

INTEGRATING CLIMATE AND GLOBAL CHANGE RESEARCH

CCSP integrates the USGCRP, which was mandated by Congress in the Global Change Research Act of 1990 (P.L. 101-606, 104 Stat. 3096-3104), and the CCRI, which was established by President Bush in 2001, to improve understanding of uncertainties in climate science, expand global observing systems, develop science-based resources to support policymaking and resource management, and communicate findings broadly among scientific and stakeholder communities. Thirteen departments and agencies of the U.S. Government participate in CCSP, including:

- Department of Agriculture (USDA)
- Department of Commerce / National Oceanic and Atmospheric Administration (DOC/NOAA)
- 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).



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 climatological 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.

O U R C H A N G I N G P L A N E T

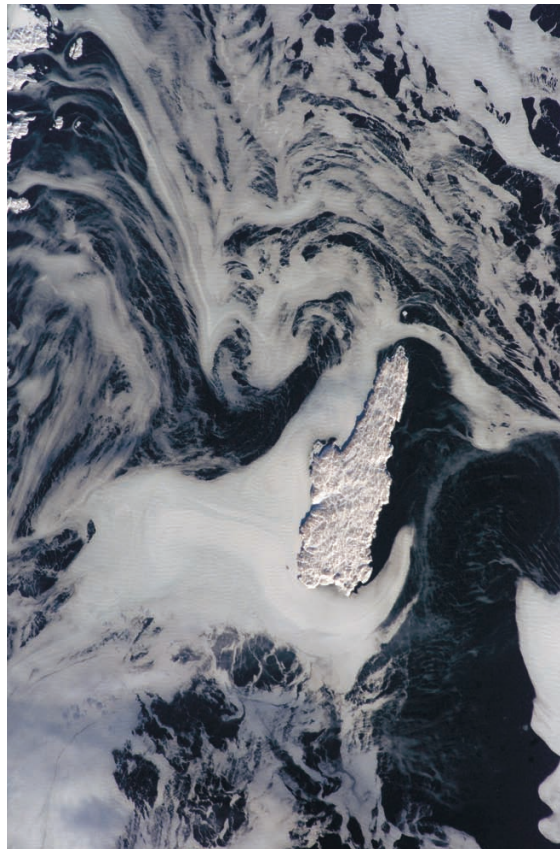
In addition, the Executive Office of the President and other related programs have designated liaisons who participate on the CCSP Interagency Committee, including:

- 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)
- National Institute of Standards and Technology (NIST).

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 2007 Budget Tables,” in the insert pocket, 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.

As a multi-agency program, CCSP harnesses the unique approaches and missions of its participating agencies to encourage research that leads to expanded and new results. 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 adds value to the individual Earth and climate science missions of its 13 participating agencies and their national and international partners by coordinating research and facilitating integration of information to achieve results that no single agency, or small group of agencies, could attain.

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 NOAA’s long-term surface, balloon, and satellite-based meteorological observations; 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. Without input from activities such as these, CCSP would be unable to fulfill its mission.



The U.S. Climate Change Science Program for FY 2007

CCSP also relies on and provides input to other major interagency programs that observe and study particular aspects of the environment and associated human activities. Foremost among these is the CCTP, which develops and studies technological options for responding to climate change. A key observational linkage is with the U.S. Integrated Earth Observation System, which is part of the international Global Earth Observation System of Systems (GEOSS). CCSP is also linked to another set of activities articulated in the *U.S. Ocean Action Plan* (see <www.ocean.ceq.gov/actionplan.pdf>) and being planned by the Joint Subcommittee on Ocean Science and Technology. 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.

Program Management

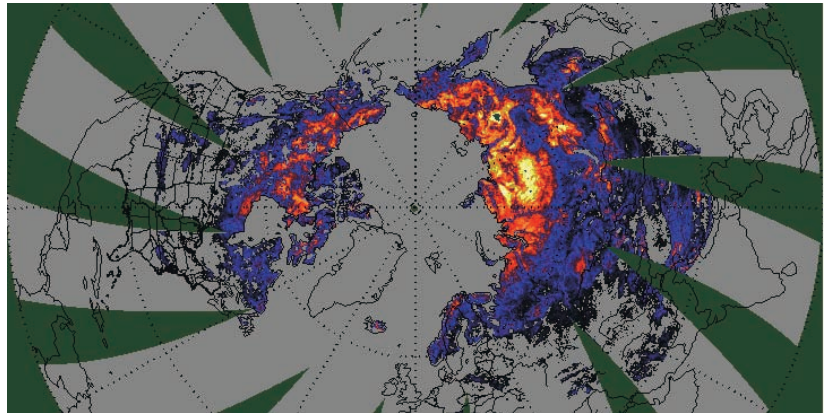
As described in the *CCSP Strategic Plan*, CCSP employs a management approach that integrates the planning and implementation of individual climate and global change research programs of the participating Federal agencies and departments to reduce overlaps, identify and fill programmatic gaps, and synthesize 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 Principals 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. For each of the research elements, recent highlights and program plans for FY 2007 are described in subsequent chapters of this report. The budget tables appendix contains information on the CCSP budget by research element. This budget cross-cut illustrates integrative management of the program that starts from research-driven requirements and extends to coordinated planning to distribute and integrate work efficiently across CCSP's participating agencies.



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 cloud microphysics. In other cases, highly interdisciplinary approaches are required, such as in the case of making projections about the future state of the Earth system and analyzing their implications. In the latter example, expertise ranging from the social sciences to atmospheric dynamics and chemistry to oceanography to the biological sciences is required.

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*.

The U.S. Climate Change Science Program for FY 2007



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 has recently requested that the National Research Council (NRC) establish a new committee to provide high-level integrated advice on the evolution of the program. The committee will provide independent advice, through annual reports, on the strategy and evolution of CCSP.

Specific topics the committee will address in its first two annual reports include:

- Evaluation of progress toward program goals. The *CCSP Strategic Plan* and the guidelines given in the 2005 NRC report *Thinking Strategically: The Appropriate Use of Metrics for the Climate Change Science Program* will provide a starting point for this examination. The committee will prepare a report that provides findings and recommendations on the process for evaluating progress toward the five CCSP goals and a preliminary assessment of progress to date.
- The committee will examine the program elements described in the *CCSP Strategic Plan* and identify priorities to guide the future evolution of the program in the context of established scientific and societal objectives. These priorities may include adjustments to the balance between science and applications, shifts in emphasis given to the various scientific themes, and identification of program elements not supported in the past.

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 also continue to utilize 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.