	This study was done on a per watershed basis using Monte Carlo analysis to avoid reporting bias across location. Thus, using this map may not be the best way to represent the findings.	Text has been added to support table info.
Tom Dietz	Michigan State University	3	15	Table 1	The Boston result is very different from the others. Is there a reason?	These are during or immediately after the event. Clarifying language inserted.
Jonathan Patz	Univ. of Wisc., NCAR	3	17	table 2	It's not clear which of these studies are from future climate model projections versus empirical analysis of weather & pathogen. So, not sure if table belongs here or in earlier WBD section. Also, the table needs to be improved upon to be more of a synthesis	Section rewritten
Tom Dietz	Michigan State University	3	21		It would be useful to have at least a paragraph summarizing Table 2.	Added
Jonathan Patz	Univ. of Wisc., NCAR	3	24		seems like enough air pollution-climate studies done to warrant making a summary table of these climate projection studies	Sentence changed
Jonathan Patz	Univ. of Wisc.,	3	25	16	I would add mention of Bell et al specific finding that, "ozone red alert days may increase by 68%."	Mitigation and co-benefits are outside the TORs of the assessment

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	NCAR					
Jonathan Patz	Univ. of Wisc., NCAR	3	26	3	last 2 items, dengue and malaria were not discussed in the body of text	Sentence rewritten
Roger Pulwarty	NOAA	3	28	12-14	Are these post-event cardiac-related impacts or during the event? There is very little on mortality (and attribution difficulties) during post-event recovery period traumatic stress within the document	The framework follows the relevant areas.
Jonathan Patz	Univ. of Wisc., NCAR	3	29	22-25	Awkward. This section needs an orienting roadmap. In fact, all the following bullets have no real organization (much needed), and should be grouped in some way (either by approach or risk area, or other structure).	Previous versions did take a regional approach, and the map became too complex to communicate effectively. Impacts reframed to be clearer
Jonathan Patz	Univ. of Wisc., NCAR	3	31	6	add something like, ".../and determine potential for interaction between climate and other environmental stressors	Planning mentioned
Roger Pulwarty	NOAA	3	32	13	Prevention is analogous to mitigation in disaster management. Adaptation can also imply a set of continuous or evolving practices as opposed to discrete up front investments	Changed
Jonathan Patz	Univ. of Wisc., NCAR	3	32	36	I recommend having a subtitle related to Mitigation and Co-benefits	Changed
Jonathan Patz	Univ. of Wisc., NCAR	3	32	9-12	Caveat – shouldn't we mention something about energy policy and upstream "exposure reduction"? e.g., health officials participating in urban or energy planning.	This is from another document, so can not add a line
Jonathan Patz	Univ. of Wisc., NCAR	3	33	section on framework for adaptation	May benefit by following CDC 10(?) areas of prevention.	Co-benefits are outside terms of reference of assessment
Roger Pulwarty	NOAA	3	34	1	Figure 1. This Figure mixes physical risk (and thus probabilities) with socially constructed risks. Similarly the red box mixes climate events (storms fires etc.) with health impacts (disease). It would be more useful to break the map out into regionally projected changes in the physical environment and attendant health risks.	The difficulty is that making more specific recommendations is limited by variations across communities and states that will affect implementation

Reviewer Name	Affiliation	Chapter	Page	Line	Comment	Authors' Response to Comments
Jonathan Patz	Univ. of Wisc., NCAR	3	34	10	add "...and green urban planning"	Thank-you
Jonathan Patz	Univ. of Wisc., NCAR	3	35	Box 2	this only addresses air pollution so delete "and drinking water"	Sentence rewritten
Roger Pulwarty	NOAA	3	36	36	Climate change is not a risk management issue. Response may be framed as a risk management issue	Deleted
Tom Dietz	Michigan State University	3	38	4-11	It's not obvious to me how the more extreme climate projections leads to fewer deaths. I can appreciate that deaths will decline given overall mortality decline trends but why would the CCC projection lead to fewer deaths.	Deleted
Jonathan Patz	Univ. of Wisc., NCAR	3	39	figure 10	for clarity add zero line	Sentence deleted
Tom Dietz	Michigan State University	3	39	Figure 10	The Hadley line seems missing.	Clarifying language added
Jonathan Patz	Univ. of Wisc., NCAR	3	40	table 5	I recommend adding a table of co-benefits as well	No change made.
Roger Pulwarty	NOAA	3	44	1	Table 6 has the potential to very useful. However it contains too many generalized comments (e.g. improve land use planning) or limited (and technocratic) views of how early warning systems may be characterized	Edits made.
Jonathan Patz	Univ. of Wisc., NCAR	3	44	6	this is especially useful	Thank you.
Roger Pulwarty	NOAA	3	47	18	Adaptive capacity is important, however just as important are governance mechanisms that allow capacity to be realized in practice	We agree.
Jonathan Patz	Univ. of Wisc., NCAR	3	47	23	"Adaptation Agency" -- not sure I'd go that big. Certainly an interagency office with designated FTEs. Also, I would focus on Risk Reduction so that co-benefits and mitigation options (with both health benefits and costs) ought to remain on the table.	We agree.

Reviewer Name	Affiliation	Chapter	Page	Line	Comment	Authors' Response to Comments
Roger Pulwarty	NOAA	3	47	35	It is unclear as to what “the adaptation process” is in the context of UKCIP	Clarified.
Tom Dietz	Michigan State University	3	47	20-42	The Pileus Project provides similar decision support tools developed in collaboration with stakeholders and is worth describing here (http://www.pileus.msu.edu/). It was developed with EPA funding. This discussion is not health specific and is very valuable. It should be in C 1 or 2.	We agree.
Jonathan Patz	Univ. of Wisc., NCAR	3	48	1	“High capacity to cope” This is a bold statement with little analysis behind it. How might residents of New Orleans react upon reading this statement? Or what about Mayors in cities with aging water systems that are rapidly deteriorating. I would be very careful here.	Pont well made.
Jonathan Patz	Univ. of Wisc., NCAR	3	Figure 6		Not sure how arrived at this figure. I don’t think there are enough qualifying statements in body text (OR IF SO, they are not clearly marked or called out). This is an important figure that needs transparent process. Are these arrows more than a general notion or impact? Did the co-authors establish an “expert judgment process” or at least have confirmed agreement on this final synthesis diagram. Users of this document will want to know.	This figure is based on expert scientific judgment.
Tom Dietz	Michigan State University	3			It is worth noting somewhere that research on climate change and animal disease is underdeveloped. Nolan (2007) found that avian botulism is substantially related to climate excursions.	We agree.
Roger Pulwarty	NOAA	4	2	27	“Certain kinds of circumstances” is an unclear statement. Suggest “Different circumstances”	Change made
Peter Gleick	Pacific Institution, NAS	4	2	30	Add something along the lines of: “Many settlements already depend on water resources brought in from distant watersheds or sources that are sensitive to existing climatic variability.”	Added
Peter Gleick	Pacific Institution, NAS	4	2	38	I don’t agree with the statement that “Periods of change tend to reward...” This is a possibility, but it depends on the rate and degree of change.	This statement is firmly grounded in social science research; somewhat edited
Tom Dietz	Michigan State University	4	2	38-39	Is there empirical evidence to support the argument about progressive, well-governed communities?	Done

Reviewer Name	Affiliation	Chapter	Page	Line	Comment	Authors' Response to Comments
Peter Gleick	Pacific Institution, NAS	4	3	40	Replace “shaky” with “limited”	Changed
Tom Dietz	Michigan State University	4	3	40-45	This is a very important point.	It is intended to communicate the sense that a settlement can be a unit of collective action
Roger Pulwarty	NOAA	4	4	14	It appears that the numbering (1) is in the wrong place. It should be before “Exposure on line 16	Changed
Roger Pulwarty	NOAA	4	4	28	Phrases such as “how able is a settlement” are imbuing settlements with the qualities of an administrative unit. Is this intended?	These other sources are summarized and cited in Clark et al., 2000
Peter Gleick	Pacific Institution, NAS	4	4	14-15	This sentence should be outside of the numbered list. It introduces the three items.	Re second sentence, the authors disagree. Agree re siting. “Impacted changed to “affected.”
Roger Pulwarty	NOAA	4	4	14-28	It should be mentioned that identification of these factors predates Clark et al 2000 by White, Hewitt and numerous others in the hazards literature	Point added
Peter Gleick	Pacific Institution, NAS	4	5	In the box	Delete the second sentence. It makes no sense. In the third sentence, “sitting” should be “siting” “impacted” is not a verb.	Done
Jonathan Patz	Univ. of Wisc., NCAR	4	7	11	I would highlight the aging water systems more here. Climate variability will particularly stress these already failing systems.	This is the technical term used in that particular literature
Peter Gleick	Pacific Institution, NAS	4	7	23	Add IPCC 2007 citation to this older IPCC citation.	Changed and reference added.
Jonathan Patz	Univ. of Wisc., NCAR	4	7	40	not sure “metabolism” is appropriate analogy	Added
Peter Gleick	Pacific Institution, NAS	4	7	6-10	Replace: Changes in precipitation patterns may lead to reductions in meltwater, river flows, groundwater levels, and in coastal areas lead to saline intrusion in rivers and groundwater, affecting water supply; and warming may increase water demands (Kirshen, 2002; Ruth et al., forthcoming). With: Changes in temperature, precipitation, and sea level (among other changes) may lead to altered	Points added, thanks

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					river flows, snow storage and melt dynamics, groundwater levels, saltwater intrusion in coastal ecosystems and aquifers (Gleick et al. 2000, Kirshen 2002, Ruth et al. forthcoming). Higher temperatures may increase water demands. Add the Gleick reference as follows: Gleick, P.H. et al. 2000. Water: The Potential Consequences of Climate Variability and Change. A Report of the National Water Assessment Group, U.S. Global Change Research Program, U.S. Geological Survey, U.S. Department of the Interior and the Pacific Institute. Oakland, California.	
Peter Gleick	Pacific Institution, NAS	4	9	Table 2	For "California" add: "Sea-level rise" under Vulnerabilities	Changed
Tom Dietz	Michigan State University	4	10	26-31	A paper presented at the PAA meeting in March based work done in part at CIESIN, estimated the size of the population within, if memory serves, 1 m of sea level. They may have separated out the US and if so this is worth citing. The Great Lakes are expected to decline due to changes in precipitation. Other lakes may also face declines. In the Great Lakes the declines will likely have an adverse effect on lakefront infrastructure and on fish populations that breed in shallows (in many key breeding areas the bathymetry of the lakes are such that there is a steep drop after the shallows. Perhaps most worrisome is that in more than a few areas toxic sediments will be exposed to erosion. See the paper by Scudder McKay at http://www.environment.msu.edu/climatechange/ This paragraph should also note that some communities are very vulnerable, and that our inability to quantify the likely impacts is a problem.	Added
Roger Pulwarty	NOAA	4	12		Western settlements. Most water (78%) is used by agriculture. The impacts will be felt in conflicts over water rights and also increasing length of the fire season. In addition pest outbreaks (e.g. pine beetle) will have an impact on fire scale.	We disagree. ICLEI is concerned with mitigation, not impacts and adaptation.

Reviewer Name	Affiliation	Chapter	Page	Line	Comment	Authors' Response to Comments
Tom Dietz	Michigan State University	4	17	22-29	It would be appropriate to cite Wackernagel or Wackernagel and Reece. Many quibble with specific applications of their ecological footprint approach but they did important groundwork in thinking about this issue, e.g. Wackernagel, M., & Rees, W. (1996).	Changed
Tom Dietz	Michigan State University	4	18	2-11	I found this hard to follow.	Wording clarified
Tom Dietz	Michigan State University	4	18	19-31	The point that we need to consider, and to analyze in tandem both mitigation and adaptation if vitally important and should be strongly emphasized in Chapters 1 and 2. It also worth noting that, at least in my subjective assessment, we have far more research to support analysis of adaptation than we do to support analysis of mitigation.	Mitigation policies are not considered in this report
Tom Dietz	Michigan State University	4	18	33-42	The results of the CLIMB study need to be detailed here and especially in Chapter 3 where the treatment is less clear. In particular, the report needs to discuss the assumptions made about adaptation, and if possible assess the evidence that supports those assumptions. This is ironic because one might argue the opposite is true in policy, so we are developing policy where we know the least, and not developing policy where we know the most (see p. 20, 1.33-42)	Change made.
Tom Dietz	Michigan State University	4	19	18-31	“Hard” and “soft” are always troubling terms. One could just as easily say “brittle” (infrastructure) and “adaptive” (policy and institutions) which puts different connotations into play. Why not just say infrastructure and policy, or show the range of	Change made.
Peter Gleick	Pacific Institution, NAS	4	20	13	Should “waster” be “water” or “waste”??	Change made.
Peter Gleick	Pacific Institution, NAS	4	20	14	Add a sentence: “Physical design changes for long-lived infrastructure may also be appropriate, such as building water-treatment or storm-water runoff outflow structures	Change made.

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					based on projected sea-level, rather than historical levels.”	
Peter Gleick	Pacific Institution, NAS	4	24		In general, the information at the end should be integrated into the main body of the text, such as the information about ICLEI’s activities.	Yes. We agree.
Tom Dietz	Michigan State University	4	24		There have been a number of studies of why cities adopt mitigation policies. These should be summarized briefly and cited here. Sammy Zahran (a contributing author to C 5) is the author of several of these.	Yes. We agree.
Roger Pulwarty	NOAA	4	25	29	What is meant by “realistic”? Practical, implementable?	Wording clarified.
Tom Dietz	Michigan State University	4	26		I would argue that such efforts need to adopt the kind of analytic/ deliberative approach recommended by the NRC in <i>Understanding Risk</i> that involves regular interaction between scientists and stakeholders in order to “get the science right” and “get the r	Yes. We agree.
Tom Dietz	Michigan State University	5	1	1-2	It seems more common to use “well-being” rather than welfare. Some readers might think that using the term welfare implies that only economic analyses are relevant. Well-being is the term used by the Millennium Assessment, for example.	See comments above regarding terminology in the welfare chapter
Tom Dietz	Michigan State University	5	1	33-35	I found this statement startling, and it is contradicted on p. 2 where we are told the systems that exist will be reviewed.	Edits were made to make the two discussions more consistent. Among other changes, the sentence referring to national measures was deleted.
Tom Dietz	Michigan State University	5	1 (renumbered)	note 6	Usually these are physical (or economic—traditional capital), human (individual level—education, health), social (community level, networks, organizations, etc.), natural (ecological). We have an analysis under review that does an initial analysis of the	We recognize that there are alternative, equally valid typologies
Tom Dietz	Michigan State University	5	2 (renumbered)	4-16	This gets me back to the same point noted above—a grocery list of indicators is dangerous if they are all tossed into a data reduction method, and they are nearly useless if <i>all</i> are taken to be equally important. One can use stakeholders to weight them.	The map developed by Zahran et al. is a data reduction effort to operationalize climate change risk/vulnerability, but the life quality table presented in the

Reviewer Name	Affiliation	Chapter	Page	Line	Comment	Authors' Response to Comments
						manuscript attempts to broaden the notion of life quality, giving researchers a reasonable inventory of constructs and indicators from which to select. We encourage others to use both data reduction procedures and stakeholder definitions of indicator importance to build more acceptable operations of the concept. The purpose of the life quality table is not to rank indicators. We simply searched and synthesized existing efforts, and leave it to scholarly and policy making communities to determine how best to proceed.
Tom Dietz	Michigan State University	5	2	31-33	This makes my point—it would be better to use the term well-being and reserve the term welfare to economic welfare. The conflation is confusing and I note that the authors needed the term well-being here to be clear. The first para on p. 3 could solve t	Following this suggestion, we reserve the term welfare for discussion of the economics of monetizing nature and things of intangible value, and use the terms well-being and quality of life as broader concepts that speak to the conditions of place that enable psychological and physical satisfaction and happiness,
Tom Dietz	Michigan State University	5	3	9-18	This para begs for citations.	Additional citations have been added in.
Tom Dietz	Michigan State University	5	4 (renumbered)	8	It is always a little maddening to see Diamond as the sole cite on this issue. He has certainly written an interesting book ,but what about the huge volume of scholarship in, for example, the <i>Annales</i> school, the substantial literature on the little ice a	Three additional references have been added: Fagan, 2001; Ponting, 1991; Tainter, 1988.
Roger Pulwarty	NOAA	5	4	41	The literature is increasingly showing that this applies only above some levels beyond of poverty See recent work on Australian wealth and happiness indicators	We are not familiar with the Australian work mentioned here, and were unable to locate relevant

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						Australian literature. The commenter will need to provide us with a more specific researcher or citation information in order to track this line of literature down.
Tom Dietz	Michigan State University	5	4	note 4	need cites	References have been added in.
Tom Dietz	Michigan State University	5	5	15-27	There are two major problems that plague the indicators approach. First, the standard methods used (exploratory or confirmatory factor analysis, cluster analysis, latent structure analysis, etc.) cannot readily differentiate causes and effects unless the	Additional discussion on the indicators approach and its usefulness has been added throughout the section, as well as discussion on the usefulness and applicability of benefit-cost analysis, but these points have not been specifically addressed. Our feeling is that they are highly specific points, which relate to the indicators approach as applied—something that we are not specifically advocating in this paper.
Tom Dietz	Michigan State University	5	5	16-19	This is just as true of subjective measures.	Yes.
Tom Dietz	Michigan State University	5	5	25-27	I am sympathetic to this and have done some analyses that move up to the edge of this. But some discussion is needed of the problem of direct and indirect effects and statistical power. It will be relatively easy to construct studies in which climate change has no statistically significant effect on well-being. That may be because it has no effect, but it may also be because the analysis did not have sufficient statistical power to find the effect. This is not a trivial point as such studies will be readily invoked in the policy debate (and in assessments such as this as saying “no effect” when the proper statements is “the effect is likely no larger than.” We have the ability to make such statements quite well. I	We were unclear what this related to in the text (partly because of the problem with page numbering in the previous draft) and were unclear on how to respond to this comment

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					hope the chapter will note the development of tools like counterfactuals and propensity score analysis as well as useful ways of looking at power and alternative explanations (e.g. Frank, K. A. 2000. "Impact of a confounding variable on a regression coefficient." Sociological Methods & Research 29:147-194. Frank, Kenneth and Kyung-Seok Min. 2007. "Indices of Robustness for Sample Representation." Sociological Methodology 37:Forthcoming).	
Tom Dietz	Michigan State University	5	7 (renumbered)	4-10	This nicely states the same problem I have been raising about indicators. The great strength of the economic approach is that it is explicit about how it deals with the "aggregation" (across goods and services or good and bad things in general) or "commensuration" problem. Many of us have problems with that solution, but at least the economics tradition notes this as one of the central problems in this business. The portfolio approach is another. There are also sociological logics (Freeman, D. M., & Frey, R. S. (1990-1991). A Modest Proposal for Assessing Social Impacts of Natural Resource Policies. Journal of Environmental Systems, 20, 375-404.) and an approach based in deliberation (Dietz, T. (1994). 'What Should We Do?' Human Ecology and Collective Decision Making. Human Ecology Review, 1, 301-309.) as well as multi-attribute methods that resemble the portfolio approach (Keeney, R., & Raiffa, H. (1976). Decisions with Multiple Objectives. New York: Wiley.) These deserve a mention as they might be fruitfully explored.	The main point of this section is to provide an introduction to key concepts of the economic framework that is applied in the remainder of the chapter. Discussion of the economic framework requires some explanation of the value of estimating economic damages of climate change (equivalent to the benefits of mitigation). The SAP does not, however, recommend a particular decision-making framework for the climate change policy question. We have added a footnote to this effect. In addition, to avoid readers interpreting our discussion of the economic framework as an endorsement of benefit-cost analysis, we have added more explication of the caveats about using a strict benefit-cost test.
Tom Dietz	Michigan State University	5	7 (renumbered)		Somewhere it might be noted that the currency metric is generally viewed as just an outcome of individual preference expressions.	We added a footnote to the introductory paragraph in the economic framework section
Tom Dietz	Michigan State	5	11 (renumbered)		Health effects discussion should reference C 3 (and the two should be checked for consistency).	The lead coordinating author for the Health Chapter reviewed the

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	University					section on Health in the Welfare chapter, and the authors of the Health section in the Welfare chapter reviewed the Health Chapter.
Tom Dietz	Michigan State University	5	12 (renumbered)		This discussion is much clearer and better documented than earlier discussions of mortality in the report. My initial reading is that it also contradicts those discussions that seemed to suggest that winter mortality gains outweigh the adverse impact of	The two sections were checked for consistency and the inconsistency rectified. Additional citations were added to the discussion in the welfare chapter, and it was clarified that any conclusions regarding the relative magnitude of summer/winter mortality are inconclusive, since this area needs considerable more research.
Tom Dietz	Michigan State University	5	15(renumbered)		I'm very pleased to see the MA approach invoked here. This report will be of much greater value if it draws on the MA and IPCC for language, conceptual frames, etc. However, Table 4 would be better labeled using the term "well being."	Change has been made
Tom Dietz	Michigan State University	5	17 (renumbered)	Box	This discussion overall should be coordinated with what is being said in the other "4" SAPs. For the box in particular, Terry Root has a number of papers discussing already observed effects of climate change on ecosystems. (http://www.environment.msu.edu)	This is a brief section and so only touches on each of the ideas presented. Dr. Root's work supports the points that have been made here, and so we have referenced her in a few additional places. The effects that she discusses (changing phenologies, range shifts, etc.) are already in the report. We have also reviewed SAP 4.3 and 4.4. While there is overlap between this SAP and 4.3, the focus is on ecosystems, not human services. Further, the purpose of

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						the discussion of physical effects on ecosystems is to support the economic discussion that follows.
Tom Dietz	Michigan State University	5	24 (renumbered)	21	One week increases round by over 50%? That seems odd.	The discussion in the paper has been clarified. It is not that one week more of golf results in a 50% increase in rounds of golf, but that combined effects of 1 more week plus higher temps inducing more golf during the existing season.
Tom Dietz	Michigan State University	5	24 (renumbered)	overall	See http://pileus.msu.edu/tourism/ for an approach to provide information on changes in tourism from climate change.	Their model does mention weather conditions as one of the four factors having the greatest influence on tourism behavior. It is now cited in the paper.
Tom Dietz	Michigan State University	5	5-6 (renumbered)	Zahran et al.	This analysis is admirable. However, the report should not that combining these variables using weights that I assume are derived from factor analysis or the like is just the first step along the journey we must make. A real measure of vulnerability would be a coefficient that shows how much impact has resulted from a given amount of climate change. Ultimately, one would want a multi-level model to show how that coefficient changes as a function of other variables. (The importance of multi-level analytical logic in global change research is discussed in Dietz, T., Rosa, E. A., & York, R. (In press). Human Driving Forces of Global Change: Examining Current Theories. In E. A. Rosa, A. Diekmann, T. Dietz & C. Jaeger (Eds.), Human Dimensions of Global Change (pp. in press). Cambridge, Massachusetts: MIT Press.	We have added new text addressing the material in Dietz and a cite to Dietz. In addition, we have added information on the procedure of measurement in new material accompanying the map, with a comment cautioning that this is only a first and not a final effort to estimate the concept of vulnerability. Future efforts can build on the life quality table in the manuscript to improve on the mapping effort highlighted in the report.
Roger Pulwarty	NOAA	5	33-43	24	The entire chapter actually lays out a research agenda and points towards the limits of present knowledge. Lines 38-39 effectively summarize this situation. More of the earlier chapter should be placed/incorporated in this important section	We have added discussion of important research gaps earlier in the chapter.

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Roger Pulwarty	NOAA	5			The chapter does a good job of describing the characteristics of welfare but very little on conditions in the U.S. itself. The theoretical aspects should be significantly summarized (as in P. 1 Table 1 Categorization) and the actual U.S. impacts sections made in greater detail.	We agree that a catalogue of impacts on well-being and welfare in the US is an important task. This chapter was designed to look more narrowly at a few intangibles and the economic values attached to them, and put them in the context of a framework for thinking about wellbeing.
Tom Dietz	Michigan State University	Appendix	Appendix	Appendix	Much of this material is redundant with the very clear and balanced explication in the chapter. I wonder if what is not redundant might be folded into the chapter.	Appendix to Chapter 5. Because we recognized that economic material is not usually part of the SAPs, we felt there was a tension between providing enough information to introduce the techniques to an audience that would be unfamiliar with them, and overemphasizing the “economic approach” which we feel to be only one of many that could be taken. We opted to provide enough information in the text to support the terminology and methods described in the sections, and to provide some perspective on what they mean and why they are – or are not – useful. However, the appendix was intended to be a standalone document providing a more full explanation and description of the issues. Initially, the material was part of the chapter, but a number of readers felt it detracted from the document and its flow.

