TESTIMONY OF
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BEFORE THE
COMMITTEE ON COMMERCE, SCIENCE AND TRANSPORTATION
UNITED STATES SENATE

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Good afternoon Senator McCain, Senator Hollings and members of the Committee. I am James R. Mahoney, Assistant Secretary of Commerce and Deputy Administrator of the National Oceanic and Atmospheric Administration (NOAA). I am appearing today in my capacity as Director of the United States Climate Change Science Program (CCSP). CCSP integrates the federal research on global change and climate change, as sponsored by thirteen federal agencies (the Departments of Agriculture, Commerce, Defense, Energy, Health & Human Services, the Interior, State, and Transportation; together with the Environmental Protection Agency, the National Aeronautics and Space Administration, the National Science Foundation, the Agency for International Development, and the Smithsonian Institution) and overseen by the Office of Science and Technology Policy, the Council on Environmental Quality, the National Economic Council and the Office of Management and Budget. In February 2002 President Bush created a new cabinet-level management structure, the Committee on Climate Change Science and Technology Integration, to manage the over $3 billion annual budget federal climate change research and technology development programs. CCSP, which integrates the work of the U.S. Global Change Research Program (USGCRP) created by the Global Change Research Act of 1990 with the Climate Change Research Initiative (CCRI) launched by the President in June 2001, is a key element of the President's climate science and technology development management structure.

In response to your invitation, I am very pleased to have this opportunity to present testimony on the Administration's November 2002 *Discussion Draft Strategic Plan* for federal research on climate change, and on the uniquely successful workshop on the draft plan, held in Washington, DC, on December 3 to 5, 2002. The workshop was designed to facilitate extensive discussion and comments on the draft plan from all interested domestic and international groups and individuals, including the scientific community, a wide range of stakeholders, interested members of the public, and the media. The open comment period begun before the workshop continues until a deadline of January 18, 2003, for receipt of written comments. We look forward to providing this Committee, as well as other interested elements of the Congress, with a report on the comments and their resolution – and with the updated strategic plan – by the end of April 2003, as announced in the workshop documents. I note that all elements of the strategic planning process, including the *Discussion Draft Strategic Plan*, all of the workshop proceedings and all written public comments, will be available at the web site *www.climatescience.gov* .

SUMMARY OF THIS STATEMENT

1. **"Credible Fact Finder"**: Responding to the direction of President Bush that the best available scientific information be developed to support decision making on global climate change issues, CCSP has developed its strategic planning and public review processes to facilitate "credible fact finding" on (a) key **climate science** issues, (b) comprehensive, high quality climate and ecosystem **observing and data management systems**, and (c) the development of meaningful **decision support resources** in the form of responses to "if …, then …" questions, which depends on achieving significant progress under (a) and (b) above.

2. **New, Integrated Management Structure**: The CCSP has implemented a comprehensive, interagency management structure to assure effective and efficient deployment of approximately $1.7 billion (annual budget) in directly sponsored research and $1.3 billion of related research conducted by the thirteen CCSP collaborating federal agencies. During the past nine months this new management structure has (a) completed a comprehensive strategic review of the ongoing research programs in all CCSP collaborating agencies, (b) produced an interagency integrated climate science budget request for FY 2004, to be included in the President's budget request to be sent to Congress, and (c) prepared the basis for operational interagency management of the FY 2003 appropriated budgets when they become available.

3. **November 2002 Discussion Draft Strategic Plan**: The CCSP recently published an extensive "draft for discussion" of its new 10-year strategic plan. The draft plan is structured around **key questions** in the science, observations and decision support areas, to encourage a focus on the information needed to underpin public discussion of climate change issues. The *Discussion Draft Strategic Plan* responds to the requirements for periodic updates as specified by the Global Change Research Act of 1990 (PL 101-606), and to the direction of President Bush that climate change research activities be accelerated, so as to provide the best possible scientific information that can be developed in the near term. *The Discussion Draft Strategic Plan* (discussed further below) is available on the web site *www.climatescience.gov* .

4. **December 3-5, 2002, Workshop on the Discussion Draft Strategic Plan**: The workshop held last month here in Washington was a key element in the process of developing the scientific basis to evaluate the effectiveness and efficiency of a range of climate change mitigation and adaptation options. The workshop was the most highly attended and structured discussion of climate change issues held to date, and it was conducted with a 100 percent commitment to open and transparent discussion of the issues. The workshop is discussed extensively later in this statement, and all of the documentation on the workshop proceedings also appears on the web site *www.climatescience.gov* .

5. **Comprehensive Review by the National Academy of Sciences**: CCSP has requested that the National Academy of Sciences – National Research Council (NAS) conduct a comprehensive review of the draft and final versions of the CCSP Strategic Plan. The

Academy appointed a special 17-member committee of experts in the physical, biological, social and economic sciences, and this committee reviewed the *Discussion Draft Strategic Plan*, and participated throughout the recent workshop. The NAS committee will provide preliminary public recommendations by February 2003 to assist in the update of the strategic plan. The committee will provide a second public report in September 2003, commenting on the updated strategic plan as well as the open public review process being used to develop the strategic plan and the subsequent findings to be reported by CCSP.

6. **Updated CCSP Strategic Plan Scheduled for April 2003**: CCSP will publish its updated strategic plan for the climate science program by the end of April 2003, after consideration of all of the workshop discussions and the full range of the written comments received by the January 18, 2003, deadline for comments. The plan, which will be subject to future modification as warranted by the emergence of key science findings and key public questions to be addressed, will guide the conduct of the federal research activities during the critical next few years of public discussion about climate change.

7. **Shift to the Reporting of Findings After the Strategic Plan is Completed**: As described in the *Discussion Draft Strategic Plan*, CCSP will focus on the development of structured, climate science findings after the updated strategic plan is completed in April 2003. Future reports will address the three principal foci of the strategic plan: (a) **reducing key scientific uncertainties**, (b) designing and implementing a **comprehensive global climate and ecosystem monitoring and data management system**, and (c) providing **decision support resources** to support public evaluation of climate change response options, based on evaluation of a wide range of scenarios and response options.

8. **Integration of Scientific and Technological Developments**: One of the principal themes of the workshop was the likely need for breakthrough technology options to address the long-term challenge of global climate change. The only effective approaches to long-term global stabilization and ultimate reduction of net greenhouse gas emissions, if found necessary, will require major new technologies, not simply incremental improvements of current technology. The likely growth of global population and economic output in the upcoming decades will only amplify this need. CCSP is working closely with the Climate Change Technology Program to assure that: (a) science drives the definition of technology needs, and (b) science is used to evaluate both the *intended* and the *unintended* consequences of proposed technology innovations.

9. **Major US-Led Earth Observation Summit Announced**: Building on the need for a truly integrated global climate and ecosystem observing and data management system as documented in the CCSP *Discussion Draft Strategic Plan* and discussed extensively during the December workshop, the Administration is taking the initiative to host an **Earth Observation Summit** to be held in Washington, DC, during the summer 2003 time frame. The meeting will bring together senior international government and nongovernment leaders in climate science, technology and environment, to develop a

commitment to a new level of comprehensive, climate-quality global monitoring, and to initiate the planning to implement this commitment. The meeting (further described later in this statement) will target the Science Advisors and the Science or Technology Ministers of the G-8 nations and other nations, and will serve as a foundation for reinvigorating comprehensive observation of the Earth's climate system, which will be a focus of the December 2003 *Conference of the Parties* of the United Nations Framework Convention on Climate Change.

10. **Request for Congressional Dialog and Input to the Strategic Plan**: The climate change science strategic planning process has already benefited from a wide range of review and comment (before, during and after the recent workshop) by the domestic and international climate science community, by a large group of stakeholders representing diverse interests on climate change issues, and by the rapidly increasing group of users of climate change information and projections. We invite comments and questions by members and staff of the Senate and the House of Representatives so that the question-based strategic plan can be fully responsive to the public interest. We have already engaged in briefings with a number of members and staff, and we are prepared to respond promptly to other requests for briefings or written responses to questions.

The remainder of this statement provides further details in four of the key areas mentioned above: (1) background information on the U.S. Global Change Research Program and the Climate Change Research Initiative; (2) the November 2002 CCSP *Discussion Draft Strategic Plan*; (3) the December 2002 Workshop on the draft strategic plan, including its purpose, structure, operations and feedback to date; and (4) the summer 2003 U.S.-led Earth Observation Summit planned to promote a new level of state-of-the-science measurement and data management capability to support decision making about global change.

I. BACKGROUND ON THE U.S. GLOBAL CHANGE RESEARCH PROGRAM AND THE CLIMATE CHANGE RESEARCH INITIATIVE

The U.S. Global Change Research Program (USGCRP), well known to many in this audience, was launched as a series of research initiatives in 1987, and was codified by the Global Change Research Act, which was signed into law by President George H. W. Bush in 1990. To date, over $20 billion of research funding has supported the USGCRP, which has contributed significantly to the international body of research, monitoring and computer modeling of global change over the past 15 years. The USGCRP is continuing its major role in the exploration, discovery and analysis of global change phenomena, and is sharing the results of this research with the entire world community.

In May 2001, the Bush Administration asked the National Academy of Sciences - National Research Council to provide an updated evaluation of key questions about climate change science, in view of the body of research developed by the international climate science community, with specific reference to the recently completed Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). The findings of the NAS Committee on the Science of Climate Change, reported in June 2001, continue to guide the development of the

focused climate research and technology programs announced by President Bush also in June 2001:

> "Greenhouse gases are accumulating in Earth's atmosphere as a result of human activities, causing surface air temperatures and subsurface ocean temperatures to rise. Temperatures are, in fact, rising. The changes observed over the last several decades are likely mostly due to human activities, but we cannot rule out that some significant part of these changes is also a reflection of natural variability."

> "Because there is considerable uncertainty in current understanding of how the climate system varies naturally and reacts to emissions of greenhouse gases and aerosols, current estimates of the magnitude of future warming should be regarded as tentative and subject to future adjustments (either upward or downward). Reducing the wide range of uncertainty inherent in current model predictions of global climate change will require major advances in understanding and modeling of both (1) the factors that determine atmospheric concentrations of greenhouse gases and aerosols, and (2) the so-called 'feedbacks' that determine the sensitivity of the climate system to a prescribed increase in greenhouse gases. There is also a pressing need for a global system designed for monitoring climate."

> "Making progress in reducing the large uncertainties in projections of future climate will require addressing a number of fundamental scientific questions relating to the buildup of greenhouse gases in the atmosphere and the behavior of the climate system. Issues that need to be addressed include: (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 and provide radiative forcing versus exchange with the oceans or net exchange with the land biosphere; (d) the feedbacks in the climate system that determine both the magnitude of the change and the rate of energy uptake by the oceans, which together determine the magnitude and time history of the temperature increases for a given radiative forcing; (e) details of the regional and local climate change consequent to an overall level of global climate change; (f) the nature and causes of the natural variability of climate and its interactions with forced changes; and (g) the direct and indirect effects of the changing distributions of aerosols. Maintaining a vigorous, ongoing program of basic research, funded and managed independently of the climate assessment activity, will be crucial for narrowing these uncertainties."

> "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. The fact that the magnitude of the observed warming is large in comparison to natural variability as simulated in climate models is suggestive of such a linkage, but it does not constitute proof of one because the model simulations could be deficient in natural variability on the decadal to century time scale."

I also quote from a February 2002 statement of President Bush, responding to the NAS report:

> "Addressing global climate change will require a sustained effort, over many generations. My approach recognizes that sustained economic growth is the solution, not the problem - because a nation that grows its economy is a nation that can afford investments in efficiency, new technologies, and a cleaner environment."

President Bush took several steps to address climate change issues in June 2001, including issuing a new challenge to the climate change scientific and technological communities. He created the Climate Change Research Initiative (CCRI) and the parallel National Climate Change Technology Initiative (NCCTI), and asked federal science and technology specialists to take on new responsibilities to accelerate the development of policies to respond to climate change issues. Specifically, a short-term focus (defined as covering 2 to 5 years) was assigned to CCRI, to speed the development of information that can improve science-based decision-making.

In February 2002 President Bush further strengthened the climate change science and technology programs by creating a new cabinet-level management structure, placing responsibility and accountability for the $3+ billion annual budget science and technology programs in the relevant cabinet departments. In September 2002, Commerce Secretary Evans and Energy Secretary Abraham reported to the President on the first six months of climate change science, technology and emission reduction activities achieved under the new cabinet level management structure. The report from Secretaries Evans and Abraham, which includes the organization chart for the federal program, is attached to this statement. Implementation of the President's new management structure has resulted in several actions that have strengthened the federal programs in climate change science and technology development. For example:

- A thorough reevaluation of the climate change science programs in all 13 participating federal agencies was completed in August 2001. This has created a substantial new basis for interagency collaboration, and has provided the essential background for preparation of the interagency CCSP *Discussion Draft Strategic Plan*.

- A full interagency crosscut of the FY 2004 climate change research budget request was prepared in September 2002. This integrated interagency budget crosscut will facilitate efficiency and effectiveness in the commitment of future budget resources to the climate change science program.

- The interagency science and technology programs are now being reviewed on a frequent basis by high-level appointees of President Bush. For example, the President has designated an operating review committee composed of deputy cabinet level officials representing each of the collaborating agencies. This review committee has held a full agenda meeting nearly every month since the President designated its oversight responsibility in February 2002, and has been responsible for achieving a substantially improved level of integration among the federal climate science and technology programs, together with the voluntary emission reduction programs and the several international collaborative programs in which the United States participates.

CCSP is designed to serve in a "credible fact finder" capacity, providing a source of credible and useful information in three broad categories:

1. **Science:** The causes and projected effects of global climate change, including the understanding of both individual processes and multiple-factor interactions.

2. **Observations and data:** Observing system design and measurement methodologies for climate and ecosystem parameters, including high quality data archives, to facilitate trend analyses and other measurement-based scientific studies.

3. **Decision support resources**: Evaluation of "If …, then …" questions, which depends on achieving significant progress under (1) and (2) above.

   The research activities sponsored by the CCSP are designed to provide critical information about a number of the natural resource issues affected by climate variability and change. This will involve both a focus on *national and global* level mitigation and adaptation issues as well as a focus on *regional and sectoral* adaptation responses to climate variability.

II. THE DISCUSSION DRAFT STRATEGIC PLAN FOR THE U.S. CLIMATE CHANGE SCIENCE PROGRAM

The CCSP *Discussion Draft Strategic Plan* outlines a comprehensive, collaborative approach for developing a more accurate understanding of climate change and its potential impacts. It builds upon the significant investments we have already made in climate change science, and it is guided by the priority information needs identified by stakeholders and scientists, both nationally and internationally.

The *Discussion Draft Strategic Plan*, the comprehensive workshop discussions and written comment processes, and the ongoing review by the National Academy of Sciences were all designed to support the "credible fact finder" role of CCSP. The following guidelines are being used to advance the CCSP "credible fact finder" strategy:

1. **Question-based strategic plan**: The draft plan was developed from a series of key questions in each of the principal climate change science topic areas. For each question the draft plan summarized the current state of knowledge; described the improved information expected within the next 2 to 4 years and beyond; and reviewed the uncertainties unlikely to be resolved within 2 to 4 years. This question-based approach fosters agreement on the appropriate questions to be addressed, and it enhances communication among the large number of contributors to and users of the strategic plan.

2. **Integration of Long Term USGCRP and Short Term Focused CCRI Studies:** USGCRP has largely focused on long-term studies in key science areas, including atmospheric composition, climate variability, the carbon cycle, the water cycle, climate-ecosystem interactions, human dimensions of climate change, land use/land cover interactions with regional climate change, and climate model development and evaluation. CCRI has a short-

term focus on reducing scientific uncertainty where possible, developing integrated global observing systems for oceans, atmosphere and ecosystems, and developing decision support resources to enhance public and policy-maker evaluation of climate change response options. The CCSP integrated management of the USGCRP and CCRI helps bridge between the *discovery and characterization* focus of USGCRP and the *differentiation and strategy investigation* focus that President Bush called for in the CCRI.

3. **Combined scientific community and stakeholder review:** All of the strategic plan review actions (including the workshop, the written comment period and future opportunities to comment on CCSP draft findings) are intended to encourage review, comments, challenges, questions and alternative recommendations from both the international scientific community and the various interested stakeholder communities.

4. **Policy relevant but policy neutral analyses:** The CCSP studies are intended to be policy relevant (i.e., focused on the range of climate change outcomes and response options of interest to the United States and other governments) while remaining policy neutral to assure credibility among all interested stakeholders. The CCSP studies and reports do not recommend specific policy options; instead, the studies address "If …, then …" questions that explore the projected outcomes of various policy options.

5. **Transparency and comprehensiveness guidelines:** CCSP has a policy of full transparency in its plans, reports and data records. To maintain credibility among users of the CCSP analyses and projections, CCSP draft and final plans, reports of findings and projections of future outcomes will be posted on publicly accessible web sites, and all comments communicated by interested stakeholders also will be posted for public review. CCSP will aim to make its analyses comprehensive (i.e., covering the range of plausible policy options) within the limits of the resources available for analysis. Moreover, CCSP will facilitate comparison with other studies whenever possible.

6. **Reporting of the basis for findings and the degree of certainty in findings:** CCSP aims to describe the basis for each of its key findings and projections, with sufficient detail to allow independent reviewers to replicate the underlying analyses. CCSP will also characterize the degree of certainty associated with its each of its key findings and projections. Where appropriate, "confidence level" descriptions will be used to communicate these characterizations. The introduction of uncertainty is not intended to imply a basis for inaction. In cases where the uncertainty of analyses or projections is so large as to make the discrimination between options impractical, this finding will be reported directly.

III. THE U.S. CLIMATE CHANGE SCIENCE PROGRAM STRATEGIC PLAN WORKSHOP

A. Themes for the Workshop

Two important themes were used to guide the workshop deliberations:

- The status of the entire Earth and climate system is a **capstone issue** for our generation and will continue to be so for our children. The Administration fully embraces the need to provide the best possible scientific basis for understanding the complex interactions that determine the constantly changing nature of our Earth's life support systems. Ultimately a **new generation of technology**, not yet developed or commercially demonstrated in most cases, will likely be needed to achieve a long-term balance between the lifestyle aspirations of the global population and the protection of essential Earth systems.

- The 13 federal agencies sponsoring the Climate Change Science Program, together with the Administration's senior science and policy leaders, intended that the workshop serve to accelerate the application of basic climate research to address the "fundamental uncertainties" identified by the National Academy of Sciences and to evaluate response strategy options. This is consistent with the President's call to focus on the profoundly important -- and challenging – range of fundamental scientific uncertainties, technology development and public policy questions that we need to address.

B. The Workshop Experience

The workshop was a seminal event in the consideration of global climate change issues, attended by a very large group of United States and international climate specialists and stakeholders.

- More than 1,300 climate specialists participated in the workshop, including individuals from 47 states and 36 nations. This appears to be the largest-ever participation in a focused climate science review program. Participants included substantial representation from all of the climate science areas, as well as extensive representation from each of the principal domestic and international stakeholder groups dealing with climate science issues.

- The workshop set a high standard for open and transparent proceedings – which was the goal of the Administration. The *Discussion Draft Strategic Plan* was published for review by all participants prior to the workshop; all plenary sessions (including all keynote addresses) were recorded and posted on the web site for public review and use; findings of all 24 specialty sessions were documented for public use; all invited commenter presentations are currently being posted on the web site; and all written comments received up to January 18, 2003, will be posted on the web site.

- The principal science leaders and the relevant cabinet-level agency leaders in the United States government all participated in the workshop, along with the principal international climate science leaders. These included:

    - The Honorable Spencer Abraham, Secretary of Energy
    - Dr. Bruce Alberts, President of the National Academy of Sciences
    - Dr. Samuel W. Bodman, Deputy Secretary of Commerce (on behalf of Secretary Donald L. Evans, who was out of the country during the workshop)

- The Honorable Robert Card, Undersecretary of Energy
- Dr. Rita R. Colwell, Director of the National Science Foundation
- The Honorable David Garman, Assistant Secretary of Energy
- VADM Conrad C. Lautenbacher, USN (Ret), Administrator, National Oceanic and Atmospheric Administration
- Dr. John H. Marburger, Director, Office of Science and Technology Policy
- Professor G.O.P. Obasi, Secretary General, World Meteorological Organization
- The Honorable Sean O'Keefe, Administrator, National Aeronautics and Space Administration
- Dr. R. K. Pachauri, Chairman, Intergovernmental Panel on Climate Change
- The Honorable Christine Todd Whitman, Administrator, Environmental Protection Agency

- Approximately 225 climate specialists were invited participants during the specialty sessions of the workshop, including presenters of the plan elements, invited review panelists, moderators and rapporteurs. More than 300 other individuals provided comments during the specialty sessions. The specialty sessions focused on specific themes of the strategic plan as well as crosscutting themes in the plan. The 24 specialty discussion sessions during the workshop were:

    1. Emerging Climate Science Issues
    2. Observations and Monitoring Systems
    3. Atmospheric Composition
    4. Carbon Cycle
    5. Climate Modeling
    6. Climate – Land Use/Land Cover Interactions
    7. Climate Variability and Change
    8. Water Cycle
    9. Human Contributions and Responses to Climate Change
    10. Climate-Quality Data Management Systems
    11. Scenario Development to Support National-Scope Decisions
    12. International Collaboration
    13. Climate Variability and Change (second session of topic #7)
    14. Climate – Ecosystem Interactions
    15. Resolution of Disparities in Tropospheric Temperature Records
    16. Stabilizing Greenhouse Gases in the Earth's Atmosphere: Opportunities for Technology and Innovation
    17. Resource Management Decision Support
    18. Grand Challenges in Observations, Modeling and Information systems
    19. Crosscut: Climate Variability – Atmospheric Composition – Water Cycle
    20. Crosscut: Carbon Cycle – Ecosystems – Land Use/Land Cover
    21. Interactions Between Data, Observations and Modeling
    22. Scenario Development and Risk – Based Decision Support
    23. Applied Climate Modeling
    24. Reporting and Outreach Plans

- We have invited all interested persons, whether they attended the workshop or not, to submit written comments on the draft strategic plan to be posted on the web site, up to the cutoff date of January 18, 2003. We will consider all comments in developing the updated version of the strategic plan, scheduled for April 2003.

- At the request of CCSP, the National Academy of Sciences - National Research Council has appointed a 17-member expert committee, including physical, biological and social scientists and economists. The NAS committee reviewed the *Discussion Draft Strategic Plan* prior to the workshop; they participated in the workshop; they will review the public comments posted on the web site; and they will issue two reports during 2003 expressing their conclusions and recommendations regarding the objectivity, quality and comprehensiveness of the draft and final versions of the new strategic plan, and regarding its implementation.

C. Feedback from the Workshop

The general response to the process of providing a public draft plan prior to the workshop, encouraging fully open discussion at the workshop, and accommodating written comments received after the workshop was extremely positive.

The following lists illustrate some of the general and specific comments received at the workshop. These comments are not priority ranked, because the open comment period is still under way.

Illustrative general comments: General recommendations voiced at the workshop included:

1. Prioritize and sequence the scientific research needs and identify the resources required to carry out the high-priority science.
2. Create a more holistic strategic plan; the individual chapters in the discussion draft were not adequately cross-linked.
3. Provide realistic timelines for the science goals.
4. Clarify the interagency process for implementing the plan.
5. Note that resource limitations are not only financial, but also include hardware capabilities and human capital.
6. Balance short-term and long-term science goals and activities, with reasons for each.
7. Increase the attention to the detection and attribution of climate change impacts.
8. Encourage accelerated development of climate models, especially for applied analyses of scenario projections.
9. Facilitate stakeholder communication with the scientific community, including international stakeholders.
10. Develop requirements and guidelines for regional climate change analyses.
11. Build on the lessons learned from the National Assessment, particularly in terms of researcher-stakeholder interactions and the need for objective analysis.
12. Develop a strategy for studying and forecasting potential nonlinear and abrupt climate changes.
13. Designate focused research programs that address specific, significant, known scientific uncertainties about climatic change, and that assign agency responsibilities for

quantifying the degree and nature of scientific uncertainties.

Illustrative specific comments: The following list is a sample of the many hundreds of specific recommendations voiced during the workshop:

1. To reduce the uncertainty in the estimates of climate sensitivity, the uncertainties in radiative forcing must be reduced, and observations and analyses of Earth's surface temperature must be continued.
2. There should be a major focus on aerosols, emphasizing the regional nature of aerosol emissions and impacts and the importance of Asia, Africa, and Amazonia.
3. An increased focus on the global hydrologic cycle, particularly water vapor and water budgets, is needed.
4. The high prioritization of aerosol effects on climate was endorsed, but stratospheric and tropospheric ozone issues also need to receive a high prioritization.
5. Effective study of climate feedbacks from polar regions will require a substantial integrated observation field program.
6. A coordinated combination of scientific research, observations, and modeling will improve understanding of climatic change.
7. Many communities will need to be involved in prioritizing and implementing studies of land-use change, including local stakeholders and international partners.
8. Linkages between the water cycle, carbon cycle, ecosystems, and land-use change should be emphasized.
9. The importance of economics and technology in predicting future land-use change should be emphasized.
10. It is essential that funding of basic scientific research that may lead to unanticipated insights, results, and breakthroughs be continued.
11. Missing items in the plan include the need for improved greenhouse gas emissions inventories and the effects of aviation on climate.
12. The plan should more fully address ecosystem and social science data and research linked to global change.
13. Sophisticated systems should be planned (and then implemented) to enable all users to search and retrieve global change data via the internet, including delivery of near-real time global temperature data sets.
14. Climate variability should be cast in a probabilistic context.
15. Guidelines for monitoring the effects of climate change on ecosystems, both on land and in the ocean, should be provided.
16. A greater emphasis is needed on how feedbacks are changing and how they could play out in the future.
17. Dynamic performance monitoring of an integrated climate observing system is needed with resources to address and fix problems in near-real time.
18. Providing decision support is not only a 2-4 year problem – the need will continue indefinitely in the future.
19. Uncertainty analysis is key to providing meaningful decision support resources.
20. Regional analyses are particularly needed by resource managers dealing with climate variability for design applications.
21. Resources are limiting the rate of progress in applied computer modeling.
22. Scenarios must integrate science insights and knowledge from other sources (e.g.,

indigenous perspectives).

23. The computational requirements for climate modeling could easily make use of a million-fold increase in computing power over the time period of the CCSP.
24. There is not enough emphasis on impacts and adaptation analysis.
25. Continuous scientific evaluation of technology options (especially breakthrough technologies) is needed.
26. The context of the 2-center climate modeling strategy must be defined within the overall CCSP strategy.
27. An outreach strategy is needed for "multiple publics" and stakeholders.
28. Seasonal-interannual timescales should serve as test beds for elucidating the processes and mechanisms important to climate change.
29. Higher resolution (regional) models are needed for both better simulations of regional climates and users/customers who want regional details.
30. Make GCOS Upper-Air Network (GUAN) into an Upper Air Climate Reference Network.
31. Independent measurements (e.g., GPS, Lidar, proxy measurements, biological and new technologies) and multiple independent analysis groups are needed to resolve disparities in tropospheric temperature records.
32. Long-term funding, access to dedicated supercomputers, full and open access to data, and stewardship of historical data are all major challenges to observations, modeling, and information systems.

D. Next Steps After Completion of the CCSP Strategic Plan

Following the April 2003 completion of the new strategic plan, CCSP will focus on the reporting of findings and "if …, then …" analyses to the interested national and international communities. We plan to report findings using the same open and transparent approach as adopted for the *Discussion Draft Strategic Plan* and the workshop. The goal is for the Climate Change Science Program to serve as "credible fact finder" on the challenging issues associated with characterizing and, where necessary, mitigating and adapting to climate change.

IV. ANNOUNCEMENT OF A SUMMER 2003 EARTH OBSERVATION SUMMIT

As part of the Administration's plan to enhance the use of sound science, credible decision support methods, and high quality observations on oceans, climate, and ecosystems, the Administration is taking the initiative to host an **Earth Observation Summit** in Washington, DC, in the summer of 2003. The CCSP workshop provided the starting point for this high level event, which will serve as a foundation for reinvigorating the Earth's observing system. This activity is being coordinated through the National Science and Technology Council's Committee on Environment and Natural Resources.

Although our capability to provide global observations of the Earth system is at an all-time high, the requirements for comprehensive, integrated climate and ecosystem observations are also demanding. The investments made by the United States over the past decade through the USGCRP, as well as by our foreign partners (notably in Europe and Japan), have provided unprecedented global views of the Earth as a complex, interacting system. However, such

advances do not limit the need for highly calibrated and well-distributed in-situ measuring systems, especially in developing countries and countries with economies in transition.

The Earth Observation Summit will be significant at the international level, particularly for ***meeting the needs of sustainable development and international environmental conventions*** such as the U.N. Framework Convention on Climate Change.

The expected applications for a fully integrated Earth observation system are many, including natural resource management, daily weather prediction, El Niño prediction, and evaluation of climate models. The ultimate goal is transparency in the global acquisition and use of climate and ecosystem information, and better international coordination in creating the measurement and data management resources. Seamless acquisition and long-term storage of data on the Earth's biological, physical and chemical cycles — water, carbon, open ocean nutrients, atmospheric chemistry, energy balance, *etc.* — are essential to fill in the data gaps for more accurate modeling. Global data collection will provide earlier and better forecasts of extreme natural events that can lead to major benefits in energy use, and in food and water management.

To achieve an integrated global observing system, a significant number of developed countries and organizations must be willing to commit the necessary resources to make it happen. The Earth Observation Summit will bring together senior international governmental and nongovernmental leaders for science, technology and the environment involved in global Earth observation. We plan to invite the Science Advisors or Science and Technology Ministers of the G-8 and other developed nations to participate in the summit. We aim to join the participants in a renewed evaluation of the benefits an integrated global observing system. We believe this summit is especially timely as all nations prepare to review the adequacy of the Earth's climate observing system at the Ninth Conference of the Parties to the U.N. Framework Convention on Climate Change in December 2003.

CLOSING COMMENT

Comprehensive, objective, transparent and well-reviewed scientific inquiry must be the core methodology used to evaluate the highly complex relationships between natural and anthropogenic influences on Earth systems, and to project potential outcomes of the many different investment and action strategies that have been proposed to mitigate or adapt to potential changes in global conditions. If we fail to fully evaluate the scientific information bearing on global change, we would be subject to the justifiable criticism that our strategy to cope with potentially our largest-ever investment in environmental management would be seen as a "ready-fire-aim" approach. CCSP will provide substantial, credible information to inform the public search for effective and efficient strategies responsive to the challenges of global climate change.

ATTACHMENTS

1. The original announcement and invitation to participate in the climate science workshop (one page) is attached.

2. The September 2002 letter report from Commerce Secretary Evans and Energy Secretary Abraham to President Bush is also attached. It provides an update on the progress on the climate change science and technology programs and the voluntary emission reduction program under the new cabinet–level management structure initiated by President Bush in February 2002.