

## OUTLINE OF RESEARCH ELEMENT ACTIVITIES

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The CCSP-participating agencies coordinate scientific research through a set of linked interdisciplinary research elements and cross-cutting activities that encompass a wide range of interconnected issues of climate and global change. Chapters 3 to 15 of the *CCSP Strategic Plan* contain more detailed discussions of the research elements as well as activities that cut across all areas of the program. This report focuses on highlights of recent research and program plans for FY 2008.



*Atmospheric Composition.* The composition of the atmosphere at global and regional scales influences climate, air quality, stratospheric ozone, and precipitation, which in turn affect human health and the vitality of ecosystems. Research and observational activities coordinated and supported by CCSP are being used to assess how human activities and natural processes affect atmospheric composition, and how that understanding may be used to inform decisionmaking in the United States and abroad. In FY 2008, emphasis will be given to studies of interactions between aerosols and non-CO<sub>2</sub> gases, enhanced measurements of atmospheric water vapor, and interactions of pollutants with climate change. Special emphasis will be given to the climate impacts of pollutants associated with aviation.

*See CCSP Strategic Plan Chapter 3.*

*Climate Variability and Change (including Climate Modeling).* Recognizing that the climate system operates seamlessly across a wide spectrum of time scales, CCSP-supported research encompasses both short-term climate variability and longer term climate change. Addressing the interaction of climate processes across time scales poses challenges not only in designing observation systems to monitor the climate system adequately, but also in constructing models that can properly reproduce its past and confidently project its future behavior. Earth system models, in combination with global Earth observations, must produce internally consistent maps of atmospheric, oceanic, land surface, and ice conditions both in near real-time and retrospectively. These maps, or “analyses,” will provide decisionmakers with tools to visualize the evolving state of the full climate system over the entire planet, and researchers with the ability to better explain observed changes in the climate system.

*See CCSP Strategic Plan Chapters 4 and 10.*

*Global Water Cycle.* Research associated with this element involves studies of the crucial role the water cycle plays both in climate variability, climate change, and the influence climate has on aspects of the global water cycle for which society and nature critically depend. Through countless interactions in the Earth system, the global water cycle integrates physical, chemical, and biological processes that sustain ecosystems and influence climate and related global change. The ultimate goal of the CCSP water cycle research is to provide a better foundation for decisions and investments by policymakers, managers, and individuals. Achieving this goal requires a program of activities that test predictions and data products in real decision contexts, demonstrate techniques and their effectiveness to potential users, and provide tools and strategies to transfer the science from the experimental realm to operations. In FY 2008, emphasis will be given to coordinated observations and modeling of selected sites, at the river basin or catchment scale, to improve understanding of terrestrial water cycle processes leading to better closure constraints on water budgets at this scale. The improvements to land surface and hydrological models resulting from this research will lead to an enhanced ability to more accurately represent global change projections at the regional scales that affect water resources and other water cycle-dependent applications sectors.

*See CCSP Strategic Plan Chapter 5.*

*Land-Use and Land-Cover Change.* Land use and land cover are linked to climate and weather in complex ways and are critical inputs for modeling greenhouse gas emissions, carbon balance, and ecosystems. Land-use and land-cover change (LULCC) studies have provided critical inputs to large-scale biomass and forest cover assessments; future LULCC goals include reducing uncertainties in biomass estimates, understanding regional heterogeneities in changes, and quantifying linkages and feedbacks between LULCC, climate change, and other human and environmental components. Research



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that examines historic, current, and future LULCC, its drivers, feedbacks to climate, and its environmental, social, economic, and human health consequences is therefore of utmost importance and often requires interagency and intergovernmental cooperation. Research plans focus on how management practices may change as climate and conservation policies change, and feedbacks related to environmental, social, economic, and human health.

*See CCSP Strategic Plan Chapter 6.*



**Global Carbon Cycle.** Increasing levels of atmospheric CO<sub>2</sub> and CH<sub>4</sub> are major drivers of climate change. The global carbon cycle element of the CCSP seeks to better quantify and understand the dynamics of the global carbon cycle that determine CO<sub>2</sub> and CH<sub>4</sub> fluxes and carbon storage in terrestrial and oceanic ecosystems. Carbon cycle processes depend on climate, thus linking carbon cycle and climate change analyses is critical. Carbon cycle research involves multiple disciplines and extends over a broad range of spatial and temporal scales. Major multi-agency activities include the North American Carbon Program (NACP), an effort to describe and reduce uncertainties about the North American carbon budget and underlying processes, and the Ocean Carbon and Climate Change (OCCC) Program, a research effort aimed at determining how climate change will affect the future behavior of the oceanic carbon sink. In FY 2008, the NACP will address key gaps and uncertainties in the carbon syntheses developed previously, and aspects of the OCCC and NACP will be coordinated to better quantify and understand the roles of adjacent ocean basins in the North American carbon budget. NASA will launch the Orbiting Carbon Observatory (OCO) to provide, for the first time, consistent atmospheric carbon observations globally from space, and carbon data assimilation systems will begin to derive estimates of carbon sources and sinks from these measurements.

*See CCSP Strategic Plan Chapter 7.*



**Ecosystems.** This research element studies the potential effects of global change on goods and services provided by aquatic and terrestrial ecosystems, using observations, experiments, modeling, and syntheses to focus on critical emerging questions. Newly initiated projects in terrestrial ecosystems are addressing cause-and-effect relationships between climatic variability and change and the distribution, abundance, and productivity of native and invasive organisms. Further, research is continuing into understanding how increasing CO<sub>2</sub> levels affect plants and microorganisms. Research in a Chesapeake Bay ecosystem is generating data to evaluate and forecast effects of warming, changes in fishing pressure, and eutrophication on economically important estuarine ecosystems. In the ocean, coral reef research is helping scientists and managers identify climatic and non-climatic stressors and thereby better manage these important ecosystems.

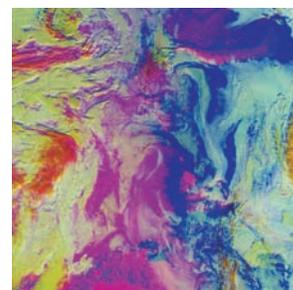
*See CCSP Strategic Plan Chapter 8.*

*Decision-Support Resources Development and Related Research on Human Contributions and Responses.* Decisionmakers and other interested citizens need reliable science-based information to make informed judgments regarding policy and actions to address the risks and opportunities of variability and change in climate and related systems. A wide variety of CCSP decision-support resources and related research on human contributions and responses is targeted at that objective. The outcomes of these activities are intended to inform public discussion of climate-related issues and to scientifically assess and expand options for mitigation of and adaptation to climate variability and change. The most prominent of CCSP's ongoing decision-support activities is its synthesis and assessment process that involves the generation of 21 different products intended to support public discussion of climate science issues of particular importance to U.S. decisions. CCSP's research on human contributions and responses to global environmental variability and change includes analyses of human drivers of change and their potential impact, societal resilience and ways of reducing vulnerability, approaches for improving the ability of decisionmakers to utilize scientific information, and the effects of global environmental change on human health. CCSP's research is paying particular attention to aspects of global change that have greatest relevance to society, including drought and extreme or abrupt climate events.

*See CCSP Strategic Plan Chapters 9 and 11.*

*Observing and Monitoring the Climate System.* CCSP provides active stewardship for observations that document the evolving state of the climate system, allow for improved understanding of its changes, and contribute to improved predictive capability for society. Some of these observations are not part of the CCSP budget (e.g., operational satellites) but are crucial to its success. A core CCSP activity is U.S. participation in the broad-based strategy of the international Global Climate Observing System (GCOS) in monitoring atmospheric, oceanic, and terrestrial domains with an appropriate balance of *in situ* and remotely sensed observations. In FY 2008, observing activities by CCSP agencies will focus on observing the polar climate as part of the International Polar Year (IPY) series of international cooperative studies. The IPY plans to advance polar observations by establishing a variety of new multidisciplinary observatories using the latest technologies in sensor web (network of spatially distributed sensor platforms that wirelessly communicate with each other) and power-efficient designs. Data from these, as well as more traditional surface- and space-based observatories, will initiate long-term, high-quality sustained measurements needed to detect future climate change. The United States plans to increase its efforts on observations of the polar atmosphere, ice, and ocean, as well as leverage its investments in polar research with international partners. A continuing challenge to CCSP agencies is ensuring the long-term integrity and understandability of data products provided by remote sensing and *in situ* observing systems.

*See CCSP Strategic Plan Chapters 12 and 13.*



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*Communication.* CCSP's member agencies support a broad array of communication initiatives. CCSP has developed a strategy and implementation plan for helping to coordinate and facilitate these activities. These efforts are intended to improve public understanding of climate change research by disseminating the results of CCSP activities credibly and effectively, and by making CCSP science findings and products easily available to a diverse set of audiences. CCSP facilitates communication of the results of individual agencies, as well as providing coordination in communicating the results of climate activities of the Federal Government.

*See CCSP Strategic Plan Chapter 14.*



*International Research and Cooperation.* CCSP, through its working groups including the Interagency Working Group on International Research and Cooperation, participates in and provides input to major international scientific and related organizations on behalf of the U.S. Government and scientific community. CCSP also provides support to maintain the central infrastructure of several international research programs and international activities that complement CCSP and U.S. Government goals in climate science.

*See CCSP Strategic Plan Chapter 15.*