

Restructuring Federal Climate Research to Meet the Challenges of Climate Change

Climate change is one of the most important global environmental problems facing the world today. Policy decisions are already being made to limit or adapt to climate change and its impacts, but there is a need for greater integration between science and decision making. This report proposes six priorities for restructuring the United States' climate change research program to develop a more robust knowledge base and support informed responses.

Rising sea level, retreating mountain glaciers, melting Arctic sea ice, lengthening growing seasons, shifting animal migration patterns, and other changes all attest to the fact that climate change is already occurring. Numerous respected scientific reports predict that the Earth will continue to warm in the coming decades, and suggest that this further climate change is inevitable—even if humans significantly reduce greenhouse gas emissions now. This climate shift could, at a minimum, disrupt supplies of fresh water and food; increase degradation of land and ocean ecosystems; and present new threats to public health, the economy, and national security.

Science is critical to the ability to respond effectively to climate change. Observations and experiments improve understanding of the changing climate system and enable scientists to more accurately predict what lies ahead. Science also can illuminate the human drivers of climate change, the response of the climate system to these drivers, and the societal impacts of and responses to climate change.

Governments around the world are taking steps to limit or adapt to climate change, and nearly 80 percent of U.S. states have adopted or are preparing climate action plans. Many policy decisions, however, are being made



Atlanta's Lake Lanier during a severe drought in 2007. Climate change may bring increased drought; science is critical to the ability to understand, predict, and respond to climate change. Photo by Ed Jackson, U. of Georgia.

without the science support that could help shape better outcomes. In the United States, the U.S. Climate Change Science Program (CCSP) is responsible for coordinating efforts to generate the scientific knowledge to understand, predict, and respond to climate change. Given the change of administration in 2009, the name and emphasis of the program is likely to change, even though its basic functions will continue. At the request of the CCSP, the National Research Council established a committee to evaluate the progress of the program and to identify future priorities. The committee's first report, *Evaluating Progress of the U.S. Climate Change Science Program: Methods and Preliminary Results*, was published in 2007 (see Box 1). This, the committee's second and final report, focuses on future priorities for the program.

Guiding Transformational Change

This report lays out a framework for generating the knowledge base needed to understand climate change and support informed responses. To meet these challenges, a transformational change is needed in how climate change research is organized and in how the results are incorporated into public policy.

Box 1. *Evaluating Progress of the U.S. Climate Change Science Program: Methods and Preliminary Results (2007)*

This report is the second and final report of the Committee on Strategic Advice on the U.S. Climate Change Science Program (CCSP). The committee's first report, *Evaluating Progress of the U.S. Climate Change Science Program: Methods and Preliminary Results (2007)*, concluded that:

- Discovery science (driven by curiosity rather than by practical applications) and understanding of the climate system are proceeding well, but use of that knowledge to support decision making and to manage risks and opportunities of climate change is proceeding slowly.
- Progress in understanding and predicting climate change has improved more at global, continental, and ocean basin scales than at regional and local scales.
- Our understanding of the impacts of climate changes on human well-being and vulnerabilities is much less developed than our understanding of the natural climate system.
- Observations have fueled advances in climate change science and applications, but many existing and planned observing systems have been cancelled, delayed, or degraded, which threatens future progress.
- Progress in communicating CCSP results and engaging stakeholders (those either contributing to or using the results of the program) is inadequate.
- The separation of CCSP program leadership and its budget authority presents a serious obstacle to its progress.

In the past, research on climate change has been aimed at understanding processes that involve only one or a few scientific disciplines. Future approaches will require much more integration—between disciplinary and multidisciplinary research, natural and social sciences, and basic research and practical applications. This integration is needed to approach the climate change problem “end-to-end”—that is, from basic science to decision support. Such an approach is needed to address many issues, including:

- Extreme weather and disasters
- Sea level rise and melting ice
- Fresh water availability
- Agriculture and food security
- Managing ecosystems
- Human health
- Impacts on the economy of the United States

Top Priorities

The report identifies six top priorities for a restructured climate change research program. Although they build from each other, work can begin on all of these priorities now.

Reorganize the Program Around Integrated Scientific-Societal Issues

Societal concerns about climate focus on changes that are visible now and the impacts of these changes.

For example, how might ice that is melting today affect the availability of fresh water in the future? Addressing such societal concerns requires a strong underpinning of research, observations, and predictive models. The research program should be reorganized to facilitate cross-cutting research focused on understanding the interactions among the climate, human, and environmental systems and on supporting societal responses to climate change. For this framework to be effective, research on the natural climate system will have to be maintained. In addition, research on the human dimensions of climate change, as well as stakeholder-driven research—that needed by state and local governments, private companies, environmental organizations, and other groups—will have to be strengthened.

Establish a U.S. Climate Observing System

Observations are critical for documenting, understanding, and predicting climate change in contexts that can help inform decision making at the local, state, federal, and international levels. Unfortunately, the satellite and ground observing systems that formed the basis for the current understanding of the climate system are in decline, even as demand grows for data capable of detecting climate variability and change.

A U.S. climate observing system—including physical, biological, and social observations—should be established to ensure that data needed to address climate change are collected or continued. In addition to augmenting current satellite and ground observing systems, the system should support new types of observations, including human dimensions observations that are needed for developing mitigation and adaptation strategies. Designing and implementing this climate observing system will require agencies to work together to develop a more strategic approach to data collection, distribution, and maintenance.

Support a New Generation of Coupled Earth System Models

Our ability to predict climate change at regional and local spatial scales and at seasonal and decadal temporal scales is inadequate for forming adaptation and mitigation strategies. A new generation of coupled human-land-ocean-atmosphere models would improve predictions at these scales and help bridge the

gap between science and decision making.

This new generation of coupled Earth system models will require investment in several areas. First, sustained climate observations are needed to further develop and constrain the models, and to begin the simulations from an accurate depiction of the state of the environment. Second, tools are needed to translate the data and model output into information that is more usable by stakeholders. Third, a larger cadre of scientists is needed to develop new approaches to predict climate change across a wide range of space and time scales, particularly at scales down to a few kilometers. Finally, new computing configurations will be needed to deal with the computational and data storage demands arising from these improved high-resolution, high-output-frequency models.

Strengthen Research on Adaptation, Mitigation, and Vulnerability

The underlying human dimensions research needed to understand and develop sound adaptation strategies is a major gap in the current Climate Change Science Program. In particular, research is needed to better understand variability in our vul-

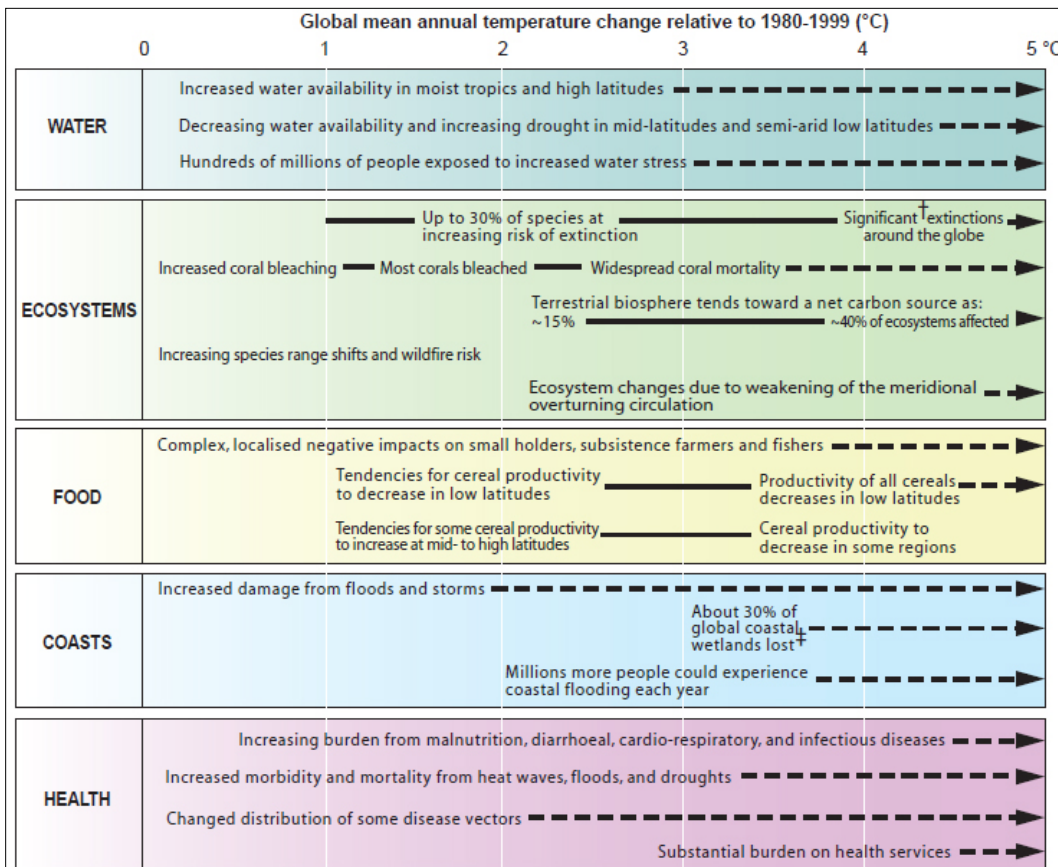
nerability and capacity to adapt to climate changes; economic costs and dynamics; and human behaviors, policy preferences, and choices. Although adaptation, mitigation, and vulnerability research would be needed for all the societal issues in the proposed new research framework, an additional focused research effort would help speed results. Agencies with appropriate expertise in these areas should take a leadership role in supporting and directing this research.

Initiate a National Assessment of the Risks and Costs of Climate Change Impacts and Options to Respond

A comprehensive national assessment is an important mechanism to determine the risks and costs of climate change impacts in the United States, and to evaluate options for responding. It also provides a means to involve stakeholders in the research program and to identify evolving science and societal needs and priorities. Although the Climate Change Science Program is mandated to carry out a national assessment every four years, the last one to involve a broad range of stakeholders was conducted a decade ago. The program has published a sizeable collection of

synthesis and assessment reports on a range of topics, as well as an overarching synthesis; however, this collection does not add up to a comprehensive national assessment.

A new assessment is needed that does not merely summarize published studies, but incorporates targeted research to produce new insights, observations, models, and decision support services. This effort will require strong political and scientific leadership, adequate funding, a careful planning process, and engagement of stakeholders at all stages of the process.



Examples of societally important issues, in the form of major impacts of climate changes associated with increasing global temperatures. Adapted from IPCC *Climate Change 2007: Impacts, Adaptation and Vulnerability*, Figure SPM2, Cambridge University Press.

Coordinate Federal Efforts to Provide Climate Information, Tools, and Forecasts Routinely to Decision Makers

Demand is growing for credible, understandable, and useful information for responding to climate change. To satisfy this demand, a national climate service is needed to facilitate two-way communication between scientists and decision makers, monitor climate trends, and issue information and predictions to support decision makers at multiple levels and in different sectors.

This climate service should likely reside outside of the future climate change research program, in part because of the potential for the research program to be overwhelmed by myriad demands for specialized services. But, the two programs should maintain strong links: the restructured climate change research program should be involved in the research and development of experimental products and tools, which the climate service could then provide routinely to decision makers.

Programmatic and Budget Implications

Funding for the Climate Change Science Program has been declining over the past 10 years.

Given the recent change in administration and the appointments of agency leaders interested in the climate-energy nexus, there is an opportunity to restructure and reinvigorate the research program to take a more comprehensive approach to climate change.

Implementing the six priorities identified in this report will require an appropriate level of investment, good leadership, and strong support from the White House. The report considers which priorities are feasible under two budget scenarios: one that would require new resources and one that could be achieved through reprogramming of existing funds. Although the report identifies important readjustments that could be made even without additional resources, a flat or decreasing level of investment would be woefully inadequate for addressing the urgent need to improve our understanding of climate change and satisfy the growing demand for information to inform action. Since the future costs of climate change are expected to greatly exceed the current cost of the federal program, investing now in climate change research should lead to reduced costs for responding, coping with, and adapting to the consequences of climate change.

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The National Academies appointed the above committee of experts to address the specific task requested by the U.S. Climate Change Science Program. The members volunteered their time for this activity; their report is peer-reviewed and the final product signed off by both the committee members and the National Academies. This report brief was prepared by the National Research Council based on the committee's report.



For more information, contact the Board on Earth Sciences and Resources at (202) 334-2744 or visit <http://nationalacademies.org/besr>. Copies of *Restructuring Federal Climate Research to Meet the Challenges of Climate Change* are available from the National Academies Press, 500 Fifth Street, NW, Washington, D.C. 20001; (800) 624-6242; www.nap.edu.

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