CCSP carries out its mission through four core approaches: scientific research, observations, decision support, and communication. These approaches build upon scientific advances of the last few decades and are deepening understanding of the interplay of natural and human-caused forces, their implications, and response options. CCSP is developing information to facilitate comparative analysis of different approaches for adapting to and mitigating climate change. CCSP also promotes capacity development among scientists and information users—both in the developed and the developing world—to address the interactions between climate change, society, and the environment.

CCSP MISSION

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

Integrating Climate and Global Change Research

Thirteen departments and agencies of the U.S. Government participate in CCSP, including:

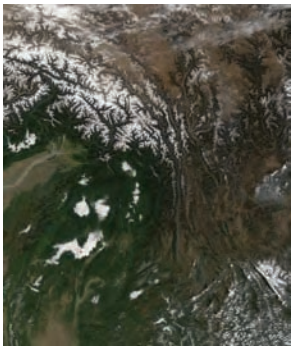
- Department of Agriculture (USDA)
- Department of Commerce (DOC)
  - National Oceanic and Atmospheric Administration (NOAA)
  - National Institute of Standards and Technology (NIST)
- Department of Defense (DOD)
- Department of Energy (DOE)
- Department of Health and Human Services (HHS)
- Department of the Interior/U.S. Geological Survey (DOI/USGS)
- Department of State (DOS)
- Department of Transportation (DOT)
- Agency for International Development (USAID)
- Environmental Protection Agency (EPA)
- National Aeronautics and Space Administration (NASA)
- National Science Foundation (NSF)
- Smithsonian Institution (SI).

In addition, the Executive Office of the President and other related programs have designated liaisons who participate on the CCSP Interagency Committee, including:

- Office of Science and Technology Policy (OSTP)
- Council on Environmental Quality (CEQ)
- Office of Management and Budget (OMB)

- Climate Change Technology Program (CCTP)
- Office of the Federal Coordinator for Meteorology (OFCM).

Appendix A, "The Climate Change Science Program Participating Agencies," contains information about the specific missions and roles of each agency participating in CCSP. Appendix B, "Climate Change Science Program FY 2008 Budget Tables," contains budgetary analyses of the program grouped by agency as well as a program-wide interagency cross-cut grouped by the strategic goals and research elements of CCSP as described in the *Strategic Plan for the U.S. Climate Change Research Program* published in July 2003.

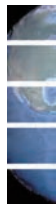


CCSP is responsible for coordinating and integrating scientific research on global environmental variability and change sponsored by these agencies to take advantage of their unique approaches and missions, and to encourage research that leads to expanded and new results. Thus, the program helps to catalyze research that goes beyond individual agency missions to address overarching national objectives and to achieve results that no single agency, or small group of agencies, could attain. A significant challenge that arises from working across many agencies is integrating climate and global change research to develop a comprehensive view of climate change and its potential significance.

CCSP relies not only on the agency programs stated in its budget cross-cut, but also on agency activities that are not formally included in the CCSP budget. Examples of these directly related activities are surface hydrologic and satellite land-cover observations from USGS; and future satellite measurement programs including the tri-agency (NOAA, DOD, NASA) National Polar-Orbiting Operational Environmental Satellite System (NPOESS) and the planned implementation of a Landsat Data Continuity Mission (LDCM).[a] Without input from activities such as these, CCSP would be unable to fulfill its mission.

CCSP is closely allied with other major interagency programs that observe and study particular aspects of the Earth system and related societal dimensions. Foremost among these is the CCTP, which develops and studies technological options for responding to climate change. CCSP is also closely linked to ongoing Federal ocean science and technology strategic planning under the auspices of the Joint Subcommittee on Ocean Science and Technology, which recently released a set of integrating decadal-scale national research priorities in key areas of interaction between society and the ocean.[2] A key observational linkage is with the U.S. Integrated Earth Observation

[a] As a result of the recent review and reformulation of its CCSP contributions, NASA considers 33% of its LDCM budget and 100% of its NPOESS Preparatory Project budget to contribute to CCSP. NASA budget figures provided in this report reflect the inclusion of this funding.



DEFINITION OF KEY TERMS

Adaptation
Adjustment in natural or human systems to a new or changing environment that exploits beneficial opportunities or moderates negative effects.

Climate
The statistical description of the mean and variability of relevant measures of the atmosphere-ocean system over periods of time ranging from weeks to thousands or millions of years.

Climate Change
A statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural internal processes or to external forcing, including changes in solar radiation and volcanic eruptions, or persistent human-induced changes in atmospheric composition or in land use.

Climate Feedback
An interaction among processes in the climate system in which a change in one process triggers a secondary process that influences the first one. A positive feedback intensifies the change in the original process, and a negative feedback reduces it.

Climate Forcing
A process that directly changes the average energy balance of the Earth-atmosphere system by affecting the balance between incoming solar radiation and outgoing or "back" radiation. A positive forcing tends to warm the surface of the Earth and a negative forcing tends to cool the surface.

Climate System
The highly complex system consisting of five major components: the atmosphere, the hydrosphere, the cryosphere, the land surface, the biosphere, and the interactions between them. The climate system evolves in time under the influence of its own internal dynamics and because of external forcings such as volcanic eruptions, solar variations, and human-induced forcings such as the changing composition of the atmosphere and land-use change.

Climate Variability
Variations in the mean state and other statistics of climatic features on temporal and spatial scales beyond those of individual weather events. These often are due to internal processes within the climate system. Examples of cyclical forms of climate variability include the El Niño Southern Oscillation, the North Atlantic Oscillation, and the Pacific Decadal Oscillation.

Decision-Support Resources
The set of observations, analyses, interdisciplinary research products, communication mechanisms, and operational services that provide timely and useful information to address questions confronting policymakers, resource managers, and other users.

Global Change
Changes in the global environment (including alterations in climate, land productivity, oceans or other water resources, atmospheric chemistry, and ecological systems) that may alter the capacity of the Earth to sustain life (from the Global Change Research Act of 1990, PL 101-606).

Mitigation
An intervention to reduce the human-induced factors that contribute to climate change. This could include approaches devised to reduce emissions of greenhouse gases to the atmosphere; to enhance their removal from the atmosphere through storage in geological formations, soils, biomass, or the ocean; or to alter incoming solar radiation through several "geo-engineering" options.

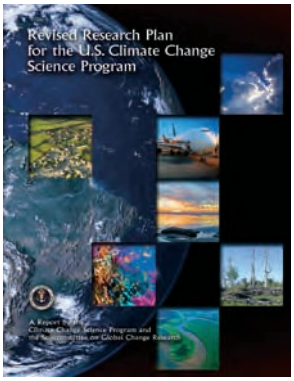
Observations
Standardized measurements (either continuing or episodic) of variables in climate and related systems.

Prediction
A probabilistic description or forecast of a future climate outcome based on observations of past and current oceanic and atmospheric conditions and quantitative models of climate processes (e.g., a prediction of an El Niño event).

Projection
A description of the response of the climate system to an assumed level of future radiative forcing. Changes in radiative forcing may be due to either natural sources (e.g., volcanic emissions) or human-induced factors (e.g., emissions of greenhouse gases and aerosols, or changes in land use and land cover). Climate "projections" are distinguished from climate "predictions" in order to emphasize that climate projections depend on scenarios of future socioeconomic, technological, and policy developments that may or may not be realized.

Weather
The specific condition of the atmosphere at a particular place and time, measured in terms of variables such as wind, temperature, humidity, atmospheric pressure, cloudiness, and precipitation.

System, which is part of the international Global Earth Observation System of Systems (GEOSS). Connections to programs such as these allow CCSP and its partners to leverage their resources to derive mutual benefits from advances in any one program.



In May 2008, CCSP released a *Revised Research Plan for the U.S. Climate Change Science Program*. This updated plan is required in order to reflect both scientific advances since the publication of CCSP's 2003 Strategic Plan, and the evolving needs of society. It provides direction for addressing remaining uncertainties in climate science, including impacts at regional scales and adaptation options. The Revised Research Plan also emphasizes the need for strengthened communication of scientific studies to decisionmakers across the United States. The updated plan focuses on near-term (1-3 year) planning needs, and specifically addresses research plans for the period 2008-2010. The release of the plan is part of ongoing extensive strategic planning in the Climate Change Science Program that began in 2007. The Revised Research Plan addresses the research plan requirements in Sec. 104(a) of the Global Change Research Act of 1990.

Program Management

CCSP's coordination of scientific research is accomplished through the research elements described in the following section. The management approach as described in the CCSP Strategic Plan integrates the planning and implementation of individual climate and global change research programs of the participating Federal agencies and departments to reduce overlaps, identify and fill programmatic gaps, and synthesize products and deliverables generated under the auspices of CCSP. Five mechanisms are used to achieve this management approach:

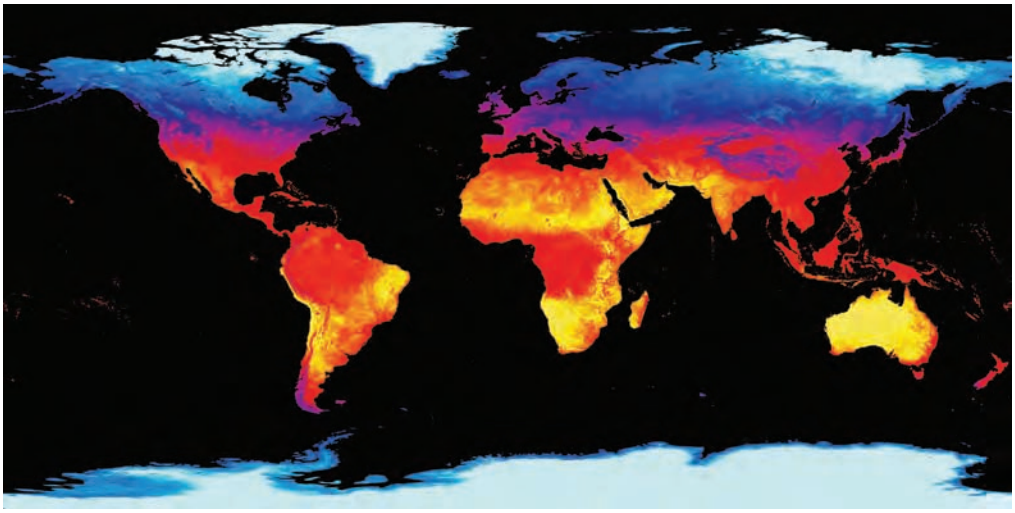
- *Executive Direction* – The Interagency Working Group on Climate Change Science and Technology and the CCSP Interagency Committee are responsible for overall priority setting, program direction, management review, and accountability to deliver program goals.
- *Agency Implementation* – CCSP-participating departments and agencies are responsible for conducting research, developing modeling tools, developing and operating observing systems, and producing CCSP-required products, often in collaboration with interagency working groups.
- *Interagency Planning and Implementation* – Several interagency working groups, including one for each CCSP research element, are responsible for coordinating planning and implementation to align agency programs with CCSP priorities.
- *External Guidance and Interaction* – External advisory groups and organizations, including the National Academies, provide external guidance, oversight, and interactions to ensure scientific excellence, credibility, and utility.

- *Program Support* – The CCSP Office provides staffing and day-to-day coordination of CCSP-wide program integration, strategic planning, product development, and communications.

Coordinating Research Elements

Efforts to foster integration occur on many levels. One is improving coordination of scientific research and the flow of information through interdisciplinary and interagency working groups focused on each of seven main research elements of the program plus a number of cross-cutting activities or themes. CCSP's research elements include atmospheric composition, climate variability and change, the global water cycle, land-use and land-cover change, the global carbon cycle, ecosystems, and human contributions and responses to environmental change. Chapters 3 to 15 of the CCSP Strategic Plan contain more detailed discussions of the discipline-specific research elements, as well as elements that cut across all areas of the program. A brief summary of each of these research and cross-cutting elements is provided herein, as well as a few highlights of planned activities.

Integrating research and observational approaches across disciplinary boundaries is essential for understanding how the Earth system functions and how it will change in response to future forcing. This is due to the interconnectedness among components of the Earth system, which often relate to each other through feedback loops. Interdisciplinary interactions in CCSP are scaled to the nature of the problem. In some cases, the necessary science may be conducted within a small set of disciplines, such as those required to improve understanding of soil biogeochemical processes. In other



cases, highly interdisciplinary and multi-scale approaches are required, such as in the case of making projections about the future state of the Earth system and analyzing their implications. In this case, expertise ranging from the social sciences to atmospheric dynamics and chemistry to oceanography to the biological sciences is required. Examples of interdisciplinary research are the coordinated planning and operation of two intensive field experiments in the Arctic region and in the tropics. The first concerned the climate impacts of aerosols and clouds in the Arctic as part of the International Polar Year (see <www.polarcat.no>). The second focused on expanding the scientific understanding of climate-cloud-chemistry interactions in the highly active and climate-relevant region of the tropical atmosphere (see <www.espo.nasa.gov/tc4>). These campaigns, involving several different agencies, were designed to address interdisciplinary science questions spanning three CCSP research elements—global water cycle, atmospheric composition, and global carbon cycle.

Interdisciplinary research is only one aspect of the integration facilitated by CCSP. Integration in CCSP also refers to the steps being taken to create more seamless approaches between the theory, modeling, observations, and applications that are required to address the multiple scientific challenges being confronted by CCSP. Finally, integration in CCSP also refers to the enhancement of cooperation across agencies toward meeting the objectives articulated in the CCSP Strategic Plan.

Integrated Program Analysis

In a highly distributed program such as CCSP, it is often a challenge to develop and maintain a cohesive perspective, ensuring that key components or interactions of the integrated Earth system are not overlooked. To help address this challenge, the program has often sought guidance from the National Academies. CCSP is funding a National Research Council (NRC) committee to provide high-level, independent, integrated advice on the strategy and evolution of the program. Specific topics follow:

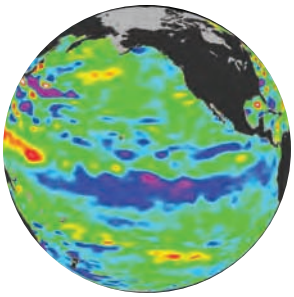
- The first committee report included findings and recommendations on the process for evaluating progress toward the five CCSP goals and a preliminary assessment of progress to date.
- The second report will identify priorities to guide the future evolution of the program in the context of established scientific and societal objectives.

At the request of CCSP, the NRC recently produced a report on global change assessments that is briefly described in a later section.

CCSP will continue to rely on other mechanisms for scientific guidance and advice, including other NRC committees that focus on particular components of the climate

system (e.g., the Climate Research Committee and the Committee on the Human Dimensions of Global Change). CCSP will continue to rely on scientific advisory groups that support individual agencies, scientific steering groups organized to coordinate different CCSP research elements, and open dialog with the domestic and international scientific and user communities interested in global change issues.

CCSP Goals and Analysis of Progress Toward These Goals



The Climate Change Science Program focuses on five goals that address the full range of global change research, observations, and decision support. These goals address understanding the components of the Earth's varying environmental system, with a particular focus on climate; understanding how these components interact to determine present conditions; understanding what drives these components; understanding the history of global change and projecting future change; and understanding how knowledge about global environmental variability and change can be applied to present-day and future decisionmaking.

This section provides an overview of the progress made toward achieving these goals in the 12 to 18 months prior to the preparation of the FY 2009 edition of *Our Changing Planet*. Because of the breadth of climate research funded by the U.S. Government, this overview only provides a general summary of some of the many climate change research activities covered under the CCSP umbrella.

In the past decade, the primary focus of U.S. climate research has been on CCSP Goals 1, 2, and 3—emphasizing understanding the global climate system through observations, identifying the various components of the global climate system, understanding how

CCSP GOALS

Goal 1: Improve knowledge of the Earth's past and present climate and environment, including its natural variability, and improve understanding of the causes of observed variability and change.

Goal 2: Improve quantification of the forces bringing about changes in the Earth's climate and related systems.

Goal 3: Reduce uncertainty in projections of how the Earth's climate and related systems may change in the future.

Goal 4: Understand the sensitivity and adaptability of different natural and managed ecosystems and human systems to climate and related global changes.

Goal 5: Explore the uses and identify the limits of evolving knowledge to manage risks and opportunities related to climate variability and change.