

1 **Summary of Revised Research Plan**  
2 **for the**  
3 **US Climate Change Science Program (CCSP)**  
4

5 **I. Introduction**  
6

7 **About the Revised Research Plan**  
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9 This Revised Research Plan is an update to the 2003 Strategic Plan of the US Climate Change  
10 Science Program (CCSP) ( <http://www.climatechange.gov/Library/stratplan2003/final/default.htm>), a  
11 document which was developed via a thorough, open and transparent multi-year process involving a wide  
12 range of scientists and managers. A significant part of this process was the review of both the draft and  
13 final plan by the National Academy of Sciences ( [http://www.nap.edu/catalog.php?record\\_id=11565](http://www.nap.edu/catalog.php?record_id=11565) for  
14 the draft plan; [http://www.nap.edu/catalog.php?record\\_id=10635](http://www.nap.edu/catalog.php?record_id=10635) for the final plan). These reviews played  
15 an important role in influencing the 2003 Strategic Plan's development.  
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17 The Strategic Plan has long-term value to CCSP, but like any strategic plan, it must be  
18 supplemented by shorter-term revisions that take into account both advances in the science and changes in  
19 societal needs, and CCSP has an ongoing long-range strategic planning process to ensure that these needs  
20 are met. The Revised Research Plan (hereinafter referred to as the Research Plan) draws on CCSP's long-  
21 range planning process and provides this update, in compliance with the terms of the Global Change  
22 Research Act (GCRA) of 1990.  
23

24 In the Research Plan, the reader will find several things: 1) an updated statement of vision, goals  
25 and capabilities consistent with CCSP's current Strategic Plan but reflecting both scientific progress and  
26 the evolution of the Program based on accomplishments and evolving societal and environmental needs;  
27 2) a description of the relationship of the Research Plan to the current Scientific Assessment; 3) highlights  
28 of ways in which the program is evolving in the context of the progress made over the years 2003-2007  
29 since the Strategic Plan was put in place, and a description of the priorities that have emerged as a result;  
30 and 4) a description of research plans for the coming years, in order to build upon the work envisioned in  
31 the Strategic Plan and begun over the past four years.  
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33 The purpose of this Summary of the Research Plan is to provide information about the structure,  
34 scope and content of the Research Plan, in order to solicit and facilitate public comment about the Plan.  
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36 **About the Climate Change Science Program**  
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38 The vision of CCSP is:  
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1 *A nation and the global community empowered with the science-based knowledge to manage the*  
2 *risks and opportunities of change in the climate and related environmental systems.*

3 The core precept that motivates the CCSP is that the best possible scientific knowledge should be  
4 the foundation for the information required to manage climate variability and change and related aspects  
5 of global change. Thus the mission of the CCSP is to:

6 *Facilitate the creation and application of knowledge of the Earth's global environment through*  
7 *research, observations, decision support, and communication.*

8 CCSP's five strategic goals are:

- 9 • CCSP Goal 1: Improve knowledge of the Earth's past and present climate and  
10 environment, including its natural variability, and improve understanding of the causes of  
11 observed variability and change
- 12 • CCSP Goal 2: Improve quantification of the forces bringing about changes in the Earth's  
13 climate and related systems
- 14 • CCSP Goal 3: Reduce uncertainty in projections of how the Earth's climate and related  
15 systems may change in the future
- 16 • CCSP Goal 4: Understand the sensitivity and adaptability of different natural and managed  
17 ecosystems and human systems to climate and related global changes
- 18 • CCSP Goal 5: Explore the uses and identify the limits of evolving knowledge to manage  
19 risks and opportunities related to climate variability and change
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26 In order to understand CCSP's role in fostering and coordinating US federally-funded climate change  
27 research, it is important to understand what CCSP is and the role CCSP has in the federal government.  
28 CCSP is not a federal agency. Rather, it is a structure and a mechanism for coordinating and integrating  
29 federal research on global change, and making recommendations on priorities that federal agencies  
30 consider in their planning, as authorized in the Global Change Research Act of 1990 (GCRA). Research  
31 on global change, including climate change, is sponsored by thirteen federal agencies; the CCSP agencies  
32 also include government entities that do not sponsor research but which play a critical role in the federal  
33 process. The latter are the Office of Science and Technology Policy, the Council on Environmental  
34 Quality, and the Office of Management and Budget. CCSP fosters coordination of federal global change  
35 activities across thematic and crosscutting elements that utilize four core approaches: research,  
36 observation, communication and decision support; it also helps to coordinate international research and  
37 cooperation. Member agencies include the following:

38  
39 *Agency for International Development*  
40 *Department of Agriculture*  
41 *Department of Commerce*  
42 *Department of Defense*  
43 *Department of Energy*  
44 *Department of Health and Human Services*  
45 *Department of the Interior*

1 *Department of State*  
2 *Department of Transportation*  
3 *Environmental Protection Agency*  
4 *National Aeronautics and Space Administration*  
5 *National Science Foundation*  
6 *Smithsonian Institution*  
7

8 The program is led by an interagency committee of senior representatives from the participating  
9 departments and agencies that is responsible for overall priority setting, program direction, management  
10 review, and accountability to deliver program goals. This committee is chaired by the CCSP Director.  
11 Interagency Working Groups for each of the program's research and crosscutting elements plan and  
12 implement interagency activities and priorities aligned with CCSP's Goals. These elements include the  
13 following: Atmospheric Composition, Climate Variability and Change / Modeling, Water Cycle, Land-  
14 Use and Land-Cover Change, Carbon Cycle, Human Contributions and Responses / Decision Support,  
15 Observation / Data Management, Communication, and International Research and Cooperation. CCSP  
16 has a single office, the function of which is to facilitate the activities of the Program by providing value-  
17 added staffing and day-to-day coordination of CCSP-wide program integration, strategic planning,  
18 product development, and communication.  
19

20 Global change research activities across CCSP's thirteen departments and agencies includes  
21 research conducted by scientists in federal agencies, academia, industry, and non-profit organizations  
22 through a mix of directed and competed programs. The Research Plan provides a summary of ways in  
23 which CCSP provides leverage for individual agency efforts through improved coordination and  
24 communication, and provides an avenue for integrating and producing reports to Congress that include  
25 both research progress and a summary of future plans. CCSP also provides climate-related input to other  
26 federal and Administration initiatives (e.g., the Ocean Action Plan, the US Group on Earth Observations),  
27 and a way for the federal climate change research establishment to assess joint opportunities and needs for  
28 programmatic evolution in response to changing societal and environmental needs.  
29

30 The Research Plan outlines CCSP's key products. One of these is CCSP's annual report to  
31 Congress, which provides a yearly update on key scientific findings and plans for the coming fiscal year.  
32 CCSP also sponsors workshops, like the 2005 workshop on Decision Support, which brought together  
33 experts and stakeholders on climate change and its impacts and yielded a report of its proceedings (  
34 <http://www.climatescience.gov/workshop2005/finalreport/default.htm> ). CCSP also contributes expertise  
35 and support to other national and international assessments, including the IPCC Fourth Assessment  
36 (2007). Other key products of the Program include the aforementioned 2003 CCSP Strategic Plan and a  
37 series of twenty-one Synthesis and Assessment Products (in progress) that are one outcome of the  
38 substantial stakeholder engagement in the earlier strategic planning process. These Synthesis and  
39 Assessment reports provide in-depth "state of the science" information responsive to CCSP overarching  
40 strategic goals and related to specific national, regional and sectoral issues. (Please see  
41 <http://www.climatescience.gov/Library/default.htm> for information on available products and the status  
42 of products in preparation.) In addition, numerous peer-reviewed scientific papers are published each year  
43 under the auspices of CCSP.  
44

45 The Research Plan provides an overview of CCSP Program management and review, including  
46 communications; how the Program is structured and how priorities are established and used; existing and  
47 planned annual and multi-year internal review processes, NRC reports and assessments; stakeholder and  
48 community engagement and guidance; ties to other national, international and sectoral assessments such  
49 as IPCC, WMO-UNEP, Arctic Climate Impact Assessment, and other reports; and linkages to agency  
50 budget processes.

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## II. Progress, Priorities and Plans

### Research Progress towards Goals 2003 - 2007

Section II of the Research Plan provides an overview of the Program’s progress and priorities. Significant progress has been made in many areas of climate change research, as evidenced by the development of the 21 Synthesis and Assessment Products; several of these reports are now complete and others are in progress. The accomplishments of the past four years have led not just to advancement of scientific knowledge, but as significantly, to the evolution and refinement of the science questions and approaches needed for current and future global change research. CCSP’s strategic goals have a direct relationship, by design, to the research elements outlined in the GCRA. The Research Plan provides a crosscut that relates progress across GCRA research elements to CCSP strategic goals and core approaches, as well as selected highlights of key progress (and the impacts and societal benefits resulting from that progress) across the research elements called for in the GCRA:

- 1) Global measurements, establishing and providing stewardship for the worldwide observations necessary to understand the physical, chemical and biological processes responsible for changes in the Earth system on climate-relevant spatial and temporal scales*
- 2) Documentation of global change, including the development of mechanisms for recording changes that will actually occur in the Earth system over the coming decades*
- 3) Studies of earlier changes in the Earth system, using evidence from the geologic and fossil record*
- 4) Predictions, using quantitative models of the Earth system to identify and simulate global environmental processes and trends, and the regional implications of such processes and trends*
- 5) Focused research initiatives to understand the nature of and interaction among physical, chemical, biological, and social processes related to global change.*

### Emerging Priorities

CCSP has an ongoing planning process, to determine yearly objectives as well as longer-term strategic approaches. The Research Plan is a reflection of the current stage of these planning activities. CCSP’s planning process uses the vision articulated in the Strategic Plan for 2003-2013 as a starting point, and is further informed by CCSP-commissioned reports from the National Research Council (e.g. the 2007 NRC review of CCSP: [http://books.nap.edu/catalog.php?record\\_id=11934](http://books.nap.edu/catalog.php?record_id=11934) ), as well as CCSP-sponsored stakeholder and scientific outreach, involvement in international global change programs, and a wide range of assessment activities in which CCSP is involved. This approach provides the basis for ongoing assessment and alignment of priorities based on emerging scientific and societal needs.

Any scientific research program must evolve over time based on what has been learned during earlier periods, and CCSP is no exception. This is particularly true for an Earth science related program,

1 in which the past several years have brought dramatic increases in knowledge; significant advances in the  
2 length and quality of observational data sets (including more comprehensive observations of climatic  
3 phenomena than was previously possible); improvements in the scope, resolution, and quality of models;  
4 and the initiation of several major observational efforts that have only now begun to yield results for  
5 integrated scientific study, or will appear shortly after the release of the revised Plan.  
6

7 One of the most significant advancements of recent years is that ongoing monitoring of key Earth  
8 systems over the past four years and analysis of records extending back through time have revealed a  
9 number of important Earth system changes and previously-unknown processes, including (but not limited  
10 to), the continuation of warm years; changes in the cryosphere, e.g. Arctic sea ice coverage, significant  
11 changes in ice mass in Greenland and Antarctica, and permafrost temperature; changes in patterns and  
12 frequency of wildfire; changes in species distributions; ocean acidification and its consequences; changes  
13 in storminess; hydrologic changes; and the recognition of unexpected behavior in seasonal greenness in  
14 tropical and temperate forests. Continued collection of paleoenvironmental data has also provided a basis  
15 for understanding the importance of not just climate change, but also climate variability and the potential  
16 for abrupt changes, to Earth systems. This legacy of past observations is key to understanding potential  
17 future changes and impacts.  
18

19 Long- and short-term monitoring efforts have benefited from advances in technology and analysis  
20 capabilities; however, there are significant challenges associated with these gains. These issues were the  
21 subject of a CCSP internal workshop on Observations in 2006. Drawing from the report of that workshop,  
22 the Research Plan addresses the major issues relative to observations, including: 1) advances and issues in  
23 capabilities and their implications; 2) gains and losses in orbital and ground-based observations networks,  
24 including NPOESS, Landsat-like systems and other climate sensors; 3) long- vs. short-term observations;  
25 4) advances in (and costs of) computational and data storage and retrieval capacity; and 5) the increased  
26 sensitivity, scope and comprehensiveness of climate models and the needs thereof.  
27

28 In the four years since the 2003 Strategic Plan was published, the climate community has also  
29 completed work on several important assessments, including the IPCC 4<sup>th</sup> Assessment Report (to which  
30 CCSP made substantial scientific contributions) and the Synthesis and Assessment Products being  
31 developed under the auspices of CCSP, which have helped to integrate many related scientific areas and  
32 to provide a comprehensive report on the state of the science. These assessments have had a significant  
33 influence on the broader climate policy community, and have helped to shape external dialogues and to  
34 frame the new questions that face policymakers. These discussions within the user community have  
35 already begun to place increased demands on CCSP to provide more regionally-resolved and sector-  
36 specific information about climate, its societal impacts and vulnerabilities, and to provide the rigorous  
37 scientific basis to support increased societal planning for adaptation to and mitigation of the effects of  
38 climate change.  
39

40 As a direct result of the past four years of Program activity and progress, as well as recognition of  
41 the important changes to earth systems noted above, there are significant new demands on CCSP. The  
42 most substantial of these is the need for information at a scale that is pertinent to direct land- and resource  
43 management issues, in order to support decision-making. The development of robust partnerships will be  
44 an essential component of CCSP's response to these needs. These areas include not just climate change  
45 itself but improved understanding of associated issues of climate change impacts, adaptation,  
46 vulnerability, and sustainability, as well as the need for tools for the delivery of information for decision  
47 support in a manner that is both timely and useful, and at scales that are relevant, to stakeholders' needs.  
48

49 This section of the Research Plan contains specific examples of issues and events that influence  
50 CCSP's research directions. The list of examples includes such major developments as:

- Dramatic increases in knowledge
- Significant advances in the length and quality of observational data sets
- Improvements in scope, resolution, and quality of models and modeling efforts
- Initiation of major new climate sensors and observational efforts that are now beginning to yield results for integrated scientific study, and potential loss of others
- Completion of important assessments, including the IPCC Fourth Assessment, assessments by WMO/UNEP, the Arctic Climate Impact Assessment, and CCSP's Synthesis and Assessment Products

## Research and Programmatic Plans

The sections outlined above are intended to provide an overview of the structure and purpose of CCSP, its products, accomplishments and challenges, and the progress which has led to the emergence of new priorities and changed emphases over the past four years. The remainder of the Research Plan's content is devoted to the articulation of Plans for the Program both programmatically and as related to CCSP's strategic goals, for the period 2008 – 2010 and beyond.

A sampling of programmatic and research plans is provided in this Summary. However, it is anticipated that the full scope of these plans will be developed with inclusion of the public input that results from the publication of this Summary. Since the public input to this Research Plan will be an essential component in developing the research directions of CCSP, this input will also be considered in the development of the current Scientific Assessment as required by the GCRA. The GCRA requires that the Scientific Assessment “integrates, evaluates, and interprets the findings of the [United States Global Change Research] Program. The current Scientific Assessment is under development; it will integrate and draw from many sources, including the 2003 Strategic Plan, the Synthesis and Assessment Products, and this Research Plan, including the public comments received during the Research Plan's development, and other published sources. **By promulgating this Summary, CCSP invites and encourages public comment to help inform both the development of the Research Plan and the articulation of CCSP's future research priorities.**

In addition to research plans aimed at achieving objectives associated directly with CCSP's strategic goals, CCSP intends to explore ways in which to improve and extend its achievement of programmatic goals. Issues related to the crosscutting elements of modeling, observations systems and networks, stakeholder engagement and communication of CCSP results to the public, to non-governmental organizations, to the climate change technology community and to state and local officials and other decisionmakers are among the areas for needed growth that were identified by the National Research Council in its recent report on CCSP progress (NRC 2007). Over the next three years CCSP will actively consider responses to these needs to determine and implement effective approaches. The CCSP agencies will also continue to take a leadership role in the dissemination of results and products that come from the program's research, observations, and decision support activities. In particular, the program will ensure that the conclusions from its assessment products and activities are widely communicated. In addition, the program will coordinate the development of interagency climate-related communications with those of the member agencies to help assure that the accomplishments of the overall national investment in climate-related science are understood and are widely available to users of the information.

1 The scope of CCSP scientific research is far-reaching. CCSP Strategic Goals encompass everything  
2 from basic scientific research on Earth's past and present climate and climate variability, the forces that  
3 result in changes to Earth's climate and related systems, reducing uncertainties in projecting future change  
4 and its consequences and the sensitivity/adaptability of both ecosystems and human systems, all the way  
5 to the application of the knowledge gained to the decisionmaking process for the management of risks and  
6 development of strategies for adaptation to climate change. In the four years since the release of the  
7 Strategic Plan, investment in and progress towards CCSP Goals 1 through 3 has been greater than that for  
8 Goals 4 and 5. Significant advances have been made in documenting climate changes and understanding  
9 the interconnected workings of Earth systems. Improvements in modeling capabilities have fostered a  
10 better understanding of forcing factors and couplings between ocean, atmosphere and land systems.  
11 Relative to the state of the science four years ago, substantial progress has been made in understanding  
12 and predicting climate change and variability at global and continental scales. Accordingly, strides have  
13 been made in characterizing and reducing the uncertainties associated with projecting the magnitudes and  
14 effects of future climate and related systems change. The value of these results is demonstrated by their  
15 inclusion in and importance to the IPCC 4<sup>th</sup> Assessment.

16  
17 As stated in Section I above, CCSP's Goals provide the focus and direction for the program, to  
18 ensure that knowledge developed by the participating agencies and research elements can be integrated  
19 and synthesized, and this remains the overarching strategy for the program. The following descriptions  
20 provide a sense of the strategic purpose and scope encompassed by these goals, and the way in which the  
21 goals inform research, observations, decision support and communications throughout the program:

22  
23 ***CCSP Goal 1: Improve knowledge of the Earth's past and present climate and environment,***  
24 ***including its natural variability, and improve understanding of the causes of observed***  
25 ***variability and change***

26  
27 Climate conditions change significantly over the span of weeks, seasons, years, decades, and even  
28 longer time scales. CCSP research will improve understanding of natural oscillations in climate on  
29 time scales from weeks to centuries, including improving and harnessing ENSO forecasts, a large-  
30 scale climate oscillation with implications for resource and disaster management. Research will  
31 continue to sharpen qualitative and quantitative understanding of climate extremes, and to what  
32 degree any changes in their frequency or intensity lie outside the range of natural variability,  
33 through improved observations, analysis, and modeling. The program also will continue to expand  
34 and refine observations, monitoring, and data/information system capabilities and increase  
35 confidence in our understanding of how and why climate is changing. Fostering improved  
36 interactions and connectivity between research and ongoing operational measurements and  
37 activities continues to be another important aspect of the program's work.

38  
39 ***CCSP Goal 2: Improve quantification of the forces bringing about changes in the Earth's***  
40 ***climate and related systems***

41  
42 Combustion of fossil fuels, changes in land cover and land use, and industrial activities produce  
43 greenhouse gases (GHGs) and aerosols and alter the composition of the atmosphere and physical  
44 and biological properties of the Earth's surface. These changes have several important climatic  
45 effects, the quantification of which has improved dramatically in recent years but upon which a  
46 substantial amount of work remains to be done. Research conducted through CCSP will continue  
47 to address the reduction of uncertainty in the sources and sinks of GHGs; aerosols and their  
48 precursors; the long range atmospheric transport of GHGs and aerosols and their precursors; and  
49 the interactions of GHGs and aerosols with global climate, ozone in the upper and lower layers of  
50 the atmosphere, and regional-scale air quality. It will continue to improve quantification of the

1 interactions among the carbon cycle, other biological and ecological processes, and land cover and  
2 land use to better project atmospheric concentrations of key greenhouse gases and to support  
3 improved decisionmaking. The program will also continue to work towards improved capabilities  
4 for developing and applying emissions scenarios in research and analysis, in cooperation with the  
5 Climate Change Technology Program (CCTP).  
6

7 ***CCSP Goal 3: Reduce uncertainty in projections of how the Earth's climate and related systems***  
8 ***may change in the future***  
9

10 While a great deal is now known about the mechanisms that affect the response of the climate  
11 system to changes in natural and human influences, many questions remain to be addressed and  
12 refined. There is still uncertainty regarding precisely how much climate will change overall and  
13 especially in specific regions. A primary objective of CCSP is to continue to develop information  
14 and scientific capacity needed to sharpen both qualitative and quantitative understanding through  
15 interconnected observations, data assimilation, and modeling activities. CCSP-supported research  
16 will continue to address basic climate system properties and the feedbacks or secondary changes  
17 that can either reinforce or dampen the initial and ongoing effects of greenhouse gas and aerosol  
18 emissions and changes in land use and land cover. The program will also continue to address the  
19 potential for future changes in extreme events and uncertainty regarding potential rapid or abrupt  
20 changes in climate. CCSP will also continue to build on existing U.S. strengths in climate research  
21 and modeling, and to enhance capacity for development of high-end coupled climate and Earth  
22 system models.  
23

24 ***CCSP Goal 4: Understand the sensitivity and adaptability of different natural and managed***  
25 ***ecosystems and human systems to climate and related global changes***  
26

27 Seasonal to annual variability in climate has been connected to impacts on ecosystems and many  
28 aspects of human life. Longer time scale natural climate cycles and human-induced changes in  
29 climate have additional effects. Improving our ability to assess the potential implications of  
30 variations and future changes in climate and environmental conditions on ecosystems and human  
31 systems could enable governments, businesses, and communities to mitigate damages and seize  
32 opportunities by adapting infrastructure, activities, and plans. CCSP research will increasingly  
33 examine the interactions of multiple interacting changes and effects (e.g., the carbon dioxide  
34 “fertilization effect”, deposition of nitrogen and other nutrients, changes in landscapes that affect  
35 water resources and habitats, changes in frequency of fires or pests) to improve knowledge of  
36 sensitivity and adaptability of systems to climate variability and change. CCSP research will also  
37 improve methods to integrate our understanding of potential effects of different atmospheric  
38 concentrations of greenhouse gases and to develop methods for aggregating and comparing  
39 potential impacts across different sectors and settings.  
40

41 ***CCSP Goal 5: Explore the uses and identify the limits of evolving knowledge to manage risks***  
42 ***and opportunities related to climate variability and change***  
43

44 In recent years, the scientific and technical community has begun to develop a variety of products  
45 to support management of risks and opportunities related to climate variability and change, but  
46 much remains to be done in this area. CCSP will foster additional studies and encourage  
47 evaluation and learning from these experiences in order to develop and improve decision support  
48 processes and products that use knowledge to the best effect, while communicating levels of  
49 uncertainty appropriately. Working in partnership with stakeholders and end-users of this  
50 information, CCSP will develop resources (e.g., observations, databases, data and model products,



1 scenarios, visualization products, scientific syntheses, assessments, tools and approaches to  
2 engage ongoing consultative mechanisms) to support policymaking, planning, risk reduction and  
3 adaptive management.  
4  
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6 As shown above, CCSP Goals 1 through 3 remain important, with significant research questions that  
7 remain to be articulated and answered. One mechanism by which CCSP undertakes these strategic  
8 priorities is through the development of near-term (i.e.1-3 year) interagency implementation priorities.  
9 One example of a near-term interagency implementation priority that CCSP has identified as needing  
10 intensive effort is a focus on understanding carbon cycling and climate change in high latitude regions,  
11 since these regions are among the most rapidly-changing areas of the planet; another is the development  
12 of an integrated Earth system analysis capability to focus toward creation of a high-quality record of the  
13 state of the atmosphere and ocean since 1979, information that is needed in order to improve the  
14 assimilation of land cover and dynamic sea ice modeling into carbon and nutrient cycling and other  
15 crucial areas.  
16

17 The coming years will see substantially increased need for CCSP to accelerate progress on Goals 4  
18 and 5, in order to more fully understand the implications of climate change for both natural and managed  
19 ecosystems and to improve the delivery of that information to land and resource managers and other  
20 stakeholders. This is an important area of potential growth for CCSP. New foci include improvements in  
21 the reliability of ecological forecasting, in order to foster and support natural resource management and  
22 decision making; an increased emphasis on the development of an early warning system for the possibility  
23 of abrupt climate change to assist managers and decisionmakers in planning for sea level rise and other  
24 potential rapid changes; and an increased focus on the development of tools for decision support, to  
25 improve delivery of needed information in formats and at scales (particularly regional scales) that  
26 maximize their usefulness to stakeholders.  
27

28 The increased emphasis on decision support and the delivery of needed information to stakeholders  
29 and decision-makers discussed above is an example of an evolving overall programmatic priority for  
30 CCSP. Further, each of the thirteen participating agencies also has its own priorities that make invaluable  
31 contributions to CCSP, and which contribute a large portion of CCSP's progress toward CCSP's strategic  
32 goals. In addition, CCSP has identified specific implementation priorities -- important topics that require  
33 the coordinated efforts of multiple agencies. While these implementation priorities are only a part of the  
34 overall program, they are vital mechanisms through which CCSP integrates agency activities to create  
35 knowledge and products that are greater than the sum of the individual agency efforts. The following are  
36 examples of implementation priorities for the next few years that are inherently interagency, and that will  
37 contribute to the program's long-term priorities (priorities that are specific to single agencies are not  
38 included here).

### 39 ***Enhanced Carbon Cycle Research on High Latitude Systems***

40  
41 The global carbon cycle has been one of the seven interdisciplinary science focus areas for CCSP  
42 and its GCRP predecessors for many years. Accomplishments include completion of CCSP  
43 Synthesis and Assessment Product 2.2 "State of the Carbon Cycle Report"  
44 (<http://www.climate-science.gov/Library/sap/sap2-2/final-report/default.htm>) as well as improved  
45 availability of CO<sub>2</sub> measurements and advances in coupled carbon-climate modeling and  
46 assimilation, plus others. Recognition that high latitude systems are increasingly important sources  
47 of atmospheric carbon as regional warming occurs makes it critical to improve our understanding of  
48 the carbon dynamics in high latitude systems, and the factors that may lead to changes in those  
49 dynamics. These are crucial elements of global carbon modeling and a priority for understanding the

1 linkages and feedbacks between carbon, ecosystems and land cover, hydrology, and climate  
2 variability and change.

3  
4 ***Quantification of Climate Forcing and Feedbacks by Aerosols, Non-CO<sub>2</sub> Greenhouse Gases,  
5 Water Vapor, and Clouds***  
6

7 The need to quantify and understand the impacts of radiative forcing on climate has long been  
8 important to CCSP/GCRP. Advances have been made in our understanding of climate influences of  
9 aerosols, reactive gas emissions and ozone in both the troposphere and stratosphere, and these  
10 continue to be important. The next level of complexity adds the importance of water vapor in the  
11 upper troposphere and lower stratosphere, as a key component of the atmospheric system. There is  
12 now increased recognition of the importance of quantifying the climate forcing associated with  
13 aerosols, clouds, the spatially-varying shorter-lived trace gases, as well as upper tropospheric and  
14 lower stratospheric ozone. Recent analysis, including that associated with the Fourth Assessment  
15 Report of the Intergovernmental Panel on Climate Change, has emphasized this need, and a number  
16 of scientific advances and improvement in observation and modeling capability make the timing  
17 appropriate for an enhanced focus on this topic.  
18

19 ***Development of an Integrated Earth System Analysis Capability: A focus toward creating a high-  
20 quality record of the state of the atmosphere and ocean since 1979***  
21

22 Just as the public and decision-makers can today easily access weather maps (i.e., “analyses” of the  
23 atmosphere) to support a wide range of applications, tomorrow’s decision-makers need tools to  
24 visualize the evolving state of the climate system over the entire planet, including its oceans, land  
25 surface, and vegetation. Substantial progress has been made in the development of coupled Earth  
26 system modeling, particularly with the adoption of a common Earth System Modeling Framework.  
27 Historical reanalysis of data for the 20<sup>th</sup> century, improvements in coupled ocean-atmosphere  
28 analysis capabilities and the incorporation of land surface processes, sea ice dynamics and the  
29 hydrological cycle will yield an improved record of the state of the atmosphere and ocean. This  
30 effort will contribute to the ability to separate natural and human-induced climate forcing of climate  
31 variations and change, and will result in improved accessibility of research-based information on  
32 climate variations and impacts to decision-makers and the public.  
33

34 ***Development of an End-to-End Hydrologic Projection and Application Capability***  
35

36 The need to provide information to water resource managers and other decision makers on issues  
37 related to how climate affects water availability, drought, and water quality has long been a  
38 component of CCSP activities, and the global water cycle is one of CCSP’s identified research  
39 elements. An end-to-end system to provide information to water resource managers and other  
40 decision makers on issues related to how climate affects water availability, drought, and water  
41 quality requires integration and improvement of existing research and monitoring capabilities to  
42 reduce uncertainties in hydrological/climate predictions. Assembling the building blocks for the  
43 development of an end-to-end global water cycle infrastructure and an development of an  
44 observations-based Generalized Hydrological (water, energy, biogeochemical) Modeling/Prediction  
45 Framework will help to reduce uncertainties and improve hydrologic predictions, leading to  
46 improved decision-support information and resources.  
47

48 ***Assessing Abrupt Change in a Warming Climate: Toward Development of an Abrupt Change  
49 Early Warning System***  
50

1 Changes in the climate system are considered “abrupt” if they occur more rapidly than the time  
2 needed by society and ecosystems to adapt to them (NRC 2002). Possible impacts range from  
3 accelerated melting of ice sheets and associated sea level rise, severe and sustained droughts, to  
4 systematic changes in weather patterns over broad regions that may result from changes in ocean  
5 circulation. CCSP has a research element aimed specifically at climate variability and change, which  
6 has fostered considerable progress in our understanding of past abrupt climate events and the  
7 potential causes for rapid changes. Given this progress, a near-term emphasis is to reduce the  
8 remaining knowledge gaps that limit our ability to provide early warning assessments of the  
9 likelihood of future abrupt climate change, at global, national and regional scales, over the  
10 remainder of this century. The effort has a special focus on those changes that have the largest  
11 potential impacts, with the overarching goal of providing policy- and decision-makers with  
12 information needed to better assess and minimize future risks due to abrupt change.  
13

### 14 *Ecological Forecasting*

15  
16 Ecological forecasting brings together modeling with observations and results from experiments and  
17 process studies to predict the impacts of natural and anthropogenic environmental changes on life-  
18 sustaining ecosystems. Many CCSP agencies are engaged in activities that include components of an  
19 ecological forecasting capability to address critical emerging questions. Progress has been made in  
20 such areas as documenting changes occurring in boreal forests. This has set the stage for reducing  
21 scientific uncertainty about possible future changes in primary production, biogeochemistry, and  
22 biodiversity, to findings that show that global oceanic phytoplankton productivity responds to  
23 changes in upper-ocean temperature and stratification. Work for the coming years builds upon  
24 earlier investigations to expand the development of models linking geophysical and ecological  
25 phenomena, to better characterize the uncertainty associated with linked models, and thus to provide  
26 more reliable ecological forecasts. The result will be an enhanced understanding of ecological  
27 response to changing climate as well as improved natural resource management and decision-  
28 making.  
29

30 The full Revised Research Plan includes -- for both programmatic and strategic goals -- the  
31 identification of emerging societal and scientific needs; the changes and shifts in emphasis to major  
32 scientific questions that have resulted from advances in knowledge and other accomplishments; the most  
33 urgent research needs that have emerged; and the expected outcomes, products, impacts and societal  
34 benefits. The brief examples above suggest the direction that CCSP will evolve in the future, towards  
35 increased engagement with stakeholders and increased attention towards relevance of scientific results to  
36 decisionmaking and policymaking. The full scope of the Research Plan will reflect the public input that  
37 results from the publication of this Summary. **By publishing this Summary, CCSP invites and**  
38 **encourages public comment to help inform both the development of the Research Plan and the**  
39 **articulation of CCSP’s future research priorities..**  
40

### 41 **III. End Matter**

42  
43 In keeping with CCSP policy and its legacy of openness and transparency of process, the Research  
44 Plan will close with information regarding the preparation of the Research Plan, including but not limited  
45 to, a listing of: 1) Authors; 2) Reviewers; 3) References; 4) Sources of images and other figures; and 5)  
46 Important Links and Contact Information.  
47  
48

1       **Comments regarding the CCSP Revised Research Plan are hereby requested, and should be**  
2 **provided using the instructions below. In order to be considered in the preparation of the Research**  
3 **Plan, comments must be received no later than 23:59 EST on the sixtieth (60th) day following the**  
4 **date of Federal Register publication of this summary.**  
5

6 This Revised Research Plan Summary is being released solely for the purpose of pre-dissemination peer  
7 review under applicable information quality guidelines. This document has not been formally  
8 disseminated by NOAA. It does not represent and should not be construed to represent any agency policy  
9 or determination. Comments received on the Summary will be taken into consideration in the preparation  
10 of the full Revised Research Plan which will be published on the CCSP web site.  
11

12 DATES: Comments must be received no later than 23:59 EST on the sixtieth (60th) day following the  
13 date of Federal Register publication of this summary.  
14

15 ADDRESSES: The Revised Research Plan Summary is reproduced in its entirety in this Federal Register  
16 Notice. It also is posted on the CCSP Web site at:

17 <http://www.climatescience.gov/Library/stratplan2008/summary/default.htm> . Detailed instructions for  
18 making comments on the Revised Research Plan are provided on the link above. Comments must be  
19 prepared in accordance with these instructions and must be submitted to:  
20 [research-plan-summary@usgcrp.gov](mailto:research-plan-summary@usgcrp.gov)  
21

22 FOR FURTHER INFORMATION CONTACT: Dr. Patricia Jellison, Climate Change Science Program  
23 Office, 1717 Pennsylvania Avenue NW, Suite 250, Washington, DC 20006, Telephone: (202) 419-3474.  
24

25 SUPPLEMENTARY INFORMATION: The CCSP was established by the President in 2002 to coordinate  
26 and integrate scientific research on global change and climate change sponsored by 13 participating  
27 departments and agencies of the U.S. Government. The CCSP is charged with preparing information  
28 resources that promote climate-related discussions and decisions, including scientific synthesis and  
29 assessment analyses that support evaluation of important policy issues.  
30

31 Dated: December 14, 2007.

32 William J. Brennan,

33 Deputy Assistant Secretary of Commerce for International Affairs, and  
34 Acting Director, Climate Change Science Program.  
35  
36  
37