physical, biological, and social sciences. Successful ecological forecasting will be related to interdisciplinary work across the CCSP working groups in order to understand and project the potential effects of human interactions with natural systems and the feedbacks from these interactions. There will no doubt be limits to what can be forecast, but discovering these limits and their causes will only enhance overall understanding of the ecosystems to manage and preserve. Likewise, explicit statements regarding uncertainties and estimates of error associated with the forecasts are essential. An FY 2009 priority for enhancing the ability to generate reliable ecological forecasts should take advantage of the full suite of research supported by the Ecosystems Interagency Working Group membership. Ecological forecasts will allow the incorporation of observations, experimental results, process studies, and modeling activities at a wide variety of scales ranging from molecular through regional and even global, addressing the needs of basic science researchers, and the agencies that support them. Development of these ecological forecasts also fulfills the requirements of natural resource managers and policymakers who seek to understand the effects of particular policies or management approaches on ecosystem function. Improved ecological forecasting capabilities will play an important role in informing decisionmakers about the potential effects of climate change and in supporting the development of policy instruments and management actions to address anticipated ecosystem changes.

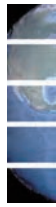
Decision Support: Information to Support Policy Development and Adaptive Management

CCSP sponsors and conducts research that is ultimately related to policy and adaptive management decisionmaking. CCSP's decision-support approach is guided by several general principles, including:

- Early and continuing involvement of stakeholders
- Explicit treatment of uncertainties
- Transparent public review of analysis questions, methods, and draft results
- Evaluation of lessons learned from ongoing and prior decision-support and assessment activities.

Synthesis and Assessment Products

As noted previously, CCSP is generating a suite of synthesis and assessment products that integrate research results focused on key issues and related questions frequently raised by decisionmakers. Current evaluations of the science can be used for informing public debate, policy development, and adaptive management decisions and for defining



SYNTHESIS AND ASSESSMENT PRODUCTS

CCSP 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.

1.1 Temperature Trends in the Lower Atmosphere: Steps for Understanding and Reconciling Differences
1.2 Past Climate Variability and Change in the Arctic and at High Latitudes
1.3 Re-Analyses of Historical Climate Data for Key Atmospheric Features: Implications for Attribution of Causes of Observed Change

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

2.1 Scenarios of Greenhouse Gas Emissions and Atmospheric Concentrations (Part A) and Global-Change Scenarios: Their Development and Use (Part B)
2.2 North American Carbon Budget and Implications for the Global Carbon Cycle
2.3 Aerosol Properties and Their Impacts on Climate
2.4 Trends in Emissions of Ozone-Depleting Substances, Ozone Layer Recovery, and Implications for Ultraviolet Radiation Exposure

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

3.1 Climate Models: An Assessment of Strengths and Limitations
3.2 Climate Projections based on Emissions Scenarios for Long-Lived Radiatively Active Trace Gases and Future Climate Impacts of Short-Lived Radiatively Active Gases and Aerosols
3.3 Weather and Climate Extremes in a Changing Climate: Regions of Focus - North America, Hawaii, Caribbean, and U.S. Pacific Islands
3.4 Abrupt Climate Change

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

4.1 Coastal Elevations and Sensitivity to Sea-Level Rise
4.2 Thresholds of Change in Ecosystems
4.3 The Effects of Climate Change on Agriculture, Land Resources, Water Resources, and Biodiversity
4.4 Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources
4.5 Effects of Climate Change on Energy Production and Use in the United States
4.6 Analyses of the Effects of Global Change on Human Health and Welfare and Human Systems
4.7 Impacts of Climate Variability and Change on Transportation Systems and Infrastructure: Gulf Coast Study

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

5.1 Uses and Limitations of Observations, Data, Forecasts, and Other Projections in Decision Support for Selected Sectors and Regions
5.2 Best Practice Approaches for Characterizing, Communicating, and Incorporating Scientific Uncertainty in Decisionmaking
5.3 Decision Support Experiments and Evaluations using Seasonal to Interannual Forecasts and Observational Data

and setting the future direction and priorities of the program. The synthesis and assessment products constitute an important form of topic-driven integration of U.S. global change assessment efforts. These CCSP products are U.S. Government reports, subject to the provisions of the Information Quality Act (Section 515 of the Treasury and General Government Appropriations Act of 2001) and the Federal Advisory Committee Act Amendments of 1997 (PUB. L. 105-153, SEC. 2(A), (B), DEC. 17, 1997, 111 STAT. 2689). Findings from several of the synthesis and assessment products were included in CCSP's recently released *Scientific Assessment of the Impacts of Climate Change on the United States*.

The synthesis and assessment products are generated by researchers in a process that involves review by experts, public comment from stakeholders and the general public, and final approval by the departments/agencies involved in CCSP. Formal endorsement of the products by the Federal Government enhances their value for decisionmakers and the public at large. The program has prepared guidelines that describe steps to be followed in each of three phases of the preparation process: developing the prospectus, drafting and revising, and final approval and publication. This methodology for product development facilitates involvement of the research community and user groups in ensuring that the products are focused in a useful fashion and meet the highest standards of scientific excellence. The guidelines also encourage transparency by ensuring that public information about the status of the products will be provided through the *Federal Register*, on the CCSP web site, and by other means throughout the review and clearance process. If further clarification of specific issues is required, the NRC will provide advice on an as-needed basis to the lead agency responsible for the preparation of each product.

A list of the titles of the 21 synthesis and assessment products, arranged by CCSP goal, is given in the table on the preceding page.

As of June 2008, eight products have been released and several others are nearing completion. Up-to-date information on production status can be obtained from <www.climatescience.gov/Library/sap/sap-summary.php>, including details on opportunities for public comment on draft products.

"Lessons Learned" in Decision Support and Assessment

To build on the experiences of earlier assessment activities, CCSP requested that the NRC carry out an analysis of global change assessments that have addressed topics broadly similar to those encompassed by CCSP. The study, released in early 2007, included a comparative analysis of past assessments that address issues directly related to the science and technical issues of CCSP. The committee concluded that global change assessments are critical for informing decisionmakers. In identifying essential properties of a successful assessment, it stressed that future assessment processes must communicate relevant information to the user, address the technical quality of the information, and demonstrate fairness and impartiality in the assessment process. The report identifies a number of essential elements that increase the probability that an assessment will effectively inform decisionmakers and other target audiences. CCSP is taking into account the findings of the NRC in its strategic planning efforts.

Outline of Research Element Activities

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 to15 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 2009.

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 2009, emphasis will be placed on studies of interactions between aerosols and non-CO_2 gases, enhanced measurements of atmospheric water vapor, and interactions of pollutants with climate change. Special emphasis will be placed on the climate impacts of pollutants associated with aviation.

See CCSP Strategic Plan Chapter 3.