Written Public Comments on the
Strategic Plan for the U.S. Climate Change Science Program
Chapter 1: Introduction (pp 4-12)
Comments Submitted 11 November 2002 through 18 January 2003
Collation dated 21 January 2003

Page 4, Introduction: This document should not ignore the previous U.S. National Assessment on the potential consequences of climate variability and change as if it never existed. Many of the stated goals and methods are similar to those used in the U.S. National Assessment. At a minimum, lessons, both positive and negative, can be learned from this previous effort, rather than ignoring it entirely. References should be made at least to the Overview document (National Assessment Synthesis Team (2000), *Climate change impacts on the United States: the potential consequences of climate variability and change*, US Global Change Research Program, 400 Virginia Ave., SW, Suite 750, Washington DC, 20024, or as USNA, 2000 to be more general) in several locations, particularly throughout Chapter 4.

BENJAMIN FELZER, MARINE BIOLOGICAL LABORATORY

Page 4, Introduction: There is a tendency in this chapter to focus only on the changes in global temperature. In fact anthropogenic climate change may be manifested in much more devastating ways through changes in the natural modes of climate variability, the incidence of extremes and the potential for climate catastrophes, such as disappearance of the Arctic sea-ice, collapse of the THC and so on. These are addressed in Chapter 6 but a more balanced assessment should be provided in the Introduction. Of course, these aspects of ACC are far more challenging for the scientist than the global temperature record whether its prediction or detection and this needs to be acknowledged.

JULIA SLINGO, NCAS/CGAM, UK

Page 4, Introduction:

First Overview Comment: Beginning in Chapter 1, and throughout the remain-ing chapters, two terms repeatedly are used, which require clear definition and, depending on context, careful delineation from the meanings intended in other contexts:

1) "*Climate change*." In IPCC reports, "climate change" refers to "any change in climate over time, whether due to natural variability or as a result of human activity." IPCC Working Group I, *Climate Change 2001: The Scientific Basis*, Summary for Policymakers, Note 1. That Note also stated: "This usage differs from that in the Framework Convention on Climate Change, where climate change refers to a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods."

It would be helpful if the Strategic Plan indicated which definition generally would be used, why it is chosen, and in what circumstances (and why) the other definition would be used, if at all.

2) "*Research.*" The draft Strategic Plan does not make clear when it uses the term "research" to mean "original" research, as distinguished from "assessment" or "review" of published research studies, such as the IPCC undertakes. The Strategic Plan should develop criteria that generally should shape the federal government's decision as to when it will sponsor original research on the many questions asked in Chapters 2 and 5 through 11 and when "research" will include *current, independent* assessment of existing studies.

These comments later urge that the Strategic Plan should establish priorities for gaining answers to the many questions identified in the draft Plan. Establishment of those priorities may be influenced by decisions concerning when federally sponsored "research" should be "original" and when it appropriately could be *current, independent* "assessment" of existing scientific literature.

This First Overview Comment has referred to *current* "assessment" of existing scientific literature for two reasons: (i) federal "research" in the form of assessments certainly should take into consideration relevant scientific research that had not been published at the time of existing assessments of scientific literature; and (ii) in our quest for scientific enlightenment, we should not shy away from new perspectives or insights concerning assessments of underlying research.

The latter reason explains why we cannot agree with suggestions made by some participants in the December 2002 workshop on the draft Strategic Plan that the Plan should "build on" the so-called "National Assessment" (National Assessment Synthesis Team, USGCRP, *Climate Change Impacts on the United States: The Potential Consequences of Climate Variability and Change,*" 2000). During the December 5, 2002 workshop breakout session on "Scenario Development and Risk-Based Decision Support," one participant (we believe it was Dr. Livezey of the Climate Services Division of the National Weather Service) said, according to our notes of the session, that it was important that anybody using a climate model have an understanding of how the model performed in replicating climate change of the past 30 years. Another participant (we believe it was Dr. Barron of Pennsylvania State University) explained, according to our notes of the session, that, because of time constraint, the "National Assessment" did not do that and, instead, projected climate-change impacts on the basis of "*if*" the models' outputs were correct. He went on to say, according to our notes of the session, that we now should go further and do the analysis of how well the models simulate the historical record. Assuming that is a fairly stated explanation of the approach of the "National Assessment," that is sufficient reason, by itself, for the federal science research program *not* to "build" on the foundation of the "National Assessment."

Second Overview Comment: The draft Strategic Plan (p. 11, lines 8-9) sets forth as the first of three "guiding principles that underpin the objectivity, integrity, and usefulness of its [the CCSP's] research and reporting" that the scientific analyses conducted by the CCSP "are policy relevant but not policy driven." Unfortunately, this idealistic, so-called "guiding principle" is vulnerable *in its application* to undermining,

not underpinning, the crucial goals of objectivity, integrity, and usefulness of scientific analyses and reporting.

This was the teaching of the IPCC sessions in 1997-99 that debated the issue of "policy relevant, but not policy-prescriptive" questions that eventually shaped the content of the Synthesis Report of the IPCC's Third Assessment Report (TAR). Recognizing that how a question is asked easily can determine the answer to it, governments having greatly different climate-change policy perspectives battled intensely over the number of questions and how they would be worded. It was apparent that the positions taken by the overwhelming majority of participants debating the wording of the "policy relevant, but not policy-prescriptive" questions were motivated by intense desire to gain, or to prevent policy opponents from gaining, potential political advantage by reason of the way the questions were worded.

It should be emphasized that these comments should *not* be interpreted as implying bias or any other criticism of the specific questions raised in the draft Strategic Plan. The questions in Chapters 2 and 5 through 11 appear to be straightforward and "neutral" insofar as policy implications are concerned. Rather, this Second Overview Comment is intended to initiate consideration of two concepts:

1) The hallmarks of solid scientific research and reporting – objectivity, integrity, and usefulness – may not be achieved when scientific inquiry is shaped by determination of what is "policy relevant." This would be a likely, highly unfortunate outcome if, at some future time, the developers of the federal government's "policy relevant" questions sought to word them in ways that produce answers supportive of the question-developers' predetermined policy preferences. It would be a serious mistake for the Strategic Plan to establish a precedent that could be misused in future development of the federal science research agenda by those seeking *post hoc* rationalization for policy decisions already made.

Our view is that the science research program should be shaped in the first instance by what *scientists* (not limited to the natural sciences, but also including economists) believe is necessary to enable them to gain a better grasp of the "science" of climate change – the natural and anthropogenic causes and the effects (including timing and magnitude of effects) of potential global climate change and the consequences of alternative ways for society to address both the beneficial and adverse effects of climate change. It may be that devoting research to arcane subjects, such as complex atmospheric chemistry issues, will produce more important results than research on explicitly "policy relevant" issues. Of course, government officials who have the ultimate responsibility to develop the science research program, as well as a great many of the climate change scientists who have been involved in the domestic and international science programs (*e.g.,* the IPCC) will have their own policy preferences. Our hope is that, by emphasizing "science," not "policy relevancy," we have a better chance of science research that truly will be characterized by its objectivity, integrity, and usefulness.

2) The notion that the scientific analyses conducted by the CCSP are policy relevant appears to lead to various problems associated with the mechanisms, processes and techniques that are identified in our comments on Chapter 4 ("Decision Support Resources").

Third Overview Comment: The draft Strategic Plan states (p. 9) that the "focus [of the CCRI] is defined by a set of uncertainties about the global climate system that have been identified by policymakers and analyzed by the NRC (NRC, 2001a)." But focus on scientific uncertainties is not limited to the CCRI component of the CCSP. Thus, the draft Plan later (p. 11) lists as one of the guiding principles for the CCSP, properly, we believe, that "CCSP analyses should specifically evaluate and report uncertainty." Moreover, the discussion of the USGCRP research agenda for the major topics covered by Chapters 5 through 11 certainly suggests continuing uncertainties that, if they did not exist, would call into question the justification for the continued existence of the USGCRP.

We urge that the serious efforts contemplated by the draft Strategic Plan for explicitly dealing with uncertainties not be deterred by those "experts" who are reported to "say talking about more research will simply delay decisions that need to be made now to avert serious harm from global warming." (Andrew C. Revkin, "Can Global Warming be Studied Too Much?," *The New York Times*, December 3, 2002).

There is ample support for having the research plan focus on the uncertainties. Sometimes, they are more than "uncertainties;" they are gaps in our basic know-ledge. The draft Strategic Plan properly refers (p. 17) to uncertainties identified by the National Research Council in *Climate Change Science: An Analysis of Some Key Questions* (2001). The next version of the Strategic Plan also should refer to the "key uncertainties" identified by the IPCC. According to the IPCC, these uncertainties include, among many others, some that account for the range of CO_2 concentrations in 2100 between about 490 and 1,250 ppm and other uncertainties that account for a range of globally average surface temperature increase, 1990-2100, of 1.4 to 5.8ºC. See IPCC, *Climate Change 2001, Synthesis Report,* Summary for Policymakers, Table SPM-3 (2001).

Fourth Overview Comment: Chapter 1 provides an overview of the CCSP, including a list of eight broad research topics (*e.g.*, atmospheric composition) that are addressed in subsequent chapters and each of which involves a few to several key questions.

A major difficulty with the draft Strategic Plan is that, with the exception of the three "key" uncertainties discussed in Chapter 2, there is no indication of the priorities for, or of a logical sequencing of, the research efforts. Even assuming, for the sake of discussion, that every research question has merit, budget realities (if nothing else) will dictate that priorities be established. It does not seem likely that appropriations will be available during the next several years that would allow *optimum* effort on each question, which turns out to be equal to the optimum effort devoted to every other question.

It would be helpful if the next version of the Strategic Plan discusses various *criteria* for development of priorities. To illustrate: there should be some guiding principles that would help the Administration (and the Congress, if it elects to become involved in program details) decide whether, with respect to research on "climate variability and change" as outlined in Chapter 6, Question 3 (likelihood of abrupt changes) or Question 4 (frequencies, intensities and locations of extreme events) should have priority, or whether both deserve the same level of effort.

Establishing priorities among the research tasks identified by the draft Strategic Plan also requires taking into account the need for logical sequencing of the research efforts. Perhaps the most troubling illustration of the failure of the draft Plan in this respect is the assertion (p. 46) that "[a] specific set of scenarios that can be used to address relevant policy and resource management questions – at the national, regional, and sectoral levels – will be developed in collaboration with stakeholders (2 years)," but there is no indication as to which of the many research projects identified in Chapters 2 and 5 through 11 should be held in abeyance so they can take advantage of these scenarios. (As indicated by our comments on Chapter 4, there are numerous problems with the Plan's ideas concerning scenario development.)

DONALD H. PEARLMAN, THE CLIMATE COUNCIL.

Page 4, Introduction: The drafters of this document have not presented a balanced statement on future needs for ecosystem research. Much is said about feedback to the climate system by ecosystems. However, missing from the document is discussion of the need for research on the **response** of ecosystems (in terms of productivity and population dynamics) to climate variability and climate change. Climate change will almost certainly have major impacts on the distribution and abundance of key populations of plants and animals, and on ecosystem structure and biodiversity. Living marine resources will be vulnerable if predictions of a warmer, more stratified ocean are realized. Society must learn how to make better use of terrestrial and living marine resources, and must do so in the face of great uncertainty of how a warmer climate will affect ecosystem dynamics. This issue is mentioned briefly here and there throughout the document, but most of the attention is given to the need for a better understanding of the carbon cycle and to learning more about feedbacks between ecosystems and climate cycles. I remind you that we can study the carbon cycle and feedback forever yet in the end we will not come away with any information that will allow us to make better management decisions related to resource management. Without new observation systems, data, process studies and coupled physical-biological models we will be unable to ascertain the response of specific populations to physical forcing, and we will be unable to make proper management decisions that lead to sustained harvests of plants and animals that are so critical to our society.

BILL PETERSON, NOAA/FISHERIES

Page 4, Introduction: **MAXIMIZING RESEARCH OPPORTUNITIES AND FUNDS**

The Climate Change Research Initiative funds should not be spent studying aspects of climate change that have already been extensively studied. Funds should be spent

on utilizing what we do know to make progress on the issue, as well as research that will help protect resources, reduce greenhouse gas emissions, and develop solutions.

Since 1990, the U.S. has spent approximately $20 billion on extensive climate change research and according to the Bush Administration, many scientific accomplishments have been achieved by the U.S. Global Climate Research Program and other research projects over this 13-year period. The Administration now says that America is ready to move into a new "period of differentiation and strategy investigation" which is the focus of the President's new Climate Change Research Initiative and the *Strategic Plan for the Climate Change Science Program*, on which we are submitting comments.

Although we realize the importance and need for research, the *Strategic Plan for the Climate Change Science Program* emphasizes the need for absolute certainty with respect to climate change—an impossibility due to the nature of climate change—at the expense of making real progress on this economically, socially, and environmentally devastating issue. The majority of countries are taking steps to deal with the problem and the U.S. should make concrete strides on greenhouse gas emissions reductions, rather than putting money into duplicating research.

In January 2001, the United Nations Intergovernmental Panel on Climate Change (IPCC) released its Third Annual Assessment on Climate Change, an up-to-date description of the certainties and uncertainties of the climate system and related factors. This assessment is based on the knowledge of more than 1,000 international scientific experts, produced by an open and peer-reviewed professional process, and based upon scientific publications whose findings are summarized for decision makers.

According to the IPCC Report, observed climate changes during the 20th century include:

- A change in atmospheric concentration of carbon dioxide from 280 ppm in 1750 to 368ppm in the year 2000, a 31.4 percent increase.
- A global mean surface temperature increase of 1° F, the largest increase in temperature of any century during the past 1000 years.
- An increase in heavy precipitation events.
- Increased frequency and severity of summer drought.
- Global mean sea level increased at an average annual rate of 1-2mm during the 20th century.
- Duration of ice cover of rivers and lakes has decreased by about 2 weeks in mid and high latitudes.
- Arctic sea ice thinned by 40 percent in recent decades in late summer to early autumn and decreased in extent by 10-15 percent since the 1950s in the spring and summer.
- Non-polar glaciers retreated.
- Coral reef bleaching frequency increased, especially during El Nino events.
- New and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities that increase greenhouse gas concentrations.

- Increased threats to human health, particularly in lower income populations, predominantly within tropical/subtropical countries.
- Recent regional climate changes, particularly temperature increases, that have already affected more than 420 physical processes and plant and animal species on all continents.

The following are some of the IPCC's predicted global climate change impacts expected to take place during the 21st century:

- Glaciers are projected to continue their widespread retreat during the 21st century.
- Global average surface temperatures will increase from 1.4 to 5.8° C from 1990 to 2100.
- Carbon dioxide concentration predictions in 2100 range from 540-970ppm.
- Global mean sea level is projected to rise by 0.09 to 0.88 m between 1990 and 2100 with significant regional variations.

The Bush Administration has allocated $1.7 billion in 2003 to identify the scientific information in two to five years to assist the nation's evaluation of optimal strategies to address global climate change risks. The goal is to eliminate or reduce the uncertainties of climate change, however many of the questions the Administration is focusing on have already been extensively studied, such as the human contribution to climate change.

For example, the Strategic Plan states:

> The challenge is that discerning whether human activities are causing observed climatic changes and impacts requires detecting a small, decade-by-decade trend against the backdrop of wide temperature changes that occur on shorter timescales (seasons to years). (p. 5)

This assertion is taken from a Natural Resources Council's *Climate Change Science: An Analysis of Key Questions* (NRC, 2001a) that states:

> Because of the large and still uncertain level of natural variability inherent in the climate record and the uncertainties in the time histories of the various forcing agents (and particularly aerosols), a causal linkage between the buildup of greenhouse gases in the atmosphere and the observed climate changes during the 20th century cannot be unequivocally established.

According to overwhelming majority of the world's scientists, climate change during the past 50 years is directly attributable to humans' burning of fossil fuels (IPCC's Third Assessment Report). Spending more money to prove this point would be wasteful.

CHRISTINE CORWIN, BLUEWATER NETWORK

Page 4, Introduction: There are references to, and endorsement of, "GCOS climate monitoring principles" (example - line 10 page 32), but these principles are not defined or otherwise referenced in the report. Should they be in an Appendix to this document?
BUTLER, DUTTON, HOFMANN, OGREN, SCHNELL, TANS; NOAA/CMDL

Page 4, Introduction: "Research" is defined as "to study something thoroughly so as to present in a detailed, accurate manner."

Fortunately, this definition was followed by all the previous, key, legitimate, climate change researchers: the congressionally mandated United States Global Change Research Program (www.usgcrp.gov), the Intergovernmental Panel on Climate Change (www.ipcc.ch) of the United Nations, and The National Research Council/The National Academy of Sciences. Indeed, these organizations have provided an enormous amount of key information about what is now reasonably well known on those issues of highest priority.

However, this draft 'research' plan fails to acknowledge, identify, or take into account the enormous research, analysis and conclusions to date. For example, the draft never refers the critical, key findings contained in the very first sentence of June 2001 National Academy of Sciences report: (1) "Greenhouse gases are accumulating in Earth's atmosphere as a result of human activities, (2) causing surface air temperatures and subsurface ocean temperatures to rise. (3) Temperatures are, in fact rising. (4) The changes observed over the last several decades are likely mostly due to human activities." (emphasis added)

Credible and valuable research always begins with a balanced review of what is reasonably understood as well as what is uncertain. That balance was present The National Academy of Sciences June 2001 report cited by the drafters.

However, this draft plan refers to what has been deemed 'uncertain' at least 135 times in 155 pages while less than 5% of the draft refers to what is already reasonably well known. That lack of balance undermines the credibility of the draft as well as its usefulness to the public and policymakers.

Second, it's well known human researchers usually see what they are pre-conditioned to look for. Credible researchers diligently work to minimize this. However, with this draft plan, it's predictable that after another four years of research, we will have more of what the federal drafters are steering toward - uncertainty.

In my experience of working with over 500 elected policymakers, more uncertainty is not what the public or policymakers are looking for. They want a fair, balanced presentation of what's reasonably well known and what's not. From there, they can generally be trusted to determine what decisions or actions they need to make based upon their own assessment of the evidence and the risk.

Third, all research should have a practical component which compares the prospective value of the research against the costs incurred in obtaining the information. In this draft, however, there is absolutely no demonstrable evidence that the resources spent on the additional research here will outweigh the enormous value of sharing with the public and policymakers the results of the world class research and analysis already performed.

A key senior representative of Weyerhaeuser participating in the U.S. National Assessment in Seattle said: "We make business decisions every day at Weyerhaeuser that involve more money than the entire budget of The National Assessment, AND we do it with far less certainty than you are hoping to get here."

Finally, while the drafters use the term 'uncertainty' no less than 135 times in this draft, at no point did the drafters attempt to define 'uncertainty'. This is critical as it's well known there can be a significant difference between what 'uncertainty' means to a natural scientist that what it means to an engineer, social scientist or policymaker.

Proposal #1 Balance The Draft with What IS Reasonable Well Known I propose the drafters go back to the beginning of the draft and specifically include the well-respected, peer reviewed, critical findings, conclusions and analysis of the international and national bodies officially designated to do just this: (1) the Intergovernmental Panel on Climate Change (2) The National Academy of Sciences and (3) the United States National Assessment performed by the United States Global Change Research Program and supported by The Executive Office of the President of the United States

Proposal #2 Define Uncertainty I strongly recommend the drafters first clearly define what they mean when they refer 'uncertainty' and then rigorously stick with it.

Second Overview Comment: The Proposal Does Not Follow the Recommendations of The National Academy of Sciences

While the drafters claim to have followed the June 2001 recommendations of The National Academy of Sciences, they simply didn't. The White House specifically asked The Academy: "What are the specific areas of science that need to be studied further, in order of priority, to advance our understanding of climate change?"

In response, The Academy listed seven specific areas of science in order of priority. Yet, despite this, the drafters effectively ignored the first three items in the draft plan. "The Big Three Issues" highlighted by the Academy for research were: (a) the future usage of fossil fuels (b) the future emissions of methane (c) the fraction of the future fossil-fuel carbon that will remain in the atmosphere.

While the drafters make two remote references to an alleged, proposed, new technology initiative to be led by The Department of Energy, there is no indication whatsoever that program will address the issues raised by the Academy - or that it is supposed to.

Further, when the speakers at the December 2002 Workshop were asked about whether the draft adequately addressed any of "The Big Three Issues" listed above, no one responded except the representative of ExxonMobil who said "yes", albeit less than 3% of the draft remotely refers to any of these issues and the projected buildup of greenhouse gases which so concerned the Academy.

The only statement made during any plenary session of the three-day event attended by 1500 people which remotely referred to any of these issues, was the statement by Dr. James Mahoney, Director, U.S. Climate Change Science Program, who thanked ExxonMobil for their financial contribution to Stanford University.

Proposal #3 Follow the Recommendations of The Academy I propose the drafters redraft the proposal along the specific lines of, and in the order recommended by, The National Academy of Sciences, as requested.

Proposal #4 Resources Commensurate with the Recommendations I also propose the resources committed to this draft plan be appropriated commensurate with the priority of the research areas identified by The National Academy of Sciences.

BLAIR HENRY, UNIVERSITY OF NORTH DAKOTA

Page 4, Introduction: The introductory material (e.g., page 4) focuses too much on past disagreements over changes in climate and whether they're primarily due to natural or anthropogenic causes. By doing this it largely ignores the fact that there is a general consensus in the climate community that the earth's climate has changed over the past ~ 100 years as a result of human activity and that future changes are expected to be even more dramatic. This consensus is clearer now than it was even at the time of the preparation of the 2001 NRC report quoted in the Draft Plan (page 5)

The plan appears to imply that a very high degree of certainty in these climate research questions will be obtained before action is taken, e.g., on page 8…Given what is at stake, the Nation and the international community need the best possible science to inform public debate and decisionmaking in government and the private sector.

If one looks at past global scale environmental problems (e.g., stratospheric ozone depletion) it is clear that the world community needed to act before all of the details of the problem were worked out. The earth system and associated atmospheric chemistry are so complex that we will always have to act under significant uncertainty. To think otherwise is to remain paralyzed, a dangerous choice when one is talking about climate problems with so much momentum and potential damage. That is, the longer we wait to act on reducing greenhouse gas emissions, the larger the damage will be and the more difficult it will be to ameliorate. While it is important to continue to act to reduce uncertainty (e.g., via the proposed research), we should also consider the costs, especially to future generations, of delaying action.

SOIL SCIENCE SOCIETY OF AMERICA, ANASTASIO

Page 4, Introduction: **First Overview Comment:** The term "climate change" first appears in Chapter I (p. 8, line 11) and as part of the term "climate and global change" (p. 8, lines 21 and 25). Both terms are frequently used in the draft plan. However, neither term is defined in the draft, although the term "global change" is defined in section 2 of the Global Change Research Act of 1990 as "changes in the global environment (including alterations in climate, land productivity, oceans or other water resources, atmospheric chemistry, and ecological systems) that may alter the capacity of the Earth to sustain life." Similarly, the term "Global change research," which is also used in the draft, is defined in section 3 of that Act. We presume that both definitions are applicable to the draft strategic plan even though they are not spelled out therein. However, there is no such statutory definition of the term "climate change" in the 1990 Act.

We are concerned about the lack of a definition in the draft of that term because usage of the term differs, as shown by the Intergovernmental Panel on Climate Change (IPCC) in a footnote to its Summary for Policymakers (SPM) of the Working Group I's contribution to the IPCC's Second and Third Assessment Reports. The footnote states:

> Climate change in the IPCC Working Group I usage refers to any change in climate over time whether due to natural variability or as a result of human activity. This differs from the usage in the Framework Convention on Climate Change where climate change refers to a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.

The draft strategic plan indicates that it is focusing on a "set of uncertainties about the global climate system" referenced by the National Academy of Science (NAS) in its 2001 study requested by the Administration, "Climate Change Science: An Analysis of Some Key Questions," which examined the IPCC's SPM for Working Group I of the Third Assessment Report. One question asked of the NAS by the Administration was: "Are greenhouse gases causing climate change?" The NAS responded:

> The IPCC's conclusion that most of the observed warming of the last 50 years is likely to have been due to the increase in greenhouse gas concentrations accurately reflects the current thinking of the scientific community on this issue. The stated degree of confidence in the IPCC assessment is higher today than in was 10, or even 5 years ago, but uncertainty remains because of (1) the level of natural variability inherent in the climate system on time scales of decades to centuries, (2) the questionable ability of models to accurately simulate natural variability on those long time scales, and (3) the degree of confidence that can be placed on reconstructions of global mean temperature over the past millennium based on proxy evidence.

A "Glossary" to the SPM for the Second Assessment Report comments further on the IPCC usage of the term "climate change" as follows:

> Climate change as referred to in the observational record of climate occurs because of internal changes within the climate system or in the interaction between its components, or because of changes in external forcing either for natural reasons or because of human activities. It is generally not possible clearly to make attribution between these causes. Projections of future climate change reported by IPCC generally consider only the influence on climate of anthropogenic increases in greenhouse gases and other human-related factors.

While it may be difficult at times to "make attribution between these causes," it is important for the CCSP to avoid conveying the implication or assumption that all climate changes are attributable to "human activities." They clearly are not. Given the Administration's question to the NAS and the NAS's response, the draft should indicate which "usage" of climate change is applicable in carrying out the U.S. strategic plan. The IPCC's definition may be the most appropriate.

Second Overview Comment (section 3, p. 11): This section sets forth "three guiding principles" that underpin the "objectivity, integrity, and usefulness" of the CCSP's "research and reporting."

The first principle is that the "scientific analyses conducted by the CCSP are policy relevant but not policy driven." It appears to mimic an almost identical principle set forth in section 4.4.1 of the "Principles Governing IPCC Work" and applicable to IPCC Reports, including its Synthesis Report (SR), which were developed and adopted in 1999 by the IPCC meeting as an intergovernmental body, not as a scientific body. That section states that the SR should address a "broad range of policy-relevant but policy-neutral questions approved by the Panel" (*i.e.*, the IPCC). At that same session, the IPCC went on under then Chairman Robert Watson's direction to develop the questions for use in the SR. The SR responses, like the questions, were approved and adopted by the IPCC, also meeting as an intergovernmental body in 2001.

The second principle is that the CCSP analyses should "specifically evaluate and report uncertainty" and the third is that the CCSP "analysis, measurements, projections and interpretations shall meet two goals: scientific credibility and lucid public communication."

Each principle is expressed with reference to "CCSP analyses," not to CCSP "research and reporting." None of the principles is elaborated sufficiently in the draft to understand how it is to be applied in the context of such "CCSP analyses." With greater elaboration or explanation, they may be more helpful.

Further, the CCSP draft strategic plan states (p. 11) that it is "built around a carefully constructed set of questions and objectives" and that the "research questions" are intended to "focus on broad science issues . . . supported by more detailed questions

and objectives that can be addressed in scientific research initiatives and projects" funded by the federal government. The "challenge," according to the draft (p. 10), is:

> "to focus attention on key climate change issues that are important for public debate and decisionmaking, while maintaining sufficient breadth to facilitate the discovery of the unexpected. Establishing a careful balance between focus and breadth is essential if scientists are to develop knowledge of the intersections between natural variability and potential human impacts on the Earth System."

All of this requires constant oversight and coordination by the CCSP to ensure that the strategic plan is implemented and the results reported, all on a timely basis. The reference to the "CCSP analyses" function in the context of three "principles" seems extraneous to the CCSP ensuring this "balance." To our knowledge, there is no discussion in this draft of the need for such CCSP analyses; how or when the analyses would be conducted or how or when the researchers, stakeholders, and the public would review them; or whether there would be a peer-review process. In short, the purposes of this section need to be reexamined and explained, or this section should be deleted.

FANG/HOLDSWORTH, EDISON ELECTRIC INSTITUTE.

Page 4, Introduction: First Overview Comment: The term uncertainty is utilized without any clear definition of the term. As this is the main theme of much of the report, it portrays an incorrect image of climate science that everything is uncertain and that no one can or should act until the uncertainty levels are diminished. It then goes on to lay out a high risk strategy of waiting until an unknown day for uncertainties to be reduced before any action can be taken. The risks are high as the lifetime of greenhouse gases in the atmosphere is long and mitigation efforts will not take immediate effect, unlike some other pollutants. This also ignores decades of research by US institutions and others that have reduced uncertainty levels on a wide range of climate issues. A guide to the uncertainty levels is clearly included in the IPCC's Third Assessment Report.
We would therefore strongly recommend that the report and the research efforts around it not revolve around reducing uncertainties per se, but rather provide new and useful information for policymakers. Finally, to infer that policymakers must have 100% certainty before taking any decisions is not consistent with the current situation. As the report notes, there are many uncertainties surrounding terrorism, but the government is not waiting for 100% certainty before taking preventative measures such as increasing security in airports.

JENNIFER MORGAN, WORLD WILDLIFE FUND

Page 4, Introduction: How to Avoid the Obvious
The introduction utterly ignores the buildup of greenhouse gases. It fails to note that based on air trapped in ice cores, the current concentration of and the rate of growth of CO_2 and CH_4 are unprecedented in the geological record for at least the past 150,000 years. Even the warming of the past century is acknowledged in later chapters of the document to be as large as any in ancient history—past 1,000 years. What is to come

will dwarf what happened in the last century, and it won't stop. The introduction uses some fuzzy statements about current models overestimating the warming, with the implication that future projections must be in error, as the warming simply hasn't occurred. The scientific literature for the past two decades, however, has predicted that the warming won't become detectable until early in this century. The introduction ignores that changes are about to take place and many changes, particularly on large continental to hemispheric scales will become detectable in this decade or the next decade. The observing system and modeling capabilities ought to be designed to detect and model such changes.

The introduction ignores the magnitude of the radiative forcing due to greenhouse gases, which represents a sizable fraction of the Earth's energy budget components. A 2 Wm^{-2} forcing is at the 1% level of the global energy budget components. Should it surprise anyone to expect a 1% level change in global temperature? What's worrisome is that at the 1% level the change is 1-2 K. Barring some yet to be identified overturning of the oceans, this change is likely to occur within the lifetimes of most now living. Furthermore, the change is greater than any that has occurred since the last ice age, at least if one believes the proxy inferences of climate that have been published. The climate has remained relatively constant during man's recorded history. Now within the lifetime of an individual, it will change more than it has during all of recorded history. There are no precedents for such a change.

While noting that the response predicted by climate models have a wide range of uncertainty, the document ignores the magnitude of even the most conservative prediction: 1 K, which with the warming of the later part of the 20^{th} century, is still larger than any that has occurred since the last ice age.

One can cite IPCC 2001 and the work on which IPCC 2001 is based to document the record of evidence supporting these claims.

These oversights are undoubtedly intentional, but the chapter's lack of acknowledgment of what is, in fact, known, rudely denigrates the decades of creative, yet laborious scientific work through which this hard-won knowledge was gained.

JIM COAKLEY, OREGON STATE UNIVERSITY

Page 4, Introduction: As mentioned in the intro itself, it will be important to address <u>how</u> priorities will be set in terms of allocation of resources to research on particular ecosystems, scales, processes, cycles, methodologies, etc. Given the enormity of the scope of research possibilities outlined in this document, by what mechanism will we "focus attention on key climate change issues . . while maintaining sufficient breadth to facilitate the discovery of the unexpected" (Page 10, Lines 38-39)? While acknowledgement is made of the importance of priority-setting for program management (end of Page 10, beginning of Page 11), the document would benefit greatly from the addition – based on stakeholder input – of a basic framework from which priorities can be generated through a rational process that includes transparency and accountability.

Priority-setting for ecosystem-related research is addressed further in subsequent comments below (sections IV, V, and VII).

JORDAN M. WEST, USEPA/ORD

Page 4, Introduction: CCSP's document asserts "sound science" principles once presumed in endeavors such as this, though grossly abused in recent years, most egregiously in the "National Assessment on Climate Change" (NACC). These "Guidelines" must more strongly assert adherence to, and the requirement that any product meet the requirements of, the Federal Data Quality Act (FDQA)(enacted as Section 515(a) of the FY '01 Treasury and General Government Appropriations Act (P.L. 106-554; H.R. 5658). They must be stated more firmly, and provide an internal enforcement mechanism, as well as review and appeal mechanisms pursuant to the White House Office of Management and Budget's (OMB) "government-wide" Interim Final Guidelines for agency compliance with FDQA requirements (66 FR 49718), finalized by OMB's January 3, 2002 Final Guidance (67 FR 369), providing a strong foundation for improving the overall quality of information which the federal government disseminates to the public. Past USGCRP efforts manifested flagrant violation of these basic standards, as detailed in this Comment, and which CCSP must avoid including through instituting advance, FDQA-compliant precautions.

HORNER, COMPETITIVE ENTERPRISE INSTITUTE

Page 4, Introduction: We would make a general comment that the introduction not only seems to emphasise uncertainty over the nature and causes of climate change but gives an impression that we know less than we do and that little progress has been made in the past 10-15 years on this issue. It might be helpful to be clearer about how uncertainty (which after all is ubiquitous in science) is related to risk assessment and decision making in this context.

WARRILOW, WILKINS – UK DEPARTMENT FOR ENVIRONMENT, FOOD AND RURAL AFFAIRS

Page 4, Introduction: First Overview Comment: This Chapter fails to recognize the most fundamental problem with the report, the failure to live up to what the title promises. "S*trategic Plan for the Climate Change Science Program*" is not a strategic plan. The document discusses at a very broad level some of the questions that ought to be answered. Unfortunately, it offers virtually no reflection on the objectives of the research program, the reasons for those goals rather than other goals, the current success and failures at attaining those objectives, reasons for falling short of the objectives, options for improving results, criteria for choosing between alternative options, or a recommendation on which options to follow and which to reject.

If for some reason, CCSPO decides to put this report out with the current title, this chapter needs an additional section which should explain whether CCSPO intends to actually produce—at a later date—a strategic plan or not. The text should explain why the report is called a strategic plan even though it lacks the elements that one would expect in a strategic.

The following line of reasoning might suffice: CCSPO recognizes that research funded by the public ought to serve the public.

A strategic plan is needed, which lays out the objectives, analyzes alternative ways to achieve those objectives, and recommends the preferred course of action. Given the complexity of the issue, as well as the many objectives and perspectives, developing a strategic plan would probably take a team of strategic planners a year to develop. But CCSPO didn't have a team of strategic planners to focus on this issue full time. Instead it had several committees of researchers who contributed time to this exercise and did the best they could given limited time constraints and the lack of a formal process to ensure that a strategic plan was created. But it seemed reasonable to keep the title to signal that CCSPO hopes to eventually have a strategic…..

If CCSPO intends to eventually create such a plan, then this section could explain the essential elements of a strategic plan, and suggest a time line for the creation of such a plan, along with an indication of those activities that must continue in the mean time. Such a time line might be something along the following lines

- 2 months—list of major headings for objectives of climate program
- 3 months—complete list of major objectives with sub-objectives specified in sufficient detail that one can tell if objective is being achieved
- 5 months—analysis of current research to achieve those objectives
- 7 months—analysis of results and expected results under each sub-objective
- 8 months—options provided for each sub-objective
- 10 months—evaluation of options for each sub-objective
- 12 months—comprehensive summary plan that ties it all together.

Second Overview Comment: This chapter omits any serious discussion of the "plan's" intended scope, which may tend to confuse some readers.

One might assume that a strategic plan would attempt to allocate—or create a process for allocating—research funds so as to achieve the greatest value for the taxpayers' investment. Under this model, CCSPO represents the national interest. It might develop a master research plan for a few alternative levels of funding, based *on what America needs to know and the incremental cost of obtaining that information,* given ongoing activities that are clearly outside the scope of the climate change arena (i.e. weather stations which measure temperature). Funds might eventually be allocated according to such a plan. Nonparticipating agencies still might receive funding or be required to consider the climate change science needs in projects undertaken for unrelated reasons.

Another approach would be to design a process primarily to optimize research, given current budgetary allocations. If the status quo is assumed, then CCSPO represents a partnership of the participating agencies. Under this model, CCSPO would presumably develop a plan that protects existing agency programs and supports their preferred initiatives. Strategic plans would essentially be coordinating mechanisms, with minimal funding implications across agencies. Non participating agencies would be unaffected.

Because either approach is plausible, and there is a general confusion about what is being attempted, the authors should elaborate of what the goal is in this context.

Third Overview Comment: The chapter devotes 10-20 times more space to the climate system than the consequences of climate change. Most sections have 2 lines devoted to impacts of climate change, 1-2 lines on adaptation, and anywhere from 10-100 lines

devoted to the climate system. This balance contrasts sharply with IPCC, which has one working group on the climate system and one devoted to impacts. This balance also contrasts sharply with the public's interest as well: The taxpayers are generally interested in the ramifications of climate change for resources and activities they care about, no climate for it's own sake. CCSPO should either devote equal amounts of space to both the causes and effects of climate change, or explain why the attention to effects is small compared with the focus on the climate system.

Plausible explanations for the disproportionate focus on the causes of climate change might include:

- The authors mostly work for programs that deal with the climate system rather than the effects of climate change;
- Related to the previous reason, all of the agencies that deal with the climate system are participating in the CCSPO process, but many programs that provide key information for effects (FEMA, Corps of Engineers, EPA Water Office, US Fish and Wildlife Service) are not participating or at least not to the same extent
- Effects are fairly straightforward once we know how the climate will change, so research should focus on the climate system
- Effects are more difficult to understand than the climate system, so we should not try too hard to understand them
- The causes of climate change are a responsibility of the federal climate science program, because it would be inefficient for 50 states and several government agencies to each undertake such a program. Coordination of effects research is less important because federal agencies and state governments can each assess their own vulnerability.
- Studies of the possible effects of climate change tend to motivate news articles and popular discussions that make the problem seem more real than it really is.
- Studies of the possible effects of climate change often are associated with efforts to adapt to climate change, which takes the focus away from the question about whether we need to reduce emissions.

Third Overview Comment: This Chapter needs to explain and justify the organization of the chapters that follow. The structure does not seem to follow the structure of the objectives of the research, which appears to prevent any serious strategic plan from being developed regarding the impacts of climate change and adaptation to those impacts (See my comments on Table of Contents).

The 5 key questions (starting on page 4 and continuing on page 5) provide a fair overview structure concerning the causes, effects, and responses to climate change. Those questions would provide a decent structure for the rest of the report. But given that the report does not follow that straightforward structure, the introduction should explain the relationship between that straightforward structure of the objectives of the research, and the chapter structure—which seems to follow a structure that had been developed by research programs that were not part of a strategic plan, i.e., instead of following a structure that would help in the development of a strategic assessment of the government's needs, the report follows a structure that fits existing programs. The

Introduction should discuss how a strategic plan can be developed for impacts and responses to climate change with a chapter structure unrelated to the questions that need to be answered.

JIM TITUS, U.S. ENVIRONMENTAL PROTECTION AGENCY (SEE DISCLAIMER).

Page 4, Introduction: Introductory chapters are notoriously hard to write and the current one illustrates the challenges well. The part that could easily be strengthened, in my view, are the questions found on pages 4 and 5. The first three of these are ultimately second order questions and I think that anyone from outside of the climate community who reads the report will not understand why these are important. Hence I believe there should be a clear statement of the fundamental questions which underpin the proposed research. These have been stated in various ways, but can be summarized as follows:

· What changes in climate are likely to occur regionally and globally?
· What will be the likely impacts of climate change regionally and globally?
· What can be done to reduce the likelihood of harmful climate change?
· What can be done to adapt to climate change either by reducing its impacts or by gaining benefits from it?

JOHN TOWNSHEND, UNIVERSITY OF MARYLAND

Page 4, introduction: Like the document does generally, Chapter 1 exhibits unwarranted skepticism concerning the reality of anthropogenic climate change. The background text on pages 4–6 portrays and characterizes the uncertainty about the reality of anthropogenic climate change as greater than it actually is. The NRC panel was pretty clear in its 2001 report that anthropogenic climate change is real even though it is not precisely quantifiable at this time (see page 6, lines 2–17).

As implied throughout the document (see later comments), a policy on climate change apparently already exists, and it comprises these elements:

- Downplaying a real problem (see analysis in *Chemical Engineering Progress*, December 2002, page 9) to avoid taking near-term action—at least 10 years as stated at page 99, line 8; 131, 9–11; 132, 25; 137, 5; 139, 6; and 163, 21;

- Proposing an "action plan" that actually represents business as usual to deflect criticism of having a "no action" policy (see analysis in *Chemical & Engineering News*, May 6, 2002, pages 6, 66); and

- Studying climate change ad nauseam with the hope (perhaps, faith) that a scientifically supportable reason—for instance, clouds caused indirectly by the accumulation of atmospheric CO_2 and other GHGs completely negate their indirect warming effect—will be found to justify both the original policy and no long-term action (see Page 150, Lines 34–36).

Given what we know about climate change and the tremendous momentum of the climate system, playing such a "game" is imprudent at best. It is much worse than the "No

Regrets" Policy of the early 1990s, espoused by then-Secretary of State James Baker under President George H. W. Bush.

DAVID L. WAGGER, PH.D., SELF

Page 4, Introduction: First Overview Comment: The CCSP must cultivate a more forward looking strategy by placing the scientific effort on questions more central to the current policy debate rather than those for which the answers are generally, though not completely, agreed-upon. If, as Undersecretary Card indicated at the workshop, the national policy is to reduce intensity of GHG emissions and eventually to reduce GHG emissions themselves (because we believe that we risk serious interference with the climate system) but to do so without serious repercussions on the national economy, then CCRI should focus much more on describing the likely costs and benefits of plausible mixtures of both mitigation and adaptation strategies much less on revisiting, however obliquely, the human role in climate change or the specification of some threshold beyond which we should worry. For instance, if we are pretty sure the LDLs are a health risk and if we have very elevated levels of LDLs, the short run issue is not the better prediction of the exact level of LDLs that will kill us for sure, but rather how to reduce LDLs without, on the other hand, starving to death or triggering some other malady. Better climate models and more research on other climate forcers (e.g. land use change) is entirely appropriate for the USGCRP, but much less so for the CCRI.

Second Overview Comment: The CCSP must incorporate the expected costs of both type I and type II errors in its comprehensive framework for decision-making. It is certainly possible that we could design policies to reduce the human forcing of climate change when in fact human actions have no effect on climate change. We would be making a type II error with considerable costs. This orientation seems to dominate the plan. But it is also possible that we do nothing to reduce human forcing when in fact human actions have a great deal to do with climate change. We would be making a type I error which also carries with it considerable costs. In emergency service parlance, the first is a "false alarm" and all emergency services do whatever they can to reduce the expensive incidence of "false alarms". But while doing so, they do all they can to avoid increasing the risk of a "miss" – calls for help that go unheeded. No emergency services organization can long survive any level of misses, and while the analogy to the CCSP is not perfect, it is indicative. The program must recognize that inappropriate INACTION on mitigation has costs just as palpable as inappropriate action.

Third Overview Comment: The CCRI could increase its impact on strategy development if it committed significant resources to regional projects within which to develop scenarioing and integrated assessment methodologies, particularly as they involve ecological and resource systems. California constitutes the Mediterranean region of the United States and is uniquely suited for a regional project. While the debate regarding mitigation strategies could arguably be conducted uniquely at a national scale, broadening the concern to adaptation strategies – one of the main thrusts of the Plan - inevitably leads to the regional scale since it is at the regional scale that the impacts of climate change manifest themselves. It might in fact be more productive to structure the CCRI first by scale (e.g. global, national and regional) and then by topic.

Fourth Overview Comment: There is a high level of uncertainty regarding the potential changes in climate that our nation will face in the next 20 to 30 years and beyond. Climate change will impact all aspects of the economy and natural systems. For this reason, climate change research must be undertaken with a well-coordinated multidisciplinary research program. The primary goal of this strategic plan should be to develop information that is needed to sharpen our qualitative and quantitative understanding of potential changes in climate in our nation due to the increased atmospheric concentration of greenhouse gases and aerosols. Important research project concerning global air pollution and global climate change should include the following:

- **Climate Data:** Improve the data needed to better understand climatic change by installing a network of environmental monitoring sensors in key regions of our nation. The goal of this task should be to enhance the collection of meteorological and hydrological variables. New sensor and wireless communication technologies designed for low maintenance operation, low power consumption and small, unobtrusive footprints are needed to monitor mountainous watersheds, which are often designated as sensitive wilderness areas. Such technologies would allow a significant expansion of data collection vital for understanding, predicting and informing about the variability of water resources in the nation.
- **Aerosol Radiative forcing:** In contrast to greenhouse gases, which act primarily on the outgoing infrared radiation, aerosols can influence both sides of the energy balance. Sub-micron aerosol particles (less than 1 μm) are highly effective at scattering solar radiation, sending a substantial portion of that scattered radiation back to space, and consequently cooling the Earth. On the other hand, Black carbon or soot absorb radiation, and thus tend to warm the planet. In addition to this direct (scattering-absorption) effect, there is also an indirect aerosol effect. Tropospheric aerosols have a substantial impact on the size distribution of cloud droplets, thus altering the radiative properties of clouds (increasing their reflectivities), and may also inhibit rainfall by potentially altering the lifetimes of clouds. This indirect effect appears to have a greater impact on global climate than previously anticipated. The radiative role of aerosols in the atmosphere is not well known and should be investigated.
- **GHGs Emission Inventory:** Central to any study of climate change is the development of an emission inventory that identifies and quantifies the nation's primary anthropogenic sources and sinks of greenhouse gas emissions. The US Climate Change Science Program needs to compile emission estimates for both the criteria pollutants and greenhouse gases and identify the sources of greenhouse gases and the amount released into the atmosphere. Calculation of CO_2 emissions from fossil fuels is straightforward. Methane and N_2O emission estimates are much more uncertain, since they are generally inferred by extrapolating experiments conducted on a small number of samples across a large regional population. Thus, methodologies for estimating greenhouse gas emissions need to be refined. Compiled emission estimates for both the criteria pollutants and greenhouse gases are needed for evaluating the effects of global climate change on criteria pollutant levels. This information will also be useful in

the analysis of regulations to consider their impacts on greenhouse gas emissions and global climate change.

- **Mitigation Options:** This program should investigate potential mitigation options. Efforts to manage the adverse climate change effects will require both reductions of GHGs from a variety of sources across many economic sectors and the implementation of adaptation approaches to compensate for the changes that are likely to occur. Sources of GHG emissions include utility power generation, combustion, transportation, waste disposal, petroleum production, coal mine, ozone depleting substances, ruminants, and agricultural operations. Currently available approaches to reduce emissions from these sources include CO_2 reduction through improved energy efficiency, improved farm management, nuclear power, hydropower, and fuel switching. While implementation of some of these options is feasible, others are either prohibitively expensive or not widely accepted by the public. New solutions for many of these sources, particularly those in the energy supply and transportation sectors, must be pursued over the next decade to ensure the US and other nations have viable and affordable options to reduce emissions. The emissions component of the program should conduct studies to investigate more environmentally beneficial techniques to use waste methane from landfills and digesters via fuel cell conversion to electricity. Fuel cells are poised to make significant contributions to stationary power generation. Stationary power generated fuel cells can play an important role in reducing CO_2 emissions. A quantitative analysis should be conducted. The US Climate Change Science Program needs to identify potential measures/technologies to reduce GHGs emissions and quantify the resultant air quality and greenhouse gas reduction benefits.
- **Coordination with Other State Research Organizations:** Greenhouse gases and climate change issues are, by their very nature, interdisciplinary. Transportation, energy production and use, industrial processes, disposal and recycling of wastes, and agriculture all contribute to the release of greenhouse gases. Thus, evaluating climate change issues and developing a nationwide control policy requires the coordinated input of many states. Presently, many federal departments and state agencies are involved in climate change research activities. The US Climate Change Science Program should aim to address key scientific questions concerning factors affecting the ecological vulnerability of terrestrial ecosystems to climate change; to examine the human health risks associated with the ecological impacts of climate change; and to examine the socio-economic effects of climate change and adaptations to mitigate those effects. The US Climate Change Science Program should seek out co-funding/coordination opportunities to ensure that related efforts are complementary rather than duplicative.

Fifth Overview Comment: The overall mission of the California Department of Water Resources (DWR) is to manage the water resources of the State, in cooperation with other agencies, to benefit the State's people and to protect, restore, and enhance the natural and human environments. Our mission requires, among many other activities, continued monitoring of current watershed conditions and production of flood warning

and water supply forecasts; these forecasts depend on the snowpack and on tracking precipitation and runoff over and from the large mountainous regions which provide most of California's water. So the California Department of Water Resources and its group on Hydrology and Flood Operations, is most interested in potential changes in climate on California's watersheds.

Insofar as climate change goes, our DWR goal would be to adapt. We aren't interested that much in identifying or blaming anyone for the changes; it appears that, for whatever reason, some changes are happening and we would like to be able to adapt our water resources systems to it. What we particularly need is good quantitative estimates down to the watershed level of the changes likely to happen. We recognize that weather and hydrology are inherently quite variable. Indeed, our rather short historical record probably doesn't include the full range of possible scenarios of flood or drought even without climate change and there is merit to paleostudies, including tree rings, that may better define the ranges in the recent past and what the driving influences of extreme events may be.

But hydrology is particularly sensitive to precipitation, so reasonable and consistent estimates of projected precipitation or the likely range of precipitation are very important. Temperature affects the pattern of runoff in snowdriven systems, which is important too, but total runoff is also most important for systems which have substantial storage, such as the Colorado River.

We would like to stress the importance of monitoring so we can identify and track changes in hydrology. Regular, consistent and sustained measurements of hydrologically important variables are essential to track what is happening, to analyze what the data is showing and to verify model predictions. This will guide us in adapting to climate change and in verifying whether the climate models used to project future climate changes are reasonably correct and in upgrading current runoff forecasting procedures and project operating criteria to reflect such climate changes that are occurring.

Items to be monitored include precipitation, rain and snow, runoff, water quality, water levels, including ocean levels, weather data, and more. It is important to measure in areas likely to see significant climate change, such as the mountain snow zone. The Climate Reference Network being developed and deployed by the NWS would be an important component.

From a water project operational viewpoint, the kinds of questions we would like answered relate to:

1) Temperature change by month, which would affect the area and amount of mountain snowpack and the seasonal patterns of natural river runoff.
2) Change in stream runoff both annual and by month. Temperature will be a factor affecting snowmelt, but changes in amounts of precipitation would also change annual amounts of runoff. This will require generation of long sequences of monthly flow, comparable with the long historical traces now used, to check on dry and wet periods.
3) Sea level rise, which is particularly important in the Sacramento San Joaquin River Delta, the hub of major California export water projects. Sea level rise could affect the stability of levee systems protecting low lying land in the Delta and the amount of salinity intrusion into that estuary from the ocean.

4) The potential for more intense rain events and for larger floods. This will require generation of short term precipitation by models down to at least daily and perhaps 6-hour intervals. (Small watersheds will need hourly data, but that could be inferred from changes in intensity of 6-hour or even daily data.) This work could enter in to revisions of floodplain maps that determine zoning of development.
5) Change in water consumption (evapotranspiration) of crops and wildland vegetation. In a warmer world, water consumption is likely to rise, but additional carbon dioxide in the atmosphere may offset some of the effect of higher temperatures.
6) Projected changes in water temperatures in our river and reservoir systems. The main concern would be maintaining water cold enough for salmon and steelhead.
7) To the extent possible, it would be nice if researchers became familiar with some of the major models used by water planners and operators in practice and could tailor their numerical outputs in such a way to be compatible with operational hydrology models. One example would be the CALSIM water project monthly simulation model developed jointly in California by the Department of Water Resources and the U. S. Bureau of Reclamation. This model uses over 70 years of hydrology. Another tool would be the flood forecasting models in current use in the NWS river forecast centers.

To expand a bit on the last point, DWR plans to evaluate with CALSIM several water project climate scenarios (2030, 2050 and maybe 2100) during the next two or three years. Generating key model hydrology inputs to mountain watershed reservoirs and other control points in the Central Valley basin water system in a way compatible with this large public domain simulation model would be helpful.

CALIFORNIA DEPARTMENT OF WATER RESOURCES

Page 4, Introduction: The introduction to the *Draft Strategic Plan* makes an attempt to provide a balanced overview of the climate change issue, yet it presents climate change as a scientific question that must be addressed, rather than a scientific principle, in which the United States has invested over $20 billion on research over the past 13 years. For example, the opening paragraph comments on the political and scientific debate over the past decade, without reference to what the scientific community has uncovered about climate change over this time period. The quotation from the NRC (2001) report *Climate Change Science* consists of one sentence on the potential for an anthropogenic signal in observed climate change. This is subsequently followed by an entire paragraph from the same report commenting that this attribution remains unproven. We do not argue with the NRC findings, but we do not believe the introduction is a reasonable reflection of that report and the body of scientific information that has emerged on climate change science over the years. The introduction appears to shy away from making any informed statements regarding the current status of climate change science and what the $20 billion investment has managed to produce thus far.

Comment 2: The *a priori* assumption in the introduction of the *Draft Strategic Plan* is that additional scientific research will reduce uncertainty and enable better decision-making. While certain decisions, such as resource management, are clearly hindered by the lack of accurate regional-scale projections for climate change, other decisions could be made based on our current understanding. Thus, decision-making benefits from, but is not dependent on, scientific progress and reductions in scientific uncertainty. In fact, debate over decisions such as the implementation of greenhouse gas mitigation policies appear to be a function of economic concerns as much as scientific concerns. We agree with the second guiding principle for the Climate Change Science Program (CCSP) stated later in the introductory chapter, "Uncertainty need not be a basis for inaction. . .". However, we also feel the opening section of the *Draft Strategic Plan* should be reworded to better reflect the implications of this statement and acknowledge the ability of policy-makers to make a broad range of decisions regarding climate change, despite remaining scientific uncertainty.

VICKI ARROYO AND BENJAMIN PRESTON, PEW CENTER ON GLOBAL CLIMATE CHANGE

Page 4, Introduction: I am in general agreement with the tone of the Introduction. However, there is an "elephant in the living room" issue that is not explicitly mentioned, or perhaps I could not find it. Simply put, any regulatory changes made to the current emission of greenhouse gases would have such an imperceptible impact on climate that we could not measure it. People should be aware of this up front (it is well documented in the literature.)

The idea I would suggest including is that we struggle with quantifying human impacts on climate in terms of the absolute quantities (i.e. 3.2 gtons of carbon equivalent per year might produce a 0.1 C per decade warming, but with large uncertainty.) Thus determining impacts of the tiny changes subtracted or added to these baseline quantities requires extracting a minute signal from large natural noise -- and this is essentially impossible. Indeed our present climate monitoring system would not be able to measure changes in the climate system, let alone attribute the changes, on the order that might be associated with a reduction of greenhouse gas emissions by 10 percent or even more. Since regulation deals with enforcing such tiny changes, it must be admitted that only draconian energy suppression measures would have a possibility of impacting the climate, and even then uncertainties would be enormous.

In other words, given our current sources of energy and our current understanding of climate change, adopting regulatory measures on the scale of proposals such as the Kyoto Protocol offer little hope of producing detectable changes to the future path of the climate system. Changes in emissions significant enough to (possibly) reduce the human component of climate change will likely arise from new sources of energy, or new ways to sequester CO2, as described in the Climate Change Technology Initiative.

Note: The American Association of State Climatologists will be submitting a statement to the CCSP which calls for using climate research to reduce vulnerabilities to which we are already exposed (i.e. hurricanes, 1850's,or 1930's droughts, 1993 floods etc.) I

strongly urge the consideration of this aspect as it reaps for the nation the real benefits of climate research.

JOHN R. CHRISTY, UNIVERSITY OF ALABAMA IN HUNTSVILLE

Page 4: General Comments on Introduction
The Climate Change Science Program (CCSP) is a combination of the Global Change Research Program (USGCRP) and the Climate Change Research Initiative (CCRI). As a new program it reflects many of the features of its predecessors. The stated goals include Accelerating development of scientific input of key climate science issues and the development of answers to key climate questions that effect policy. These questions concern the rates of change, relative roles of natural and human induced forcing, how the climate system has and will respond, climate sensitivity to human interventions and the costs of various response strategies. An example of a scientific uncertainties and problems to be resolved is the difference between surface temperature trends as observed from satellite measurement and from ground based observing systems. A stated goal is to roduce the best possible science to inform public debate and decision making.

Remark 1. There will always be scientific issues to be resolved in the study of the earth's climate. Science must remain open to new theories and interpretations. But these should be kept in perspective. The "answers" given to policy and public must be updated periodically to reflect the development of new ideas and theories. The overview section seems to reflect a more rigid and limiting view of science research and the role it plays in the public awareness. We should not be under the illusion that the theory of climate change will be complete in the near future. A long observational record encompassing the timescales of the ocean (and in some cases geologic scale) must be obtained before the book can be closed. But this does not preclude expressing a level of certainty about human induced climate change. The plan seems to confuse issues with uncertainties.

Remark 2. Having said this I support the guiding research principles described on page 11. These principles are particularly effective for the product-driven emphasis of the CCRI. But they will not suffice for the entire CCSP. The curiosity driven research, usually associated with the intellectual freedom embodied in our university and college system will require emphasis on other principles, such as innovation and creativity. The program is most appropriate for the mission oriented agencies of the federal government such as NOAA and DOE. The role of NSF, where much of the national talent in climate science currently finds its funding, is somewhat obscure given these guiding principles. So Part I of the plan outlining the CCRI is a needed focusing for short term decision support.

JOHN DRAKE, OAK RIDGE NATIONAL LABORATORY

Page 4, Introduction: **Needs Upfront Explanation, E.G.:**
There is an obvious anthropogenic consequences of increased urbanization and industrial activities that includes local Heat Island phenomena, indicated by high 'smog/ozone/particulate loading of the surface layers, typically trapped by inversions of the lower atmosphere. These consequences are broadly attributable to the increase in human populations since the mid 1800s from one Billion, to over six Billion, a complex

consequence of general Global Warming following the cooler centuries before, and an array of social and technological developments that ensued. The distribution of the majority of the population is in the northern hemisphere, with the largest urban centers located near lake shores, and along coastal terrain – which have continued to spread at increasing rates as more of the terrain has been claimed for agricultural and forestry purposes.

Given this simple relation, and that the global surface temperature observing system numbers are decreasing and those that exist are increasingly within the ranges of these expanding urban centers. Thus, the recent increased convergence of the sources of local heating and observation systems has biased the generic measures of Global Surface Temperatures. In fact, the use of 'average surface temperature' from such a system is an unlikely indicator of real Climate Change, in contrast to the more likely "Urban Heat Island Expansion" a non-climatic issue. Sorting out the natural from the anthropogenic is the primary task.

Also, the general cyclical patterns of such phenomena as ENSO Warm and Cold Events and regional Climate Regime Changes, i.e., AO, NAO, PDO, ACI that cause decadal scale weather patterns to shift over the typical 50-70 year cycle period, allow for generational experiential differences that preclude the general acceptance of equilibrium or stability that is implicit in much of mathematically simplified and statistically smoothed forecast procedures, too often used in planning for natural perturbations. The best example that I can offer is the recent (1957-1997) epoch when ENSO Warm Event Frequencies have approached but not exceeded those of periods such as the early 1700s, the period from about 1780-1810 and again from about 1855-1880, when ENSO Warm Events occurred on the average of every two years.
Oddly enough, the period of the greatest measured warming, 1920-1941, was the least active ENSO Warm Event period in the recent 300 year record.

GARY D. SHARP, CENTER FOR CLIMATE/OCEAN RESOURCES STUDY

Page 4, line 10: Referring to the human-induced changes on climate that is "widely accepted" as a "possibility" is really poor phrasing. It would be much more helpful to the general reader to summarize what is known now and if felt necessary, to indicate that this understanding has developed over time.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 4, line 13: The key point here should be that the IPCC (which deserves early mention as the consensus mechanism fro reviewing the science that has been established by the nations of the world) is in full agreement—150 or so nations (and all the leading academies of science) unanimously endorse their scientific findings. Just because there is some public debate does not mean that the authoritative summary of the science is somehow contentious, even if there is indeed no consensus on how to deal with the problem and evaluate it in the context of all other issues. Much tighter phrasing is needed here so that the public policy debate is not mixed in with the scientific discussion and findings. [As a parenthetical note, if this issue is said to be contentious, then every one of

the President's proposals, from taxes to actions on Iraq on the political front to genetically modified foods and cloning on the more technical front, must be considered as highly contentious as there is nothing like the agreement that there is here. To be credible, this plan really needs to better indicate the level of understanding that exists.]

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 4, Line 15-17 of the Overview**:**
The issues are NOT just about "…whether most of the observed overall change in temperature of the last 50 years is attributable to human activities (principally…)".

GARY SHARP, CENTER FOR CLIMATE/OCEAN RESOURCES STUDY

Page 4, lines 17-19: "... and whether proposed response strategies, such as reductions in emissions or efforts to enhance natural carbon sequestration processes, would produce economic or other effects more detrimental than the effects of climate change itself." I strongly agree that the debate over climate change policy must include consideration of the costs and benefits of alternative strategies. Expensive actions to reduce CO2 emissions now with current technology will likely leave the world poorer and less able to invest in discovering and using newer technologies in the future, when the nature of the threat (if the threat materializes) is better understood, or to adapt to some of the expected consequences of climate change as they occur. –

JOSEPH L. BAST, THE HEARTLAND INSTITUTE

Page 4, Line 19: The statement is appropriately made that one question that the climate research needs to answer is whether or not proposed response strategies would produce economic or other effects more detrimental than the effects of climate change itself. The report should acknowledge the fact that the earth is presently in a long term ice age period, that our modern climate represents a very short-term (possibly induced or enhanced by man) warm period between glacial advances, and that there have been over 20 such glacial advances and retreats during the last 2 million years. Therefore, we may need to be careful not to reduce a potentially beneficial effect of man-induced warming that could be reversing our current ice age climate. The research should address potential POSITIVE effects with as much insight as potential negative effects of man-induced climate change.

OREST LEWINTER, CITIZEN

Page 4, line 21 (Chapter 1) "to inform public debate" sort of like the royal "we" sounds better to say "for an informed public debate". Picky but stands out.

SOIL SCIENCE, GLASENER

Page 4, lines 21-22 (and elsewhere in this document): The notion that the scientific information is needed only, or even mainly, for "public policy and stewardship of natural resources" and to "inform public debate" are much too narrow. This phrasing needs to be greatly generalized so that it is clear that the information is needed by and will be useful for levels of government at all levels (local to international), for industry as well as natural resource management, for public and private groups of all types, etc. In addition, it needs to be made clear that the information is needed not only for issues relating to

mitigation and sequestration, but for planning and adaptation to past and prospective changes, etc. In addition, in that this is not just a climate change program, but also a global change program (so encompasses issues ranging from seasonal prospects of climate fluctuations to long-term issues of biodiversity and land cover), the information needs to be of many different types—not just for debate, but for application. The phrasing here is much, much too narrow.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 4, Lines 24-27 and Page 5, Lines 1-2: These questions have been extensively researched and results reported in the IPCC reports. While CCSP should continue to fund research related to these two questions, they are not the highest priority for policy planning

CALIFORNIA RESOURCES AGENCY

Page 4, line 26: Actually, the global climate has been relatively stable in "historical" times (the last several thousand years, which is what historical refers to)—the really significant climate variability has taken place in geological time. The prospective climate changes over the next century are comparable to the geological changes, and so are projected to far exceed the climate variations of historical times.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 4, line 26. There is always this link to the distant historical periods., as it is hard to obtain information on the past, ice records are used but data is reported in 1000 year periods and we are now looking at year to year or even at decade changes, is there any relevance. What was observed over a 1000 year period could have varied greatly and this is and will not be know. The idea of large changes in the past is used to say man is not impacting now. We had an ice age about 10,000 years ago. Really need to focus on the extreme changes in GHG that man is not causing, mainly through the burning of fossil fuels. Land use and land use change was the major cause up unit about 50 years ago.

SOIL SCIENCE, GLASENER

Page 4, line 24 to Page 5, line 9: These questions all refer to climate and to no other aspect of global change. This narrowness needs to be corrected.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 5: even as living standards for billions of people have improved tremendously. 26
What's the point of this remark here?
Further, in Climate Change Science: An Analysis of Key Questions (NRC, 2001a), 41

It is ridiculous to emphasize this report over the IPCC report. The NRC report was a rushed effort of a few months, which essentially just looked over the IPCC report and commented on it. Not only does this draft act practically as if IPCC didn't exist (a general problem with the whole document), it gives a wholly unfair impression of the NRC report. The document selectively quotes from the NRC report to over-emphasize the uncertainties, and under-emphasize the features of the climate change problem that point to the need for swift and decisive action.

RAYMOND PIERREHUMBERT, THE UNIVERSITY OF CHICAGO

Page 5, Lines 3-9: These three questions are of greater priority for research as results can guide policy and programs. The final question is particularly germane and should include both mitigation as well as adaptation options.

CALIFORNIA RESOURCES AGENCY

Page 5, line 8: I would suggest that the phrase "potential response" should be changed to "potential adaptation and response" as adaptation will be essential and the program should be developing information to facilitate this.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 5, about line 10. This might be a good spot to indicate that we are looking for both positive and detrimental effects of alternatives, and that these alternatives include a do-nothing strategy. The costs and benefits of alternative *actions* should be compared against a baseline of what will happen without deliberate actions to ameliorate negative effects (or to take advantage of positive effects). E.g., see lines 20-21 on p. 8.

ANN FISHER, PENN STATE UNIVERSITY

Page 5, line 10 (blank) I would add another item "what is the cost of no action" The reason for the US not signing the Kyoto protocols is give as its effect on the US, but the long term effects of not doing something need to be addressed.

SOIL SCIENCE, GLASENER

Page 5, lines 11-15: This paragraph is written as if there has been no earlier work on this issue, basically as if no information of any type exists about these or other questions. At this point, the plan should recognize the earlier work that has been done and accept the scientific assessments that have been done by the IPCC on climate, by WMO/UNEP on ozone, by the National Assessment on impacts, and so forth. This program is about doing research to improve confidence in the tentative information that we may have—not to start5 from scratch, and this phrasing does a disservice by not recognizing this.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 5, line 16: It would really help if there were a box that provided a primer on the climate change issue, explaining basically what it is about. This section (and the plan) seem to basically assume this is understood, yet this may well not be the case for the members of Congress who are the audience for the plan.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 5, lines 17-22: While it is true that environmental systems are constantly changing and that the climate is variable, these are meaningless statements unless the statements are quantified (and to correct the grammar, the "climate system" does not vary—the "climate does"). What matters is if these systems are beginning to change in unusual ways or beyond past bounds to which we have become accustomed. To imply, as is done here, that because there are variations of some unspecified size over some unspecified

time that concerns of human-induced changes are therefore an over-reaction is really improper—many of these variations are quite small (or irrelevant). Most people have experienced a relatively stable climate, and the longer-term changes they are noticing are likely largely human-induced. Changes in the Earth's orbit go over cycles of tens of thousands of years—much longer than the scales of the ongoing change in atmospheric composition; the responses of volcanic eruptions typically have time scales of years, much less (and smaller) than will be affecting sea level and the conditions to which society has become accustomed. To start off this section on what matters to society with things that are mostly irrelevant seems very inappropriate—and was not at all why the Congress established the USGCRP or the President is pursing the CCRI. This paragraph seems mostly for obfuscation.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 5, line 17: The climate is described as "highly variable" when, in fact, it is remarkably stable. The actual point, I believe, is that our human systems (e.g., agriculture, economy) have become very sensitive to small climate variations or changes. So, it might be better to say that the climate is variable and that this variability is significant for humans.

WILLIAM B. ROSSOW, NASA GODDARD INSTITUTE FOR SPACE STUDIES

Page 5, Line 17: very circuitous statement.
Should read: Earth's environmental systems change continuously.

GARY D. SHARP, CENTER FOR CLIMATE/OCEAN RESOURCES STUDY

Page 5, line 18: **Seasons are NOT climate variability**. This confused idea is scattered throughout the whole document and is incorrect. One of the fundamental elements **defining** climate in a particular region is the nature of its seasons. Please correct this mistaken usage throughout.

This is also where the confused (interchangeable) usage of "climate variability" and "climate change" begins. These are different concepts and they have to be properly defined and used in the document

WILLIAM B. ROSSOW, NASA GODDARD INSTITUTE FOR SPACE STUDIES

Page 5, lines 19-22: **(1-S)** The "ocean temperature and currents" phrase is really part of climate itself, while the others are more acceptably "external" forcings. Here is an alternative for lines 19-22:
timescales. Factors external to the climate system, such as fluctuations in the amount of energy emitted by the Sun, slight deviations in the Earth's orbit, and volcanic injections of gases and particles into the atmosphere, all cause variability and changes in climate conditions. Further, natural variations long-time-scale processes, such as ocean temperatures and currents, can force climate variability on shorter timescales.

HP HANSON, LANL

Page 5, line 21: The terms "variability" and "change" need to be defined. More generally, this plan uses a lot of terms rather loosely and without defining them. This needs to be corrected.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 5, Line 22: Natural variations in the atmosphere's chemical composition, the carbon cycle and other biogeochemical cycles are also potential causes of variability and change in the climate system

JULIA SLINGO, NCAS/CGAM, UK

Page 5, lines 24ff: **(2-P)** Why are "humans...[as] agents of environmental change" linked to a standard of living? Surely this many people on the planet living in a Victorian-era coal-burning society would have an even stronger influence on the environment than our present society. Or, with this many people trying to burn wood for fuel, the Earth would be an ecological disaster zone, making Madagascar look tame by comparison. As written, this is extraordinarily value-laden, and surely that is something to avoid in a document at this level.

HP HANSON, LANL

Page 5, lines 24-25: The remark about living standards seems a non sequitor to the comment about human influences on the environment.

DIAN SEIDEL, NOAA AIR RESOURCES LABORATORY (R/ARL)

Page 5, Lines 24–26: "*Against the backdrop of these natural forces, humans have become agents of environmental change, at least on timescales of decades to centuries,* ***even as living standards for billions of people have improved tremendously***."

While the bolded phrase may be true, it is a nonsequitir and largely irrelevant. This reflects the authors' mindset that anthropogenic climate change is an unavoidable consequence of high living standards. Under such a mindset, all that we can and should do is to accept the change and to ride it out (i.e., adapt to whatever comes).

DAVID L. WAGGER, PH.D., SELF

Page 5, lines 25-26. This phrase seems not to fit; perhaps rewrite to convey that a side effect of improved standards of living is that humans have become agents of environmental change.

ANN FISHER, PENN STATE UNIVERSITY

Page 5, lines 25-28: "... even as living standards for billions of people have improved tremendously. Emissions of greenhouse gases and pollutants and extensive changes in the land surface (both tied to widespread development of modern living standards) have potential consequences for global and regional climate." I strongly agree that the "story" of rising emissions is incomplete unless it includes the dramatic rise worldwide in human population and in living standards. Emissions rise and land use patterns change because

billions of human beings are living better, healthier, and longer lives. In many parts of the world it is simply not an option to stop emission growth or return farmland to forests. Rising emissions and changing land use are endogenous to human progress; the debate is whether and how best to limit or counteract the effects of these changes, not how quickly to stop or reverse them. –

JOSEPH L. BAST, THE HEARTLAND INSTITUTE

Page 5, Line 26. "… people have improved tremendously. **Insert:** It should also be recognized that while there are also Billions of people whose lives are not improving, and their security is a growing issue, as well, as health threats and habitat marginalization place more and more of these people in harms way. In fact, the real issue is that "too many people is the problem", and that "fewer people in these situations is the solution". That is not just about , or even primarily CO2, the Carbon Cycle, or other Green House gases.

GARY D. SHARP, CENTER FOR CLIMATE/OCEAN RESOURCES STUDY

Page 5, line 26: The terms "greenhouse gases" and "pollutants" are undefined, and need to be differentiated, if some point is being made here. In addition, aerosols need to be defined—and note is needed that some pollutants can have radiative effects. This is all quite imprecisely written.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 5, lines 27-28: Actually, extensive land cover change (some human induced) started well before modern times (e.g., the change of land cover over Europe and the northeastern US). The research effort really needs to go back and determine what influences these may have had on climate and sea level—this might help to explain some of the past inconsistencies such as why the rate of sea level rise accelerated in the 19th century.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 5, line 28: What does "They" refer to?

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 5, lines 33-35: It is not at all clear that this is the challenge that we face. While detecting the early human influence might well improve confidence, the challenge is really projecting what will happen in the future.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 5, Line 33 **Insert:** The real point being that the concerns about CO2, and other GHG contributions is much less an issue than the health issues related to the smog/ozone/particulate loading of local, surficial environments where so many people are being exposed to known and unknown health threats. Human history is highly affected by natural Climate Change, and more recently, the greatest threats to human population centers are more related to health threats, than natural phenomena. The increased 'marginalization', i.e., increased habitation of river flood plains, near shore

lowlands, and less protected habitats of a large proportion of the human population has continuously increased the numbers exposed to natural weather phenomena. While an immense amount of research and computing resources have been applied to Global Climate modeling and generic Scenario Development, the utility of the present output is minimal, as the more important issues are denied appropriate resources, as both human population and urbanization expand.
Then **Continue with**: The challenge is…

GARY D. SHARP, CENTER FOR CLIMATE/OCEAN RESOURCES STUDY

Page 5, line 34: I would suggest changing “detecting a small” to “detecting what is now a small.”

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 5, line 35: We actually now have data extending over a century to use for detection, with variations also occurring on decadal scales.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 5, lines 37-38. Attribution of causes could be less important than figuring out what to do about its (positive as well as negative) effects on society and ecosystems, especially given the evidence that the climate IS warming.

ANN FISHER, PENN STATE UNIVERSITY

Page 5, lines 38-40: "Currently, measurements taken at the Earth's surface, in various layers of the atmosphere, in boreholes, in the oceans, and in other environmental systems such as the cryosphere (frozen regions) indicate that the climate is warming." I strongly disagree with this sweeping generalization, which fails to specify where and over what interval "the climate" is warming and omits contradictory evidence of cooling in some parts of the world and during some time intervals. I suggest page 5, lines 38-40 be revised read "... indicate that the climates of some parts of the world and during some intervals of time are warming." –

JOSEPH L. BAST, THE HEARTLAND INSTITUTE

Page 5, line 39 should be "various lower layers of the atmosphere ..." (upper layers, such as in the stratosphere, have actually cooled.

JOHN R. CHRISTY, UNIVERSITY OF ALABAMA IN HUNTSVILLE

Page 5, Line 40: Only parts of the Earth are experiencing climate change in any particular pattern associated with anthropogenic climate interference. This line should be changed to reflect that reality.

KENNETH GREEN, FRASER INSTITUTE

Page 5, line 40: Actually, the climate is changing. At the next level of refinement, the temperature of the surface and lower atmosphere are warming, but the stratospheric temperature is cooling. It is really essential that a *scientific* plan be precise rather than sloppy in its use of terms.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 5, line 40 to Page 6, line 17: The deference and primacy given to the NRC report here is really improper. The NRC report did nothing original. What it did do was to summarize and endorse the findings of the IPCC report and the US National Assessment reports, both of which had done very thorough reviews of the literature and some original analysis and interpretation. For a scientific report such as this plan to feature the NRC quotes and findings would be as if a scientist writing a paper were referencing a book review in *The New York Times*—a scientific document such as this should be referring to primary materials rather than to a report that very quickly reviewed these reports.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 6: Apparently contradicting the evidence of warming are inconsistencies in the observational 19

The biases of the document are evident in this remark as well. The observations referred to do not in any way "contradict" the evidence of warming. Another NRC report concluded that the warming observed at the surface is "undeniably real." Rather the (short) satellite record shows that there are subtle features of the vertical structure of atmospheric temperature over the past twenty years that are not adequately captured by models. That's a far cry from saying that the data "contradicts" warming.

RAYMOND PIERREHUMBERT, THE UNIVERSITY OF CHICAGO

Page 6, Lines 1 to 17. Taken out of context this paragraph seems to over emphasise uncertainties. If a quote is needed the paragraphs at the top of the 2nd column on page 3 of the summary of the NRC report are perhaps more balanced in this regard and better reflect the state of knowledge.

WARRILOW, WILKINS – UK DEPARTMENT FOR ENVIRONMENT, FOOD AND RURAL AFFAIRS

Page 6, lines 5-9: The CCSP should reconsider if “thresholds for dangerous interference” and “unequivocal causal linkages” constitute the appropriate evidentiary guidelines for policy formulation. If we consider “our actions are changing the climate” as our hypothesis, these guidelines would lead one to believe that type II errors, that is, accepting this hypothesis as true when it is not, are the only errors with costs. However the evidence is mounting that type I errors, that is, rejecting the hypothesis when it is in fact true, have significant costs. Emphasizing type II over type I is not only incomplete but also possibly foolhardy. Applied in different circumstances, the current guidelines would lead one to get off an airplane of uncertain airworthiness only if there were a 95 or 99 percent chance of crashing. How many of us would use such a criterion in our everyday lives, particularly if we were flying with our children and grandchildren?

CALIFORNIA RESOURCES AGENCY

Page 6, lines 5-17: In featuring this quote having to do with things that are “uncertain,” it is really essential that this term be defined. A major failure of the NRC report was the omission of a definition. If they had done so, they would have indicated that they were

referring to the traditional scientific definition that typically requires a 95% assurance that all other possibilities have been ruled out—that is a 20:1 assurance that no other explanation is valid. While this may be appropriate for building the scientific pyramid of knowledge, a separate value-based judgment must be made to determine if this definition is appropriate for conveying the level of scientific understanding for policymakers. That a discussion of this issue is needed is readily apparent by the presence of the terms "unequivocally established" and "proof" which are used in this quote to indicate that science does indeed not yet have absolute certainty that the explanations are correct (science is seldom absolutely certain of anything—and indeed no one and no assessment has ever claimed that certainty existed). However, as the IPCC assessment that the NRC report endorses makes clear, the preponderance of evidence indicates a human influence. In that virtually all public decisions are made under conditions of uncertainty, many based on which outcome is more likely to lead to the desired result and other based on a desire to avoid risk at even a much lower likelihood, it is essential that this plan be much more forthcoming in explaining what is meant by the term "uncertainty" and not seem to obfuscate the issues and challenges by using a term that means different things to different groups.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 6, lines 6-19: This paragraph states:

> "Apparently contradicting the evidence of warming are inconsistencies in the observational record, particularly related to the differences between temperature trends measured at the surface and measurements taken from satellite observations of the lower- to mid-troposphere."

The implication that the inconsistencies between the surface temperature record and the satellite record are a "contradiction" (apparent or otherwise) of the evidence of global warming is an overstatement. The 2000 NRC review of this issue (*Reconciling Observations of Global Temperature Change*) acknowledged the disparity, but concluded:

> "In the opinion of the panel, the warming trend in global-mean surface temperature observations during the past 20 years is undoubtedly real and is substantially greater than average rate of warming during the twentieth century. The disparity between surface and upper air trends in no way invalidates the conclusion that surface temperature has been rising."

The language in the introduction suggesting a contradiction does not appear to reflect this assessment by the NRC, nor does it reflect language later in the report on this subject (Chapter 3).

VICKI ARROYO AND BENJAMIN PRESTON, PEW CENTER ON GLOBAL CLIMATE CHANGE

Page 6, line 17. Even natural variability can trigger big effects in already stressed ecosystems. So some of the research and findings will be helpful for improving the resiliency of threatened but especially valued ecosystems.

ANN FISHER, PENN STATE UNIVERSITY

Page 6, line 19 - The word "Contradicting" seems too political. I think "confounding" is better.

RONALD STOUFFER, GFDL/NOAA

Page 6, lines 19-24 - It seems to me that Santer et al. has resolved many of these issues. The statements about the lack of agreement are too broad.

RONALD STOUFFER, GFDL/NOAA

Page 6, lines 19-24: The paragraph overstates the significance of the lack of observed warming since 1979 in most upper-air temperature records. An alternative to the first sentence would be: “Although extensive evidence indicates that the surface has warmed in recent decades, some satellite and radiosonde observations show little or no warming of the lower to mid-troposphere since 1979. This difference has not yet been explained completely.”

MELISSA FREE, NOAA ARL

Page 6, Lines 19 – 24. There are clearly issues to be resolved here but the differences are not as great as implied by this text. It would help to note that deduction of trends from a 20 year (inhomogeneous) satellite data is inevitably going to reflect short term variability over long term trends. It is worth recalling that comparison with the longer radio-sonde record reveals greater similarity. Recent work suggests that the main discrepancy in any case lies over the tropical oceans for reasons which *do* warrant closer investigation. In any case whatever the reason for differences between the surface and mid-troposphere there is no question that surface temperatures have risen over the period in a manner which is consistent with increased GHG forcing.

WARRILOW, WILKINS – UK DEPARTMENT FOR ENVIRONMENT, FOOD AND RURAL AFFAIRS

Page 6, lines 19-24: "Apparently contradicting the evidence of warming are inconsistencies . . ." This partially and awkwardly corrects the error described in the immediately preceding comment. The presence of the long NRC quotation preceding these lines adds to the perception that anthropogenically forced "global warming" is a fact, and that satellite data (and presumably other sources of data which are not mentioned) do not contradict this assertion but are merely "inconsistencies." I suggest these lines be revised to read "Contradicting the evidence of warming is data from the observational record, particularly satellite and weather balloon measurements of temperature trends in the lower- to mid-troposphere, which show no significant warming trends in the last two decades of the 20th century."

JOSEPH L. BAST, THE HEARTLAND INSTITUTE

Page 6, lines 19-24: The report makes more of the surface/lower tropospheric 20-year trend difference than is warranted. A more complete treatment of the vertical structure of atmospheric temperature changes, from the surface through the troposphere, stratosphere, mesosphere and beyond, is justified by predictions of major temperature changes in all these regions, which impact a range of human concerns, including stratospheric ozone layer recovery. This comment also applies to page 49 lines 29-35 and most of pages 30-31.

DIAN SEIDEL, NOAA AIR RESOURCES LABORATORY (R/ARL)

Page 6, line 19: "Apparently contradicting...." The satellite measurements do not contradict the surface observations. They are made in a different part of the atmosphere than the surface observations. What they do contradict are the model results that there should be more upper troposphere warming. The satellite measurements show that the climate system is more complicated than we thought. A better phrase to use here would be "Apparently complicating interpretation of warming trends,...". It should also be emphasized that the satellites have serious data issues and are less reliable than ground observations. In fact, abundant documentary evidence demonstrates that high altitude tropical glaciers are receding at a fast pace, consistent with the model predictions of upper troposphere warming.

SEVERINGHAUS, SCRIPPS

Page 6, line 21: should be "... taken from satellite and radiosonde observations ... "

JOHN R. CHRISTY, UNIVERSITY OF ALABAMA IN HUNTSVILLE

Page 6, line 22: The statement that the lower to mid-troposphere temperatures show “no significant warming trends” is contentious at best. For a plan that is based on indicating what is uncertain, this statement fails to recognize the controversy over this finding, the Wentz et al results presented at the workshop that contradict it, and the results of other studies that question the conclusion (e.g., the results of Santer). In fact, even the Christy data now show some increase. More generally, however, this is a troubling example of stating a conclusion in a way that is at odds with the overall approach of the plan to indicate that results are uncertain—if this plan is going to accept the findings of one group as certain (and recall that the NRC report on this matter said that another group should perform the analysis from scratch) and then claim that when two or more groups have different results everything is uncertain, then clearly the way to have confidence in the results is to fund only one group on any question. Of course, this would violate basic scientific principles.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 6, line 24: It would be very helpful to know what the “significant potential implications for decision-making” might be. Does this mean that the authors accept that this is actually the main issue that the “skeptics” rely on for disagreeing with the IPCC, and that if this is resolved their whole argument and case disappears and then a major decision on mitigation will be made. If so, then much more money should be going into addressing this issue. If not, then the phrasing here needs to be changed or explained.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 6, line 24: **(3-S)** This is the first use of "projecting" (or "project" as a verb; or "projection") in the sense of predicting or forecasting. The precise usage in this document is defined clearly on p. 7. Because of its importance, I'm calling attention to its first use here. More to follow.

HP HANSON, LANL

Page 6, line 32: **(4-S)** "capability to project" is used in the first sentence, and "improved forecasts" is used in the second. Because "project" (as a verb) hasn't been defined yet, people will confuse it with "forecast." In line 40 of this paragraph, "predict" is also used, further confusing matters. More to follow.

HP HANSON, LANL

Page 6, line 32 to Page 7, line 4: The phrasing and example here are quite interesting. Interestingly, there is no indication given here about uncertainties. The successful ENSO forecasts come with significant uncertainty, and in fact some argue that there is no skill at all above what can be gotten from analogues. It could well be argued that the long-term climate projections are likely to be as accurate as the present level of ENSO forecasts—after all, the response to boundary conditions is at least as well understood as internal system interactions. The point that needs to be made here is that there will always be uncertainties, but that various parts of society can deal with that and make economically efficient and even life-saving decisions by considering the chances of what might happen. A much more nuanced discussion of these issues are needed, and mention needs to be made here of the US National Assessment, which started to explore how existing climate science could be used to work to ameliorate potential future impacts from changes in climate. This is really the perfect place to introduce the National Assessment's vulnerability approach—not to ignore it.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 6, line 42: The ENSO forecasts do not refer to "storms" but to "stormy seasons"—be careful in phrasing. Also, the phrase "will be" is too strong and does not recognize the uncertainties here—should say, "are likely to be required."

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 7, lines 6, 14, 24, 27: **(5-S)** "project" and "projection" again, in the sense of model forecasts, and then (line 18) "projection" in the sense forecasting of society's inputs to the system. More to follow.

HP HANSON, LANL

Page 7, line 9: For this to make logical sense, please change "requires" to "justifies"

Michael MacCracken, LLNL (retired)

Page 7, lines 10-11: The statement that "Such models have been under construction for decades" gives the serious misimpression that the models have not also been applied over this time. In fact, the way the process works is an on-going iterative one where model

development and refinement goes hand in hand with model testing and evaluation and with model application to determine what insights might be gained, and to test to determine if the model results are consistent with longer sets of observations. Without change, this sentence is thus quite misleading about what has happened and how the process works.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 7, lines 13-15: This is a really incorrect way of reporting on the current status of models, especially given that the next sentence then explains that much of the range comes from a factor not part of the climate models (and won't be reduced by improving the climate models!!). About half of this range in projected temperature change is due to differences in projected emissions and forcings that have nothing to do with the climate models. In additions to this, there is no uncertainty associated with this finding. It has been suggested that the range of climate sensitivity from 1.5 to 4.5 C per CO_2 doubling represents perhaps a 90-95% range of possibilities for the response of the climate system. If a range is going to be given, then tie it to the definition of uncertainty that is being used in order to add substance to the discussion.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 7, line 13. "…significant uncertainties need to be addressed. **Insert:** Principally the uncertainties lie in the dynamic interactions at local to regional scales, i.e., Deep Convection from equatorial ocean and tropical rainforests are not simulated, nor are the episodic Polar Subsidence events that define the seasonal, epochal, and downstream weather and climate. Neither the 2002 Oktoberfest snowfall and subsequent floods in Eastern Europe, nor the Mid-USA snowstorms and recent West Coast downpours are 'forecast' from the present scales of dynamic interactions modeled by the present suite of GCMs. That these processes and their dynamics are repetitious, on a 50-70 year cycle, underlain by a continuously shifting baseline is too often not made clear by these models – as their 30-50 year empirical observational bases are simply inadequate for describing the full potential scales of natural weather and climate dynamics. Until these local to regional scale processes and their forcing's downstream transfers and interactions are accounted for, the GCM outputs remain in the realm of computer speculation. These are not likely scenarios upon which to base decisions, particularly when only Green House gases are allowed to vary.

GARY D. SHARP, CENTER FOR CLIMATE/OCEAN RESOURCES STUDY

Page 7, line 14: **New paragraph** – start with: "Current models project…".

GARY D. SHARP, CENTER FOR CLIMATE/OCEAN RESOURCES STUDY

Page 7, line 15 - Why use these estimates and not the IPCC TAR range? 1.5 to 5.8C

RONALD STOUFFER, GFDL/NOAA

Page 7, line 16: **(6-ES)** "estimates of climate sensitivity". A common sensitivity index is indeed the response to a CO_2 doubling (as noted in the parenthetical clause), but it's not

the only possible one, as implied by the wording of that clause. Using “such as” would help, or more extensive wordsmithing.

HP HANSON, LANL

Page 7, line 18-24: A list is provided regarding needed research to reduce the uncertainty in climate models. Astronomical variables should be added to the list, including earth's orbit, solar intensity, etc.

OREST LEWINTER, CITIZEN

Page 7, line 19: One reduces the uncertainty in the “results of climate models” rather than in “climate models”.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 7, line 24: "...and making progress on other fundamental challenges." After this sentence, I would suggest inserting the sentence, "One of these challenges is the failure of current models to reproduce the magnitude and areal extent of past abrupt climate change that is known to have occurred from paleoclimate records."

JEFF SEVERINGHAUS, SCRIPPS

Page 7, line 24: **New Paragraph start with:** Improved projections of climate changes on decadal and longer time scales, as well as for local and regional spatial scales, are also important for many areas of planning and resource management where decisions made today have implications for decades to come. Etc…

GARY D. SHARP, CENTER FOR CLIMATE/OCEAN RESOURCES STUDY

Page 7, lines 26-28. These are the standard argument for doing more research and give us more money. It is true not all models agree to the degreed of warming but all say there will be warming. This is and can be used to say we do not need to do anything.

SOIL SCIENCE, GLASENER

Page 7, lines 26 – 28. The range of uncertainty in regional predictions due to different models is probably far greater for rainfall than temperature and there is often a consistent sign although values might vary. As to whether they are sufficiently reliable for planning depends entirely on how they are used. In our view the need is to develop decision-making methodologies that takes such uncertainties into account. Unfortunately, where infrastructure projects have a long lifetime we may not have the luxury of being able to wait until uncertainties are reduced to levels that planners would normally want.

WARRILOW, WILKINS – UK DEPARTMENT FOR ENVIRONMENT, FOOD AND RURAL AFFAIRS

Page 7, lines 26-28 - Reference is needed for this statement or delete.

RONALD STOUFFER, GFDL/NOAA

Page 7, line 28: The conclusion that the model projections “are not sufficiently reliable tools for planning” is a political and not a scientific judgment that is based on a particular

set of values and on the decision-making process being invoked (which may well be weighing other matters versus the level of likelihood or uncertainty in a manner completely different from the scientific basis for the evaluation). If a conclusion such as this is going to be included (and this presumably applies only to the climate change models—though something similar might be applied to the ENSO forecast models, etc.), then these political (non-scientific) values have to be explained and explicitly indicated. The National Assessment found that there are all sorts of potential decisionmakers and that they each have their own ways of evaluating the likelihood and usefulness of the available information. The obligation of the scientific community is to accurately summarize what they have done, what is indicated and what basis is used for making evaluations, etc. and then to let others make this judgment. Really, a judgment such as this should not be included here—it is not a scientific one, but a judgment that depends on the particular type of decision and who is making the decision—such a general statement is really totally unjustified.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 7, line 30: **(7-S)** This paragraph is where "project" is defined (implicitly) and differentiated from "predict." As such, it's quite important to the overall document. Because of comments (3), (4), and (5) above it's even more important that the usage be consistent in those paragraphs and clearly spelled out here. To be clear: I believe that this differentiation is a very good idea and should be retained in the Plan. It just needs to be done carefully.

In particular, it might be useful to move the definitions up in the document, so that the confusion of comment (4) is avoided. Further, it seems useful to work "forecast" into these definitions somehow. It would be especially useful to be able to use the related terms "predictive forecast" and "projective forecast," except that the latter isn't sufficiently standard usage.

HP HANSON, LANL

Page 7, lines 30-43, and p. 8, lines 2-8: Good.

ANN FISHER, PENN STATE UNIVERSITY

Page 7, Lines 38-43: Models were used to project if … then scenarios for the U.S. National Assessment on the potential consequences of climate variability and change in the exact approach suggested here ("Scenarios are plausible alternative futures – each an example of what might happen under particular assumptions. Scenarios are not specific predictions or forecasts", NAST, 2000), so there should be a reference to USNA, 2000.

BENJAMIN FELZER, MARINE BIOLOGICAL LABORATORY

Page 7, lines 38-40: It is important that this discussion of the differences between projection and prediction needs to be expanded a bit, and applied more generally to the issue of climate models, etc. Reference might even be made to the January 2002 article on this subject in *Climatic Change* by MacCracken.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 8: Improving our ability to project potential future variations and changes in climate and 2 As is typical in this document, this statement inappropriately emphasizes adaptation to climate change rather than the case for mitigating climate change before it happens.

RAYMOND PIERREHUMBERT, THE UNIVERSITY OF CHICAGO

Page 8, line 2: Use of the personal pronoun "our" should be avoided, as it is not clear whom this refers to. The real issue is building up the set of knowledge so that everyone can make sue of it. A better phrasing would be "Improving capabilities for projecting …"

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 8, lines 2-4: This text seems to imply that one can simply provide results of climate model (or even environmental model) simulations directly to decisionmakers and that they will then know what to do with them. The National Assessment clearly indicated that this was not the case and that considerable effort is needed for interfacing. In fact, this plan calls for development of decision tools to assist this process, and these should be mentioned here.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 8, lines 5-7: Stakeholder interactions are also required.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 8, Lines 9–10: "*How might changes in climate, chemistry* ***(e.g., the CO2 "fertilization effect" (increased plant growth due to higher atmospheric CO2 levels))****, nitrogen deposition, and disturbance (e.g., fire, pest infestations) affect the water use efficiency, biomass allocation, and composition of natural and managed ecosystems over long periods of time?*"

Why point out this particular "effect"? It is rather convenient that the one example presented among many possible examples should (according to the authors) help to constrain atmospheric CO_2 concentrations. The problem is that this "effect" may not be particularly significant in the real world (see *Nature* **388**, 576–579 (1997); *Nature* **412**, 469–472 (2001); *Nature* **419**, 915–917 (2002); *Science* **298**, 1987–1990 (2002)).

An important chemistry change worth noting, for example, is the dwindling tropospheric concentration of the hydroxyl radical ($OH^{\bullet}$). It is rather surprising that this document does not mention it ($OH^{\bullet}$) at all when discussing tropospheric chemistry (see page 18, lines 41–43 and page 19, lines 7–10).

DAVID L. WAGGER, PH.D., SELF

Page 8 line 10. "plant growth" problem here is all that is focused on is quantity not quality and this happens all the time. The CO2 fertilization effect is cited as a way to enhance biomass production without any consideration for changes to plant QUALITY they need to be linked and quality needs to be considered.

SOIL SCIENCE, GLASENER

Page 8, lines 14-15: This question should mention that many of the aspects here relate to issues relating to sea ice and sea level. Mention should also be specifically made of "mountain glaciers" as these will have the most immediate effect on sea level, as well as on water resources for those drawing water from the mountain areas.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 8, line 16: There has been no explanation of how sea level rise is tied into climate change. This plan really needs a climate change primer up front indicating what the overall issues are.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 8, Line 17. Replace "biological function" with "biological productivity and biodiversity".

BILL PETERSON, NOAA/FISHERIES

Page 8, line 18: There needs to also be an indication of how much adaptation may cost and what the implications of adaptive steps might be. Research is required on adaptation possibilities.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 8, Line 19. Include new bullet, "How will changes in the physical dynamics of coastal regions (e.g., coastal winds and ocean circulation) affect nutrients and productivity of living marine resources in coastal areas of our nation's waters?

BILL PETERSON, NOAA/FISHERIES

Page 8, line 29 (same as first comment). We need an informed public debate and even this document needs to be discussed and this means not "to inform"!

SOIL SCIENCE, GLASENER

Page 8, Line 32: Explain the Need for the CCSP

It's unclear what difference the CCSP makes. It simply appears as an add-on to the USGCRP. Yet, the document is written as though under the USGCRP we're not doing enough. More coordination is needed. Better data sets are needed. More observations are needed. Models need to be improved, etc. So, how does the CCSP make this possible when the USGCRP didn't? Why the extra bureaucracy? The explanation in the document is unsatisfactory. It describes the CCSP as doing the same things that the USGCRP does, but for some reason, fails to do satisfactorily. What's the difference? The need for the CCSP is utterly unclear.

<u>Second Suggestion:</u> Give an Accounting for the $1 Billion/year Expended on Climate Research

There's a strange number: $1 billion per year has been spent on climate research in the U.S. for the past 20 years. This claim is misleading. If the figure is to be used, an accounting of how the money is actually spent should be given.

One suspects that sizable fractions of this $1 billion is not for climate research but pays for platforms and instrumentation: satellites, ships, research aircraft, space station, space shuttle flights. Vast amounts of money are spent on this hardware and many times more could be spent without one iota of knowledge being gained concerning the climate system. Based on the breakdown of the budgets given in the report "Our Changing Planet" for FY 2003 it would appear that about half to three quarters of this $1 billion is spent on platforms and instrumentation. Perhaps a quarter or less is spent on the scientists who analyze the data and build models to understand the implications of the observations. This hardware, of course, is crucial for climate research. But the same hardware is also used for many other endeavors such as weather forecasting, space science support, military support, geology, oceanography, etc. It seems that the price of these systems should not be lumped with the money actually devoted to supporting the scientists who do the research. Those doing the work have been getting only a small fraction of this $1 Billion per year. In any case, if more is needed, and it is most certainly needed, the budget for climate research will have to increase accordingly. The document should clarify how this money is being spent, how much goes to the hardware, which is necessary but which is also put to other services, and how much actually goes to support research. The document should also provide a picture of how these numbers have changed over say, the past three decades.

JIM COAKLEY, OREGON STATE UNIVERSITY

Page 9: and analyzed by the NRC (NRC, 2001a). Areas addressed in the NRC report include climate 11 observations, aerosols, North American carbon sources and sinks, climate feedbacks and 12 modeling, scenarios of human-induced forcing, and development of methodologies for risk 13

Again, this document acts as if the IPCC didn't exist and spend 15 years analyzing and discussing these issues, generally in much more detail than the NRC report.

RAYMOND PIERREHUMBERT, THE UNIVERSITY OF CHICAGO

Page 9, line 6: The phrase "provide oversight" needs to be better defined and explained. While it is appropriate for these agencies to participate in the setting of research priorities and indicating the needs of policymakers, it is not appropriate for them to be involved in the actual conduct or even the technical summarization of the science. To make clear that this is a scientific effort, it is important to make clear what the relative roles are, remembering that if not done by this Administration, then an Administration of the opposite party may do otherwise. To be credible, summarizing the science needs to be independent of the political party (and so of politically oriented offices in the EOP).

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 9, line 8: It is very unfortunate that there is not a paragraph up front indicating that the planning of scientific aspects is done in coordination with the various international scientific bodies (like WMO, IGBP, etc.). This section is supposed to be about "The Research Program" but it is really not about that at all, but about the funding and

organization of the effort, not even really being about the overall planning of the research program.
MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 9, line 10: Here, again (as in the Foreword), it is indicated that the policymakers identify the uncertainties. This is really not their role or capability—they need to indicate the types of information they need to make decisions and how they deal with uncertainties and likelihoods, and then the scientific community needs to indicate what it can. Note that on page 17 this is phrased differently, saying the NRC (the scientific community) identifies and explains the uncertainties.
MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 9, lines 10-14: Why isn't this reflected better in the list on p. 8, lines 9-18?
ANN FISHER, PENN STATE UNIVERSITY

Page 9, line 16: **(8-E)** I'd suggest the "have done this and that" list as bullets.
HP HANSON, LANL

Page 9, line 21: The use of „in situ at fixed sites‰ is too limiting. In situ observations, as distinguished from remote observations, do not need to be at fixed locations but could be from moving platforms such as ships, airplanes, buoys, balloons, ...
Dian Seidel, NOAA Air Resources Laboratory (R/ARL)

Page 9, line 21: The term "in situ" actually means within the system, so includes not only instruments at fixed sites, but also aircraft, balloons, etc.
MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 9, line 25. Again, delete "our" as it is supposed to be understanding useful to all.
MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 9, lines 30-31: The phrase "started to lay the foundation for understanding …" is a judgment call. IPCC and the NRC (which endorses their assessments) might well say that the foundation has been established and what is going on is elaboration. Such value-based judgment statements are not really appropriate for a scientific research plan—we are where we are—and we are so far along that there is really not any other competing explanation with any credibility at all.
MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 9, lines 36-39: Without indications of funding, this is really a meaningless commitment. The phrase, "to the extent funding is available" should be added, and it is essential for the plan as a whole that a priority setting mechanism and rationale be provided.
MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 9, line 40: Again, delete "our"

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 10: On page 10, the following appears, "Research carried out under the auspices of the CCSP addresses a diverse set of topics including - Improving the understanding of the driving forces of climate and global change including natural forces such as solar variability and human forces such as changes in land cover and emissions of greenhouse gases and aerosols"

Yet no research or monitoring program is mentioned in this CCSP Strategic Plan. Routine, monitoring measurements of total solar and solar spectral irradiance will be made by National Polar-orbiting Operational Environmental Satellite System satellites which are managed by the Integrated Program Office of NOAA, DoD and NASA affiliation. The instrument is the Total Solar Irradiance Sensor (TSIS). TSIS is a total solar irradiance monitor plus a 0.2- 2 micron solar spectral irradiance monitor.

HERBERT KROEHL, NOAA-NESDIS

Page 10, lines 1-5: It is incumbent on the plan, if it is not to be seen as a partisan political document, to at this point be referring to the IPCC and National assessments as sources of evaluated information. In fact, the main NRC report being referred to is simply a lengthy book review of these two reports (which are the primary documents, whit detailed chapters with references, etc.). To have any semblance of legitimacy, the Plan needs to acknowledge the existing scientific assessments as the state of current knowledge and to then work from there. This need have no real effect on the questions that are included here or on the Administration's position on mitigation policy—and it would get the CCSP on the side of the international and national scientific communities, instead of in opposition to them. The plan's set of questions in fact is really based on the uncertainties and areas of limited knowledge that these assessments identify.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 10, lines 9-14: Why are the first and third bullets separate?

ANTONIO J. BUSALACCHI, EARTH SYSTEM SCIENCE INTERDISCIPLINARY CENTER (ESSIC), U. MARYLAND

Page 10, Line 11: insert
Achieving a validated consensus on the fundamental physical chemical property data that underlie models of processes related to climate change.

Note: This and other additions reflect the observation that models are useless without good underlying physical and chemical property data (and their uncertainties). The comments below reflect the application of that observation to specific cases. It should be NIST's responsibility to obtain, evaluate, build consensus, and disseminate the data that are key to correctly modeling climate change.

NIST

Page 10, line 12: Phrasing here is obscure—the atmosphere does not really integrate. Perhaps this is meant to mean that the climate system is responding to all of the forcings that it is experiencing.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 10 line 12: The atmosphere, ocean and land integrate ….

MARTIN VISBECK, COLUMBIA UNIVERSITY

Page 10, lines 15-16: The word "oscillates" implies regularity—it would be better to say "fluctuates." This also occurs over time periods of "decades and beyond." The terms "rapid" and "significant" have not been defined—rapid compared to what? Significant for whom or what? The basis for such statements is essential.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 10, lines 22-23: The phrasing here is confusing, implying that one can somehow identify the fates of particular molecules (a confusion that is rampant in the community). This could say, "the net increase in CO_2 caused by human activities and its variation over time" or something similar.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 10, line 26: It is nice to see that there is agreement that it is the "Earth's basic life support system" that is being affected (and this is true). It is not at all clear that certainty can be gotten in some relatively short-term way—rather, there must be continued vigilance, and a response based on what we understand at any given time in an adaptive way.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 10, line 37: **(9-E)** Delete "The challenge:"

HP HANSON, LANL

Page 10, lines 40-41: It is not at all clear that scientists "develop knowledge" as opposed to "discover and deduce additional information and insights"

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 11, Line 3: section 3, delete and renumber section 4 "The Research Strategy" as section 3.

FANG/HOLDSWORTH-EDISON ELECTRIC INSTITUTE.

Page 11, Lines 5-24: **Specific Comment:** CCSP's document asserts "sound science" principles once presumed in endeavors such as this, though grossly abused in recent years, most egregiously in the "National Assessment on Climate Change" (NACC). Replication of this is impermissible as CCSP must comply with FDQA's requirements as set fort, herein. CCSP's principles are as follow:

"To fulfill its mission as the publicly sponsored research program addressing climate change issues for the United States, the CCSP must continuously adhere to three guiding

principles that underpin the objectivity, integrity, and usefulness of its research and reporting:

·

The scientific analyses conducted by the CCSP are policy relevant but not policy driven. CCSP scientific analyses (including measurements, models, projections, and interpretations) are directed toward continually improving our understanding of climate, ecosystems, land use, technological changes, and their interactions. In developing projections of possible future conditions, the CCSP addresses questions in the form of "If…, then…" analyses. Policy and resource management decisions are the responsibility of government officials who must integrate many other considerations with available scientific information. · **CCSP analyses should specifically evaluate and report uncertainty.** All of science, and all decisionmaking, involves uncertainty. Uncertainty need not be a basis for inaction; however, scientific uncertainty should be carefully described in CCSP reports as an aid to the public and decisionmakers.

· **CCSP analyses, measurements, projections and interpretations should meet two goals: scientific credibility and lucid public communication.** Scientific communications by the CCSP must maintain a high standard of methods, reporting, uncertainty analysis, and peer review. CCSP public reports must be carefully developed to provide objective and useful summaries of findings." (emphases supplied)

These "Guidelines" must more strongly assert adherence to, and the requirement that any product meet the requirements of, the Federal Data Quality Act.

Specifically, consider how past USGCRP "climate science" has disregarded such basic guidelines presumed in any credible, apolitical research and analytical product rising to the level of "science".

CEI has previously provided USGCRP, and NOAA, a detailed explanation of I) relevant issues relating to all agencies promulgating Data Quality guidelines, incorporating a selection of how various proposed agency guidelines address these important topics, including a) an example of a satisfactory agency proposal on the issue, if any, and the reasoning for that conclusion, & b) numerous unsatisfactory examples of current agency proposals; and **II) a direct example of information currently disseminated by Commerce/ NOAA violating FDQA, OMB's "government-wide" guidelines and any Commerce/NOAA guidelines which could be acceptable under FDQA.**

> Regarding the latter, in sum, due to a failure to institute stronger protections than those provided, *e.g.*, in "III. Guiding Principles for CCSP", politics was permitted to infect an expensive and important scientific undertaking, leading Commerce and NOAA to disseminate significant data that fails the test set forth by FDQA and OMB's government-wide guidelines. Any Commerce/NOAA "guiding principles" that would permit the continued dissemination of such data, as exemplified by but in no way limited to the example provided, *infra*, cannot withstand scrutiny as acceptable under either FDQA's or OMB's requirements.

CEI considers CCSP's "Guiding Principles" to rise to the level of FDQA-covered "agency guidelines" regarding data quality. OMB's interagency Data Quality guidelines implement section 3504(d)(1) of the Paperwork Reduction Act (PRA). 44 U.S.C. § 3516 note. Section 3504(d)(1) requires that "with respect to information dissemination, the [OMB] director shall develop and oversee the implementation of policies, principles, standards, and guidelines to apply to Federal agency dissemination of public information, regardless of the form or format in which such information is disseminated...." 44 U.S.C. § 3504(d)(1). All federal agencies subject to the PRA must comply with OMB's interagency Data Quality guidelines when they issue their own Data Quality guidelines. 44 U.S.C. §§ 3504(d)(1); 3506(a)(1)(B); 3516 note. Congress clearly intended OMB's Data Quality guidelines to apply to all information agencies subject to the PRA in fact make public.

Further, the process envisioned by CCSP triggers the FDQA consideration of Third-Party Submissions of Data to An Agency. Much of the information disseminated by federal agencies is originally developed and submitted by states or private entities. In addition, federal agencies often disseminate research from outside parties, some of which is funded by the agency.

Congress clearly intended the Data Quality guidelines to apply to all information that agencies in fact make public. OMB's guidelines reiterate this (see "Case Study" immediately below). Consequently, all third-party information that an agency disseminates is subject to the Data Quality guidelines.

Where an agency does not use, rely on, or endorse third-party information, but instead just makes it public, the agency might claim it should not have the initial burden of ensuring that the information meets the quality, objectivity, utility and integrity standards required by the Data Quality guidelines. The information remains subject to the Data Quality requirements and correction process through administrative petitions by third parties.

Yet this claim offers a distinction without a difference because when an agency uses, relies on, or endorses third-party information, the agency itself must have the burden of ensuring that the information meets the required quality, objectivity, utility, and integrity standards.

CCSP's process also envisions use of Third-Party Proprietary Models. Federal agencies often use various models developed by third parties (often government contractors) to formulate policies based upon influential scientific information. The third-party models are sometimes asserted to be confidential and proprietary. Worse, agencies use the involvement of third-party proprietary information to justify withholding related, non-proprietary data, access to which is indispensable to assessing the quality of modeled and other data.

This issue does not involve the concerns that arise when regulated entities are required to submit confidential or proprietary data to an agency pursuant to a regulatory program.

Instead, this issue is limited to situations where any agency and a contractor agree to use a model on a proprietary basis to develop influential scientific information.

OMB's interagency Data Quality guidelines require that influential scientific information be reproducible. This reproducibility standard generally requires that the models used to develop such information be publicly available. The OMB guidelines further explain that when public access to models is impossible for "privacy, trade secrets, intellectual property, and other confidentiality protections,: an agency "shall apply especially rigorous robustness checks to analytic results and documents what checks were undertaken." 67 F.R. 8452, 8457. **(note: see Annex 1 for "Case Study: Abuse of Third Party Model and "Proprietary Claim")**

HORNER, CEI

Page 11, line 1: how will this "rational sequencing" be determined? The traditional way has been (unfortunately) dominated by scientists doing work seeking to further and further reduce the uncertainty about their particular aspect of the issue. The IPCC and National Assessment processes were established to try to put all the information together in order to determine the relative importance of various uncertainties and gaps. Yet, this plan simply lists a lot of uncertainties and does not describe any coordinated process for putting all the information together and determining which uncertainties are relatively more or less important than others in the context of what is called for under the USGCRP Act and by decisionmakers.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 11, line 2: The set of those that are to be involved in this evaluation is too narrow, unless decisionmakers is very broadly defined. As the set of those who rely on information from the program is very large, including all levels of government and many public and private organizations and their representatives, as well as our international partners, this statement needs to be broadened and a process defined.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 11, line 6: "must" seems a strange word unless there is some legal mandate for this. Perhaps say, "will be expected to"

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 11, lines 8-15: It would be a major mistake for the CCSP to actually "conduct" analyses as opposed to "providing support" for them. To be considered credible, analyses (including assessments) that are carried out must be openly conducted and peer-reviewed (and better yet, major assessments need to be publicly reviewed as has been done for the IPCC assessments in the US and for the US Nat8ioanl Assessment through a Federal Register review process. Those preparing the reports must be seen to be independent of any partisan government structure. While policymakers must of necessity be involved in the review and overview efforts to ensure clear presentation of the relevant information, it is absolutely essential that the scientific analyses be maintained as independent, with the agencies supporting the process and not actually conducting the analyses.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 11, lines 8-24. This is a good list.

ANN FISHER, PENN STATE UNIVERSITY

Page 11, Line 13-15: Replace sentence "Policy… information." with "These 'If…Then…' analyses will supply the full range of possible scenarios, including both the costs of adaptation and mitigation actions on short and long term timescales, so that government officials can base their decisions on the most complete set of information available."

EESI, CAROL WERNER, JR DRABICK

Page 11, Lines 13-15: as stated, the implication is that government officials have the freedom to ignore the science if it is either inconvenient or envisioned to have consequences they do not wish to deal with. Priority needs to be given to preserving the global environment on a sustainable basis.

STELLA M. COAKLEY, OREGON STATE UNIVERSITY

Page 11, Line 17-19 changed to: "All of science, and all decisionmaking, involves uncertainty. CCSP reports and outreach will communicate both what is understood as well as what is still uncertain with regard to the causes and effects of global climate change as well as the methods available to mitigate against global climate change. Furthermore, CCSP reports and outreach must also note the expected timescale for reducing those remaining areas of uncertainty and the potential risks associated with waiting for these uncertainties to be resolved."

EESI, CAROL WERNER, JR DRABICK

Page 11, Line 18. "Uncertainty need not be a basis for inaction" This is a curious statement as it seems to suggest some presumption that it is! In fact uncertainty may imply that precautionary action may be needed. A wider basis for action should be risk assessment for which uncertainty is only a part.

WARRILOW, WILKINS – UK DEPARTMENT FOR ENVIRONMENT, FOOD AND RURAL AFFAIRS

Page 11, line 18: This call for the CCSP to carefully describe scientific uncertainty needs to be done in this plan. This should start with a definition of what is meant by the term, an overview of various general perceptions about what it means and how different groups use and apply information that is not certain, etc. In addition, as indicated above, CCSP should be encouraging the scientific community to be explaining what is meant by the term uncertainty, and to make clear their value-based choice in how it is expressed.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 11, lines 20-24: The independent assessment efforts of the IPCC (for example) need to be specifically indicated here. It was recognized during the Reagan and Bush I Administrations that national summarizations of climate science made no sense and that international understanding would necessitate international assessments, and so the IPCC

was created. The IPCC effort (and the WMO/UNEP for Ozone, etc.) needs to be indicated here as the primary means for conducting assessments (especially since the word "research" includes "assessment" per the USGCRP Act). The National Assessment process for determining what climate change (and other aspects of global change) will mean for the US should also be mentioned—and that it will be an independent effort needs to be indicated—only putting out what every USG agency agrees to is not at all how science should be summarized.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 11, Line 24: Add sentence: "CCSP public reports must be tailored to the needs of decisionmakers such that the findings regarding scientific uncertainties can be understood in a risk management context."

EESI, CAROL WERNER, JR DRABICK,

Page 11, lines 31-32: This notion that this draft plan summarizes the state of the science only makes sense if the plan recognizes that the underlying scientific understanding on these issues has been stated in the major assessments that have been undertaken (i.e., the IPCC and other assessments). It is essential that these be indicated as the fundamental basis for the plan—that is, it will build from these. Otherwise, the statements of science that are included are subject to all sorts of question and would need to be written in terms of references and would need to go through their own independent review. Such a statement is also necessary to make clear that the summary of the science is not a political judgment—this is critical in that this document is in many senses a political document indicating what needs to be done. To provide the separation of the political side from the summary of the science, it is critical that the IPCC, WMO/UNEP and National Assessments be indicated as the summaries of the science from which this research effort is building (and it may change those results through more science, etc., but these are the basis from which things start). Clarification here is ESSENTIAL or the science summaries here will need to be evaluated in terms of the political inputs for this plan.

MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 11, lines 34-35: Not true. Listed yes, described no.

ANTONIO J. BUSALACCHI, EARTH SYSTEM SCIENCE INTERDISCIPLINARY CENTER (ESSIC), U. MARYLAND

Page 11, Line 37-38: There does not appear to be a white paper on the climatescience.gov web site for the first research topic in Chapter 2, the role of aerosols in climate change. Such a white paper exists, in the form of an NRC report (NRC, 1996) and it would be useful to cite this report in lieu of a white paper. The NACIP white paper cited on p.33 represents an update to the NRC report, but the NRC report is much more comprehensive and also includes specific recommendations on how to integrate the various elements of the research plan (process studies, long-term atmospheric measurements, satellite observations, modeling studies). Not surprisingly, those recommendations for integration would yield something very similar to a "Climate Process Team", as described on p.48.

OGREN, DUTTON, HOFMANN, BUTLER, SCHNELL, TANS; NOAA/CMDL

Page 11 Line 37: Where is the list of accompanying white papers?
PAUL HANSON, ORNL

Page 12, lines 1-2: When will these papers be issued? In addition, even with these papers, it is critical to be indicating that the official summaries of the science are the assessments and not these papers that have been prepared and reviewed through a political filter. It would not be correct to say that their review as part of this effort to review what is proposed for the future is really a peer review of them as the science is not really the major focus.
MICHAEL MACCRACKEN, LLNL (RETIRED)

Page 12, Lines 14-21: What is most critical for decisionmakers, of course, is the integrated evaluation of all of these—how all of what we know fits together. Yet this plan leaves out the assessment process that would make this happen. This is a serious omission.
MICHAEL MACCRACKEN, LLNL (RETIRED)