Julie Teel (CA Bar No. 208282)
CENTER FOR BIOLOGICAL DIVERSITY
P.O. Box 7745
San Diego, CA 92167
Phone: (619) 224-3400
Facsimile: (619) 224-3700
Email: jteel@biologicaldiversity.org

Brendan Cummings (CA Bar No. 193952)
CENTER FOR BIOLOGICAL DIVERSITY
P.O. Box 549
Joshua Tree, CA 92252
Phone: (760) 366-2232
Facsimile: (760) 366-2669
Email: bcummings@biologicaldiversity.org

Attorneys for Plaintiffs

IN THE UNITED STATES DISTRICT COURT

FOR THE NORTHERN DISTRICT OF CALIFORNIA

OAKLAND DIVISION

CENTER FOR BIOLOGICAL DIVERSITY, *et al.*,

Plaintiffs,

v.

BRENNAN, *et al.*,

Defendants.

Case No. 06-CV-7062 (SBA)

DECLARATION OF DR. MICHAEL MACCRACKEN IN SUPPORT OF PLAINTIFFS' MOTION FOR SUMMARY JUDGMENT

Date: March 20, 2007
Time: 1:00 p.m.
Courtroom: 3, 3rd Floor

I, Michael MacCracken, declare as follows:

1. The facts and perspectives set forth in this declaration are based on my personal knowledge. If called as a witness in these proceedings, I could and would testify competently to these facts.

Qualifications

2. I received my Bachelor of Science in Engineering degree with high honors in Aerospace and Mechanical Sciences from Princeton University in 1964. I was also recognized by election to the Phi Beta Kappa honor society. I then received my Master of Science and Ph.D. degrees in Applied Science from the University of California Davis in 1966 and 1968, respectively. My dissertation research was focused on use of an early global climate model that I had constructed to evaluate several proposed explanations for ice age cycling. My graduate studies were recognized by election to the Phi Kappa Phi honorary society. From 1968 to 2002, I was employed as a physicist at the University of California's Lawrence Livermore National Laboratory (LLNL), where I led a number of scientific projects using numerical models of the atmosphere to simulate the effects of transport and industrial emissions on air quality and to study the response of the climate to a range of natural and human-induced perturbations, including the likely impacts of an increase in the concentrations of greenhouse gases such as carbon dioxide. In addition, I served as Deputy Division Leader of the Atmospheric and Geophysical Sciences Division from its formation in 1974 to 1987 and as Division Leader from 1987 to 1993.

3. From 1993 to 2002, I was on assignment from my permanent position with LLNL to serve as the senior scientist on global change at the interagency Office of the U. S. Global Change Research Program in Washington, DC. In this capacity, I served as the first Executive Director of the Office of the U.S. Global Change Research Program (USGCRP) from 1993-1997. I was responsible for assisting in the coordination of the global change[1] research programs of ten federal agencies, including the Environmental Protection Agency, the Department of Energy, the National Science Foundation, the

[1] The term "global change" encompasses research relating to climate variability and change, depletion of stratospheric ozone and atmospheric chemistry, changes in land cover such as deforestation and desertification, and associated impacts such as changes in water, resources ecosystems and land cover.

National Oceanographic and Atmospheric Administration, NASA, and others. In addition, in my role as senior scientist, I was responsible for keeping up with scientific advances in the field for the USGCRP and assisting the Office of Science and Technology Policy (OSTP) of the Executive Office of the President in summarizing the scientific advances for government leaders.

4. Following my tenure as Executive Director of the Office of the USGCRP, I was appointed Executive Director of the National Assessment Coordination Office, and served from 1997 through 2001. In this role, I led a small staff that had responsibility for coordinating the assessment entitled *Climate Change Impacts on the United States: The Potential Consequences of Climate Variability and Change* (hereafter referred to as the National Assessment), which was carried out under the auspices of the USGCRP at the direction of the Director of OSTP in his role as Executive Secretary to the National Science and Technology Council (NSTC). The NSTC is chaired by the President and its members consist of the cabinet secretaries. The National Assessment brought together the efforts of approximately 20 university-based regional teams, 5 joint university-government scientific teams focused on particular sectors of the economy and natural resources, and a federal advisory committee composed of 14 leading scientists and experts known as the National Assessment Synthesis Team (NAST). My responsibilities included helping to design and support the overall assessment activity, ensuring the high quality of the scientific aspects of the assessment effort, and otherwise facilitating the effective conduct of the assessment effort. In addition to participating in and reviewing many of the regional and sectoral activities and reports, I contributed to the preparation of the National Assessment, which included both a 154-page Overview Report and a much more detailed and fully referenced 612-page Foundation Report, together titled *Climate Change Impacts on the United States: The Potential Consequences of Climate Variability and Change*. This two-part report was completed and officially transmitted to Congress in November 2000 in fulfillment of Section 107 of the Global Change Research Act (GCRA). The Overview Report is attached as Exhibit 1 to this declaration. In addition, the two sections of the report were published and made available to the public shortly thereafter.[2] While the full

[2] Subsequent to their completion and transmission to Congress in early November 2000, the two components of the National Assessment report were published and made available to the public by Cambridge University Press. These published versions can be cited as U.S. Global Change Research

National Assessment Synthesis Team is considered the author of the Overview component of the National Assessment, I was included as an "Additional Lead Author" in recognition of my contributions. For the Foundation component of the National Assessment, I served as one of the lead authors for two chapters: "Chapter 1: Scenarios for Climate Variability and Change;" and "Chapter 12: Potential Consequences of Climate Variability and Change for Native Peoples and Homelands." In my role as Executive Director of the National Assessment Coordination Office and subsequent to the completion of the National Assessment, I also prepared Chapter 6 of the U.S. Government's *Climate Action Report 2002*.[3] This report was the U.S. Government's quadrennial national communication under the United Nations Framework Convention on Climate Change (UNFCCC). Chapter 6, on impacts and adaptation, incorporated and summarized the findings of the 2000 National Assessment. In 2002-2003, I also assisted the U.S. Department of Transportation in the conduct of a workshop on the potential impacts of climate change on transportation, and gave the opening invited talk on the science of climate change. As a result of my role as an author of parts of the U. S. National Assessment and as the Executive Director of the office responsible for coordinating its preparation, I have a detailed knowledge of the findings of the National Assessment and have presented a number of talks and written several papers describing its results.

5. Since retiring from LLNL in September 2002 upon the completion of my assignment with the Office of the USGCRP, I have continued to be active in assessment of the science of climate change and its consequent impacts. I am currently serving as Chief Scientist for Climate Change Programs with the Climate Institute in Washington DC. The Climate Institute is the oldest non-governmental organization focused on understanding and helping to address the climate change issue. I was also appointed to and served on the 13-member Assessment Integration Team of the 8-nation Arctic

---

Program, *Climate Change Impacts on the United States: The Potential Consequences of Climate Variability and Change: Overview Report* (2000) and *Foundation Report* (2001). The two parts are also available over the Web at http://www.usgcrp.gov/usgcrp/nacc/default.htm. A true and correct copy of the Overview Report is attached as Exhibit 1 to this declaration.

[3] A true and correct copy of Chapter 6 of the U.S. Dept. of State, *U.S. Climate Action Report 2002* (U.S. Government Printing Office 2002) is attached as Exhibit 2 to this declaration.

Climate Impacts Assessment (ACIA), which recently completed its two-part report[4] on how climate change and enhanced ultraviolet radiation are now affecting and are likely in the future to affect the Arctic region, and how these changes in turn affect the global climate and environment.

6. Since 1990, I have served in various capacities in the preparation of the First, Second, Third, and Fourth Assessment Reports of the Intergovernmental Panel on Climate Change (IPCC). The IPCC is the international organization responsible for preparing authoritative assessments of the science of climate change, impacts, adaptation, and mitigation in support of the UNFCCC. For the IPCC's First Assessment Report, which was completed in 1990, I was a contributor to two chapters in the Working Group I report: Chapter 5 on "Equilibrium Climate Change—and its Implications for the Future" and Chapter 8 on "Detection of the Greenhouse Effect in the Observations." For the Second Assessment Report, which was completed in 1995, I was a contributor to Chapter 8 of the Working Group I report, "Detection of Climate Change and Attribution of Causes," and a lead author of Chapter 25 of the Working Group II report, "Mitigation: Cross-Sectoral and Other Issues." For the Third Assessment Report that was completed in 2001, I was a contributing author to Chapter 12 of the Working Group I report, "Detection of Climate Change and Attribution of Causes." I was also an invited reviewer of various chapters for each of these assessment reports. As part of my responsibility with the Office of the USGCRP, I served as scientific coordinator for the official U.S. government review of both the Working Group I and II contributions for the Second and Third IPCC Assessment Reports. I also served as scientific advisor to the U.S. delegation at the plenary meetings of Working Group I for the Second and Third Assessment Reports,[5] contributing to the preparation of the Summary for Policymakers of each report. A true and correct copy of the 2001 IPCC Third Assessment Report Synthesis Report is attached

---

[4] Arctic Climate Impact Assessment (ACIA), *Impacts of a Warming Arctic: Arctic Climate Impact Assessment (Synthesis Report)*, Cambridge University Press, 2004; and *Impacts of a Warming Arctic: Arctic Climate Impact Assessment (Technical Report)*, Cambridge University Press, 2005, available on the Web at http://amap.no/workdocs/index.cfm?dirsub=%2FACIA%2Foverview. A true and correct copy of Chapter 18 of the ACIA Technical Report (Summary and Synthesis of the ACIA) is attached as Exhibit 3 to this declaration.

[5] Held, respectively, in Madrid, Spain in November 1995 and in Shanghai, China in January 2001. Prior to joining the Office of the USGCRP, I also served as a scientific adviser to the U.S. delegation for consideration of the IPCC Working Group I special report in January 1992 held in Guangzhou, China.

as Exhibit 4 to this declaration and includes the summary for policymakers and technical report for each of the Working Groups. For the IPCC's Fourth Assessment Report to be completed in 2007, I am serving as Review Editor for Chapter 14 of the IPCC's Working Group II report, which focuses on past, ongoing, and future impacts of climate change on North America. In addition, I have been an active technical reviewer of many of the chapters in the Working Group I (science of climate change) and Working Group II (impacts and adaptation) assessment reports.

7. As a result of these and related projects through my career, I am the co-author/co-editor of eight books, 24 journal articles, and hundreds of other less formal reports and notes. In addition, in 2003 I was elected to a four-year term as President of the International Association of Meteorology and Atmospheric Sciences (IAMAS), which is an international scientific organization whose sponsoring members are the national academies of science of the leading nations of the world. As a result of my service in this position, I also serve (or have served) on executive or planning committees of several additional international organizations/activities. I also am a member of the Scientific Expert Group (SEG) on Climate Change and Sustainable Development organized by Sigma Xi, The Scientific Research Society at the request of the United Nations Commission on Sustainable Development. I am a member of the American Meteorological Society, the Oceanography Society, the American Geophysical Union, the American Association for the Advancement of Science, and Sigma Xi. I was also elected as a Fellow of the American Association for the Advancement of Science in 1988.

The Role of National and International Scientific Assessments

8. Collective scientific understanding of climate change is best represented in major assessment reports that assemble, evaluate and critically summarize the results of thousands of scientific papers and studies that have been written about the many aspects of the climate change issue. These carefully peer reviewed assessment reports present the most authoritative international consensus available of the scientific understanding of the effects of human activities on climate, as well as of the potential impacts of climate change on the world and the U.S. While there are those critical of these major assessments, in no case have their contentions been found to have any significant influence on the consensus findings when carefully considered by the scientific community at large as part of the review process for these assessments.

9. The following summarization of the science of climate change draws extensively from the international assessments prepared by the Intergovernmental Panel on Climate Change (IPCC), which has issued assessments in 1990, 1995, and 2001.[6] These assessments, after preparation by scientists from around the world and extensive peer review, were unanimously endorsed by the nations of the world, and subsequently endorsed by the national academies of science of at least two dozen of the world's leading nations, including the United States. Based on my expert scientific opinion and drawing from my education, qualifications, experience, and knowledge of the relevant scientific literature, the findings that I include below are scientifically valid and consistent with the findings of the IPCC and the results of the US National Assessment. These findings, in my expert opinion and based on the content of national and international assessments, also reflect the strong consensus of opinion among qualified scientific experts involved in climate change research in the U.S. and around the world.

a. The atmospheric concentrations of three important greenhouse gases, namely carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), have been increasing since about 1750 as a result of human activities, principally the combustion of fossil fuel (i.e., coal, oil, and natural gas). The higher concentrations of these (and a few other) greenhouse gases enhance the Earth's natural greenhouse effect and exert a warming influence on the Earth's climate. Theoretical analyses and climate model simulations make clear that the human-induced increases in the concentrations of CO_2, CH_4, and N_2O are the major factors responsible for the global warming of about 0.6ºC (about 1ºF) that occurred during the 20th century and has grown larger over the early 21st century.

b. The most probable scenarios of future societal development indicate that, in the absence of limits on the emissions of these greenhouse gases by all sectors of the economy and international community, atmospheric concentrations of greenhouse gases will continue to rise relatively rapidly through the 21st century, very likely exceeding concentrations experienced on Earth over at least the last 10 million years, and likely even longer. As a result, global average surface air temperature will continue to rise at rates unprecedented in human history. In the IPCC's Third

[6] *See* Exhibit 4(f), 2001 Summary for Policymakers and Technical Summary for IPCC Working Group I, The Scientific Basis.

Assessment Report in 2001, considering the range of possible emissions and averaging across the results of the available set of climate models, it was concluded that global surface air temperature is likely to increase by about 0.2 to 0.5ºC (about 0.3 to 0.9ºF) per decade over the 21st century. In order to point out the importance of limiting future emissions, the IPCC has developed a range of emissions scenarios that assume ongoing technological development, but do not assume the implementation of emissions control policies beyond those in place today. Using this set of plausible emissions scenarios and accounting for the ramifications of uncertainties in the scientific understanding incorporated in climate models, the IPCC projected in 2001 that global average surface air temperature is likely to increase to about 2 to 4.5ºC (about 3.5 to 8ºF) over 1990 (i.e., 1981-1999 average) levels by the end of the 21st century.

c. In that the current warming of over 0.6ºC (about 1ºF) is already having significant environmental and societal consequences in some areas, a further rise by even the minimum increase identified by the IPCC would have widespread climatic, environmental, and, consequently, societal consequences around the world. Entities such as the European Union are now suggesting that such levels would exceed the "dangerous anthropogenic interference" level set as a standard in the United Nations Framework Convention on Climate Change (UNFCCC) to which the U.S. is a signatory. Independent of the uncertainties in the climate projections, the amount and consequences of climate change will become much more significant over the course of the 21st century, at whatever level of reduced emissions can be achieved. The question is thus how great the consequences will be, not whether there will be any significant consequences or not.

d. Important environmental impacts of the global warming of about 0.6ºC (about 1ºF) that have occurred to date include[7]: (i) warming of the oceans and increased melting of many mountain glaciers and ice caps around the world, contributing to the 10 to 20 cm (4 to 8 inches) rise in

[7] Some of the text in this subparagraph is drawn from the Working Group II contribution to IPCC's Third Assessment Report, *Climate Change 2001: Impacts, Adaptation and Vulnerability*; Cambridge University Press, page 3 (*see* Exhibit 4(g)).

global sea level observed during the 20th century;[8] (ii) higher ocean temperatures that are likely to be providing the energy that has led to indications of increases in both the intensity and duration of tropical cyclones (known in the U.S. as hurricanes), adding to the vulnerability of those living on U.S. coastlines; (iii) lengthening of the growing season in mid- and high-latitudes that has contributed to poleward and altitudinal shifts of plant and animal ranges and the decline of some plant and animal populations, thereby adversely impacting biodiversity; and (iv) coastal erosion in regions where the sea ice that suppresses storm waves has been melted back, where the permafrost is thawing, and where there is later freezing and earlier break-up of ice on rivers and lakes is already leading to plans for moving endangered communities to safer ground.

e. The most important environmental impacts of projected global warming over the 21st century for the United States are likely to include: (i) a significant increase in the rate of sea level rise as compared to the rate experienced during the 20th century, amounting to an average rate of rise of about 1 to 9 cm (about 0.5 to 3.5 inches) per decade and totaling between 9 to 88 cm (about 4-35 inches) by the end of the century (with the most likely value being, in my expert opinion, near or above the middle of this range as a result of the faster than expected melting of mountain glaciers and parts of the Greenland Ice Sheet that have been identified since the most recent IPCC assessment report); (ii) further intensification of tropical cyclones and other convective rain storms, increasing direct damage to coastal ecosystems and communities; (iii) severe and irreversible changes to important natural ecosystems, including: significant stress and then loss of coral reef systems and arctic and alpine environments; shifts and relocation of ecological features such as forest and tundra boundaries; inundation and deterioration of barrier islands and low-lying coastal regions; and widespread melting of glaciers and ice sheets; and (iv) continued and accelerating reduction of water storage in winter snowpack in mountainous regions such as the Sierra Nevada, with direct and important environmental and economic consequences

[8] More recent analyses of the observed record than appeared in the IPCC's Third Assessment Report in 2001 suggest that the 20th century rise was likely in the upper half of the indicated range. That the rate of rise has recently increased appears to be confirmed by satellite observations over the past decade, which indicate that sea level is now rising at a rate that is about 50% greater than over the 20th century as a whole.

resulting from changes in the amount and seasonal availability of water resources.

10. With the existing rate of emissions already inducing significant impacts in some regions and with the challenge of slowing the build-up in atmospheric concentrations of greenhouse gases proving difficult, significant changes in climate lie ahead. As a result, adverse environmental and societal consequences will continue to increase, thereby making adaptation more and more challenging.

The 2000 National Assessment

11. Spurred by the IPCC's finding in 1995 that "[t]he balance of evidence suggests a discernible human influence on global climate,"[9] and mindful of the call for more comprehensive assessments of climate change impacts included in the Global Change Research Act [Public Law 101-606, Section 107], the leaders of the U.S. Global Change Research Program (USGCRP) concluded that the impact assessments that had been previously undertaken under USGCRP auspices (including EPA's multi-region assessment study in 1989-90, the chapter on impacts prepared for the first U.S. Climate Action Report under the UNFCCC in 1994, and the IPCC chapter on impacts in North America completed in 1995) were inadequate in representing the extent of scientific understanding that was emerging. In response, the preparatory workshop phase of what became the U.S. National Assessment was initiated in 1997, with the intent of making the best scientific understanding and knowledge available to: Congress and government leaders at local to federal levels; public and private sector managers; resource and river management managers; and many more "stakeholders in climate change"[10] (hereafter, simply stakeholders). The National Assessment was to be designed to communicate effectively to the identified stakeholders by allowing them to inquire about, debate, and develop approaches for dealing with the significant impacts of global warming (and, more generally, climate change) for their management sector. The overall purpose of the National Assessment was therefore to help to reduce the magnitude and scope of potentially adverse consequences for the U.S. by increasing

[9] See IPCC 1995 Contribution of Working Group I, *Climate Change 1995: The Science of Climate Change*, page 4, available on the Web at http://www.ipcc.ch/pub/reports.htm.

[10] The term "stakeholders" was interpreted very broadly, encompassing representatives of local, state, regional, and federal governments, resource managers from the public and private sectors, members of industry and labor groups, representatives of public interest groups and professional organizations, formal and informal educators, the general public and representatives of various of its components (such as American Indians), the scientific community, and more.

awareness and the time available to adjust or alter the activities or facilities that are likely to be most adversely impacted.

12. The resulting National Assessment process, which was designed to provide the basis for preparing the National Assessment report that was transmitted to Congress in November 2000 as well as to more generally serve the American public, was a multi-component effort. To develop estimates of the potential impacts at the regional level, workshops were held in 20 regions around the country during 1997 and 1998 and the issues identified led to full regional assessments being undertaken in 15 of the regions (for the other regions, it was not possible to have proposals prepared and reviewed and to secure funding in the time available). To provide national crosscuts regarding key issues, 5 sectoral assessments were organized covering the likely impacts on agriculture, forests, human health, water resources, and coastal areas and marine resources. To provide the national integration called for in the GCRA of 1990, a National Assessment Synthesis Team (NAST) was formed to draw together the results from the regional and sectoral assessments, identify key national messages, and prepare the National Assessment report. Each of the regional and sectoral assessment efforts drew upon a broad range of scientific expertise from within and outside the USGCRP research community, involved a range of stakeholders in their deliberations, and prepared reports that were reviewed by experts and made available for comment by a wider set of experts and stakeholders. In support of its preparation of the National Assessment report, the NAST was therefore able to draw from the detailed information developed by the regional and sectoral teams and from materials prepared by other experts. To assure the quality and comprehensiveness of the National Assessment report, the NAST also carried out a multi-stage review by scientific experts and a further review by the U.S. public at large. The result of these efforts was the preparation of a series of regional and sectoral reports[11] that underpinned and supported the preparation of the National Assessment report, ensuring that it was based on the best analyses that could be provided by current understanding. To fill the remaining gaps and further refine, develop, and update the findings of the National Assessment, the initiation of a long-term national assessment process was envisioned that would continue indefinitely the two-way dialogue and discussion between the scientific community

[11] The full set of regional, sectoral, and national reports is available over the Web at http://www.usgcrp.gov/usgcrp/nacc/default.htm.

and the expert user and stakeholder communities that had been initiated during the initial National Assessment. This interaction proved especially important because both sides have substantial information and expertise to exchange and are able to identify substantial questions that remain to be explored.

13. The success of the National Assessment was made clear in several ways: (a) the 2000 National Assessment became the primary resource for use by the authors of the chapter on the likely impacts of climate change for North America contained in the Third Assessment Report of IPCC Working Group II, *see* Exhibit 4(g) (and the National Assessment's findings stood up well through the IPCC's international review process); (b) the findings of the National Assessment were endorsed in the 2001 report of the U.S. National Academy of Sciences that was prepared in response to questions submitted by the President[12]; and (c) the findings of the National Assessment, with the formal approval of the relevant agencies and departments of the U.S. government (including the Executive Office of the President), served as the basis for Chapter 6 of the *US Climate Action Report 2002*,[13] which was the U.S. government's official quadrennial national communication under the United Nations Framework Convention on Climate Change (UNFCCC).

The Situation Since the Completion of the National Assessment Report in 2000

14. The Climate Change Science Program (CCSP's), which was created by the Bush Administration in 2002 and incorporated the USGCRP, made a decision to prepare 21 synthesis and assessment (S&A) products and not to conduct a fully developed National Assessment process or prepare an integrated National Assessment report. This has greatly limited the comprehensiveness and effectiveness of the national impact studies. This is the case because the S&A products have focused primarily, at least in the reports completed to date, on very limited questions, such as the amount of climate change, the consistency of models and observations with regard to temperature change in the upper troposphere, changes in atmospheric composition, representation of key processes, and similar detailed scientific questions. There is currently a much lower level of activities aimed at working with

[12] National Research Council, 2001: *Climate Change Science: An Analysis of Some Key Questions*, National Academy Press, Washington, DC.

stakeholders to inquire and identify how best to prepare in advance for and ameliorate the likely adverse consequences of climate change. It is, in my expert opinion, therefore very likely that U.S. stakeholders will experience greater damage and have less time to respond than if the national assessment process had continued and the Administration had focused on preparing and submitting an updated National Assessment to the Congress on the quadrennial basis that is called for in Section 107 of the Global Change Research Act [P.L. 101-606].

15. This failure to prepare the quadrennial National Assessment due in 2004 (which would necessarily have required having an ongoing national assessment process that was generating underpinning regional and sectoral assessments) has been particularly damaging because: (a) the state of scientific understanding and the identified impacts of climate change have continued to accumulate—see paragraph 16; and (b) there were a number of gaps and limitations in the initial National Assessment that can now be much more rigorously addressed, making clear that regular quadrennial updating of the National Assessment would provide increasingly valuable information for stakeholders—see paragraph 18.

16. Since 2001, the dominance of human-induced climate change over natural variability on a global basis has increased, leading to what appear to be more frequent and persistent than expected occurrences of climatic extremes such as drought, melting of Arctic sea ice, heavy downpours, etc. In particular, the amount of warming has increased (making the most recent ten years very likely the warmest for the globe as a whole in more than a thousand years[14]); the rate of sea level rise over the past decade is more than 50% greater than over the 20th century as a whole (and the rate appears to be in the upper range of current IPCC projections); unusually prolonged and intense drought has occurred in the western U.S., leading to increases in the area consumed by wildfire; the global hydrologic cycle has intensified, with more evaporation and precipitation, including more extreme rainfall; the pace of retreat

---

[13] *See* Exhibit 2, Chapter 6 of the U.S. Dept. of State, *U.S. Climate Action Report 2002* (U.S. Government Printing Office 2002).

[14] Northern Hemisphere warmth several thousand years ago, in contrast to the global warmth evident this century, was likely due primarily to the long-term cycling of the Earth's orbital parameters. Over the last few thousand years, this cycling has likely exerted a cooling influence, only recently overwhelmed by the warming influence caused by human activities.

of mountain glaciers and sea ice has accelerated, and there are indications that the Greenland and Antarctic ice sheets are starting to lose significant mass; the ranges of a wide variety of plant and animal species have been found to be shifting poleward and upward in altitude, clear indications that the biosphere is feeling the warming; and population growth and development are continuing at a high pace along the U.S. coastline in regions that are particularly vulnerable to increases in sea level and the higher storm surges projected to result from more intense tropical storms and hurricanes. Overall, in my expert opinion and that of much of the scientific community, the impacts of climate change are appearing sooner and with greater intensity than had been projected.

17. Given the urgency of getting National Assessment activities going in 1997 and recognizing the impracticality of and delays inherent in the traditional governmental budget process for assembling substantial new and dedicated fiscal resources across the eight major agencies and departments participating in the USGCRP, the National Assessment effort that was begun in 1997 was considered to be the first comprehensive attempt to comply with the Global Change Research Act's National Assessment requirement.[15]For many reasons, it was recognized by the Congress in the GCRA and by USGCRP leaders that the National Assessment would require updating and refining on an ongoing basis, with attention given to incorporating results based on new information, exploring additional issues and questions, and expanding the effort to communicate with the Congress, stakeholders, and the general public. However, with the phase down of National Assessment activities since 2001, the needed updating and improvement of the National Assessment has not been carried out. As a result, the limits of the 2000 National Assessment are becoming more apparent and more serious.

18. By taking advantage of the improved scientific capabilities and understanding since the 2000 National Assessment, and by filling the gaps and limitations that were identified, a much more comprehensive and useful information base can be developed. Updating the 2000 Assessment (now at least 5 years delayed), would thus provide the opportunity to achieve the following advances:

a. An updated National Assessment is needed in order to fully consider the environmental and societal impacts across the full set of U.S. regions. While the intensity and pace of climate

[15] Earlier efforts had generally been qualitative, undertaken by single agencies or by the IPCC, and had involved mainly literature reviews that could summarize results for only parts of the U.S.

change are best estimated starting with a global perspective, evaluation of the likely environmental and societal consequences of climate change necessarily must start at the local level and then work up to regional and larger scales. The 2000 National Assessment led to preparation of regional assessment reports for 12 regions;[16] however, regional reports were not completed in other important regions.[17]

b. A more robust set of results from global climate models is now available as compared to what was available for the 2000 Assessment. The initial assessment activity was, in most cases, only able to draw upon the early results of two global climate models because of limitations in the simulations of other groups. The IPCC's Fourth Assessment Report, to be completed in 2007, has made clear that results are now potentially available from about 20 climate models, which would provide a much more statistically robust representation of the types of climate impacts to be expected. Such results would help greatly in providing, for example, more definitive indications of changes in snowline and water resources in western mountain regions and of precipitation in various regions and seasons of the year, particularly in the southeastern U.S. (where the outcome will determine if it stays forest-covered or is so dry that more frequent fires turn the landscape into savanna) and in the Great Plains (where the outcome will determine the likely consequences for agricultural production).

c. Model results now incorporate greater spatial detail than was available for the 2000 Assessment. The model results available for the studies between 1997 and 2000 were relatively coarse grained, meaning that the representations of changes in precipitation (both rain and snow) were generally available only for spatial scales larger than western states (so little differentiation was available between changes in northern, central, and southern California) and the sign and magnitude of the projected changes were sometimes contradictory. Current model simulations have much finer spatial resolution and even more finely resolved regional models could be used

[16] Alaska, Central Great Plains, Great Lakes, Gulf Coast, Metro East (NY-NJ-CT), Mid-Atlantic, New England, Pacific Islands, Pacific Northwest, Rocky Mountains and Great Basin, Southeast, and Southwest/Colorado Rive Basin.

to generate improved results in regions of particularly sharp topographic features (e.g., the Sierra Mountains, the Rocky Mountains, etc.). Of critical importance would be the opportunity to develop better estimates of changes in precipitation (both rain and snow), runoff, and evaporation in the western mountains where water resources are so critical. For the 2000 National Assessment, changes of several types were considered, giving such a broad range of likely consequences that, for example, California felt compelled to initiate a state research program and even the city of Aspen, Colorado initiated an assessment to consider changes in snowfall and skiing conditions.[18] The snow and water resource issue, however, has much wider scope than covered by these two region-specific studies, covering, for example, management of water for the Colorado and Rio Grande river basins (both of which involve multi-state allocation of water and treaties with Mexico), sustainable management of western grasslands, the potential for increased wildfire, Indian tribal rights, tourism and public lands and parks,[19] and much more. Quite clearly, a nationally organized effort is needed.

d. Scientists are now able to consider model results for a range of plausible emission scenarios, which would help in comparing the costs of a rapid versus a slow transition away from use of fossil fuels. While the Climate Change Science Program's current activities do include an effort to develop a set of emission scenarios independent of the IPCC set of scenarios, the main need is to have multiple climate models carry out simulations of a range of emission scenarios and to have the National Assessment team(s) evaluate the relative outcomes for various regions and sectors across the country.

---

[17] California, Native Peoples/Native Homelands in the Southwest, Northern Great Plains, Southern Great Plains, Appalachians, Eastern Midwest, South Coast/Caribbean Islands, and Southwest/Rio Grande Basin.

[18] For the City of Aspen assessment, I served on the national advisory committee. The assessment is available over the Web at http://www.agci.org/aspenStudy.html.

[19] In the absence of adequate information being provided by the Climate Change Science Program, the Congress has asked the Government Accountability Office (GAO) to undertake a study on the potential consequences of climate change on public lands. Such a comprehensive effort is proving quite a challenge for the GAO, given limited funding and personnel resources because such an assessment, involving stakeholders and a wide range of experts, is not traditionally within the scope of GAO activities.

e. The updated Assessment effort will be able to analyze the effects of climate change on the various ways in which the United States is coupled to the rest of the world. The National Assessment identified four general categories of connections:[20] linkages related to economic coupling, including investment, trade, markets, vital products, and corporate operations; linkages relating to shared resources, including water resources shared with Canada and Mexico, international fisheries, and migrating species; linkages relating to human health, including the potential for new diseases to be brought into the U.S., and the likelihood of exposure of U.S. citizens out of the country to diseases and harm from natural events; and linkages relating to social bonds, including issues of environmental refugees, pressure for immigration, social well-being, war and civil strife, etc. An updated National Assessment would be expected to consider how what happens elsewhere would be expected to affect U. S. interests, and how such impacts would depend on the abilities of other nations to prepare for and adapt to changes in climate.

f. With emerging capabilities and with greater involvement of corporate and community stakeholders, examination of the potential economic consequences of climate change is possible and should be undertaken in the updated Assessment in order to provide a more quantitative basis for policy development at national, regional, state, and community levels, and to assist in differentiating important and unimportant economic impacts. For example, a key issue for many coastal communities and shipping ports is to evaluate the options for dealing with sea level rise—what areas need to be protected by levees, where will retreat be needed, how will issues of land ownership and coastal access be accounted for, etc. There are a wide number of similar areas where early analysis will open the potential for effective action (e.g., the City of Aspen's assessment provides an indication of what approaches might be considered for sustaining the success of the ski industry—the entire nation deserves such high quality assessments, not just the richest communities).

g. An updated National Assessment would allow consideration of linkages to demographic trends, changing types of economic activity, and other societal couplings (e.g., ongoing growth of

[20] U.S. Global Change Research Program, *Climate Change Impacts on the United States: The Potential Consequences of Climate Variability and Change: Overview Report* (2000), page 8 (Exhibit 1).

coastal communities in especially vulnerable regions) as well as of how climate change might affect the changing economic base of a region (e.g., alter the potential for growing certain crops, for hosting certain types of tourism and businesses). In addition, an updated Assessment could consider how such changes might enhance or degrade the potential to adapt to and respond to climate change (e.g., more frequently endanger the coastal transportation infrastructure needed to evacuate populations from the impacts of severe storms). Building the community of researchers capable of bringing consideration of societal development and behavior into the assessment activities will require sustained support and additional resources to strengthen the assessment teams—cutting off assessment activities significantly disrupted the process that had gotten started.

h. The Global Change Research Act [Public Law 101-606] actually requires that the National Assessment encompass the potential significance and consequences of "global change" rather than of just climate change. The 2000 National Assessment started this process,[21] and ultimately did consider some aspects of the broader change (e.g., consideration in high latitudes of the implications of stratospheric ozone depletion on UV radiation, consideration of the potential for changes in land cover that would change the spatial distribution of ecosystems, etc.). New knowledge and understanding gained will enable the updated Assessment to provide more comprehensive evaluations that should be much more useful to decision makers faced with simultaneously dealing with the full range of issues facing society.

i. An updated National Assessment would be able to provide information and analyses tailored to the interests and needs of specific stakeholders, which would have significant potential for improving their ability to plan for and adapt to climate change. The type of information many stakeholders indicated would be especially useful included projections of changes in variables that were generally not yet available during the initial National Assessment (e.g., changes in the likely occurrence of extreme events, changes in the magnitude and frequency of peak runoff,

[21] In particular, this was accomplished at workshops convened to identify key issues to be evaluated by asking, as the first question, what were, other than climate change, the key long-term environmental issues facing the region (e.g., availability of sufficient water, changes in vegetative cover, etc.).

and changes in the nature of weather and climate variability). With the research community building new tools and capabilities (e.g., improved global, regional, and other specialized models) to provide at least some of this information, the updated National Assessment has the potential to provide a much more useful and comprehensive evaluation of climate change impacts.

19. The GCRA considers the scope of the assessment activities to include changes in climate and impacts on the environment and society. In addition, however, Congress and agency decision makers expect the National Assessment to provide a basis for evaluating the economic, societal, and environmental costs and benefits of steps that might be taken to limit emissions of greenhouse gases (e.g., by increasing carbon stored by ecosystems). The Administration's Climate Change Science Program has, organizationally, recognized the need for coordination of adaptation and mitigation research. Future National Assessment activities should be able to provide information needed to help develop a coordinated response to climate change.

20. The GCRA mandates a National Assessment no less frequently than every four years. The initial National Assessment activities made clear that the quadrennial National Assessment needs to be supported by an ongoing assessment process that provides the information needed to update its findings, to address the evolving questions and needs of new and current stakeholders, to account for societal and economic change, and to be updated as the climate continues to change. Information that is not current or being continually updated is really of diminishing use and utility to the Congress, agency decision makers, and public and private stakeholders.

21. Overall, therefore, the decision of the present Administration not to prepare and issue an updated National Assessment is squandering the tremendous opportunity of building on the 2000 Assessment effort. This delay has also limited the provision of important and useful information to stakeholders and is therefore likely postponing adaptive responses that could limit and ameliorate the early stages of climate change. This delay will thereby increase costs for dealing with impacts in the future, when faster and greater responses are going to be needed. In addition, the failure to update the National Assessment has limited the amount of information made available to the IPCC for its Fourth Assessment Report due out in 2007 and for use in the quadrennial updating of the US Climate Action

Report, which was due to the UNFCCC in 2006, the draft of which has yet to even be released for public comment despite a Federal Register announcement in 2005 that this would be occurring.

22. From even before the time of my initial association with the US Global Change Research Program in 1993, assessment of the impacts of climate change was a key focus of the program. As documented in the annual issues of *Our Changing Planet* prepared for Congress to document USGCRP activities, understanding the significance of global change and helping society to deal with it were viewed as critical objectives, serving to shape the focus of the ongoing research program and prompting the comprehensive National Assessment process set up to generate the 2000 National Assessment. In turn, an important aspect of the National Assessment process (and the National Assessment report, in particular) was the call for additional research to be undertaken. Indeed, ensuring a vital and effective USGCRP requires an ongoing exchange and iteration between the research program (achieved by periodic updates of the research plan required by the GCRA) and the assessment activity (achieved by periodic updating and issuance of the National Assessment). For this reason, it was widely expected that the results of the 2000 National Assessment were then particularly timely as input to preparation of the CCSP/USGCRP research plan in 2003 (entitled the "Strategic Plan"). Although strongly favored by those invited to participate in the development of this plan, as pointed out by participants in a major workshop called by the Climate Change Science Program and in the National Research Council (NRC) review of the draft version of the research plan,[22] the CCSP leadership failed to officially incorporate the results and findings of the National Assessment in preparation of the 2003 research plan (e.g., there are no substantive references to the National or regional reports except in one sentence that misstates the dates of its completion). Even a follow-up review of the final version of the research plan by the NRC,[23] which pointed to their earlier recommendation regarding the importance of coupling the research and assessment activities and to the shortcoming of the draft and final research plans in this area, did not prompt the Administration to prepare the legally required update of the National Assessment.

[22] National Research Council, 2003: *Planning Climate and Global Change Research*, National Research Council, Washington DC.

[23] National Research Council, 2004: *Implementing Climate and Global Change Research*, National Research Council, Washington DC.

23. In addition, given the goal-focused nature of the USGCRP (and the Climate Change Science Program) as expressed in the GCRA, not having an updated National Assessment to ensure that USGCRP and the Climate Change Science Program research is strongly focused on key stakeholder needs will be an important impediment in preparation of the required update of the research plan. The update to the research plan is especially needed given the important scientific advances being made, the needs for research that are expected to be identified in the IPCC's Fourth Assessment Report, and the general sense amongst scientists active in the field that the impacts resulting from the changes in climate that have occurred are generally larger and more significant than had been expected only 4-5 years ago. In addition, the GCRA requires that the ten-year research plan specify the funding required to carry out the research needs and priorities enunciated in the plan, to the extent practicable.

24. There is a significant and growing demand for the results of impact assessments including the National Assessment. This is evident not only from inquiries from Members of Congress, with their general level of interest regarding the effects of the timing of policy adoption, but also from inquiries from the broad-based community of stakeholders (ranging from water resource managers to land managers to urban planners). This interest in the information that would be provided in an updated National Assessment was made especially clear at the November 2005 conference called by the Climate Change Science Program leadership and entitled "U.S. Climate Change Science Program Workshop: Climate Science in Support of Decisionmaking." The workshop attracted several hundred participants from across the country, ranging from those wanting to demonstrate and enhance capabilities for evaluating the consequences of climate change on the environment and society to those wanting the results of such studies. The discussion in the various breakout groups made it very clear that what was needed was an on-going, distributed, and very comprehensive National Assessment process that would lead to periodic updates of findings, as called for in the GCRA. There was particular interest in the need to update projections of sea level rise and hurricane intensification, regional changes in temperature and precipitation, changes in soil moisture and runoff, and of the potential for a higher frequency of conditions favorable for drought and wildfires. While the convening of such a workshop would appear to be a forward step in rebuilding the National Assessment process, the USGCRP/CCSP leadership indicated that no additional funding was being provided or promised to build up to the needed level of

effort. In addition, there are not yet any indications that the leadership of the Climate Change Science Program is taking actions to update the National Assessment in view of all the scientific advances over the past 7 years.

25. Although the Climate Change Science Program is preparing a series of "synthesis and assessment products," they tend to focus on quite specific and narrow questions and issues, while not making any visible effort to produce a comprehensive, updated National Assessment. The type of comprehensive and coordinated assessment activity required by the GCRA would build upon the initial National Assessment and provide a useful and significant return to society on their investment in global change research and observations. As a result, there are very significant gaps and limitations in the information being provided about impacts and adaptation to U.S. decision makers and other stakeholders, while at the same time other nations are aggressively working to build capabilities for protecting their societies and economies. Thus, not only are the U.S. public and private sectors being stressed by the changes in the climate that are occurring, but they are not being provided the information needed to make optimal adjustments for protecting resources at home and for keeping up with their international competitors.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge, information, and belief.

Executed at Bethesda, Maryland on January 17, 2007

Michael MacCracken

EXHIBIT LIST

Exhibit 1. U.S. Global Change Research Program, *Climate Change Impacts on the United States: The Potential Consequences of Climate Variability and Change: Overview Report* (2000), available at http://www.usgcrp.gov/usgcrp/nacc/default.htm; (Overview Report).

Exhibit 2. Chapter 6 of the U.S. Dept. of State, *U.S. Climate Action Report 2002*, U.S. Government Printing Office, 2002.

Exhibit 3. Arctic Climate Impact Assessment (ACIA), *Impacts of a Warming Arctic: Arctic Climate Impact Assessment (Scientific Report)*, Cambridge University Press, 2005 (Chapter 18).

Exhibit 4. IPCC's Third Assessment Report, *Climate Change 2001: Synthesis Report*, Cambridge University Press, 2001, which includes:
(a) cover sheets;
(b) overall Summary for Policymakers;
(c) summary questions 1-3;
(d) summary questions 4-6;
(e) summary questions 7-9;
(f) Summary for Policymakers and Technical Summary for Working Group 1 (climate science);
(g) Summary for Policymakers and Technical Summary for Working Group 2 (impacts of climate change);
(h) Summary for Policymakers and Technical Summary for Working Group 3 (options for limiting emissions); and
(i) Annexes.