



7 | Decision-Support Resources Development and Related Research on Human Contributions and Responses

CCSP Decision-Support Goals

Decision-Support Goal 1: Prepare scientific syntheses and assessments to support informed discussion of climate variability and change and associated issues by decisionmakers, stakeholders, the media, and the general public.

Decision-Support Goal 2: Develop resources to support adaptive management and planning for responding to climate variability and climate change, and transition these resources from research to operational application.

Decision-Support Goal 3: Develop and evaluate methods (scenario evaluations, integrated analyses, and alternative analytical approaches) to support climate change policymaking and demonstrate these methods with case studies.

Strategic Research Questions

- 9.1 What are the magnitudes, interrelationships, and significance of the primary human drivers of, and their potential impact on, global environmental change?
- 9.2 What are the current and potential future impacts of global environmental variability and change on human welfare, what factors influence the capacity of human societies to respond to change, and how can resilience be increased and vulnerability reduced?
- 9.3 How can the methods and capabilities for societal decisionmaking under conditions of complexity and uncertainty about global environmental variability and change be enhanced?
- 9.4 What are the potential human health effects of global environmental change, and what climate, socioeconomic, and environmental information is needed to assess the cumulative risk to health from these effects?

See Chapter 11 of the *Strategic Plan for the U.S. Climate Change Science Program* for detailed discussion of decision-support resources development and Chapter 9 for these specific research questions.

One of the main purposes of CCSP is to provide information for informed decisionmaking through the development of decision-support resources. In the context of activities within the CCSP framework, decision-support resources, systems, and activities are climate-related products or processes that directly inform or advise stakeholders in order to help them make decisions. These products or processes include analyses and assessments, interdisciplinary research, analytical methods (including scenarios and alternative analysis methodologies), model and data product development, communication, and operational services that provide timely and useful information to decisionmakers, including policymakers, resource managers, planners, government officials, and other stakeholders. Decision-support resources and activities include not only research activities based in the natural sciences, but also activities related to human contributions and responses to climate variability and change, such as demography, economics, history, anthropology, political science, and sociology.



SCIENTIFIC AND STAKEHOLDER INPUT AND GUIDANCE

National Research Council Advice

An important source of scientific expertise and judgment on societal issues related to global change is the Committee on the Human Dimensions of Global Change (CHDGC) of the National Research Council (NRC). The committee was formed in 1989 to help guide U.S. research on the interactions between human activity and global environmental change. CHDGC focuses on two main tasks: developing the intellectual basis for progress in understanding human-environment interactions, and advising on future research directions. The committee's advice is particularly relevant to CCSP's human contributions and responses research element, as well as some aspects of the program's decision-support activities. An *ad hoc* committee has also been convened to conduct a comparative analysis of assessments related to climate change, and will produce a report that will be used to inform CCSP's future climate assessment activities (Decision-Support Goal 3). This study, *Lessons Learned from Climate and Global Change Assessments*, will attempt to identify ways to make global change assessments more useful for policy and research.





CCSP Workshop

The program's progress and future plans regarding its three decision-support goals were addressed in November 2005 at a CCSP workshop, *Climate Science in Support of Decisionmaking*, in Arlington, Virginia. Over 700 individuals participated in the workshop, including an international audience of climate scientists, decisionmakers, and users of information on climate variability and change from academia, governments at the State, local, and national levels, nongovernmental organizations, Congress, interest groups, and the private sector.

The workshop featured plenary presentations from high-level policymakers, scientists, and the private sector, and several breakout sessions conducted over a 2-day period. The first set of breakout sessions was organized to provide information to participants on the status of assessments being prepared (or recently completed) by CCSP, the Intergovernmental Panel on Climate Change (IPCC), the NRC, and other institutions, and to develop recommendations to improve the conduct and utility of future assessments. On the second day, five breakout sessions addressed applications of climate science to management of different sectors: water, ecosystems, coastal, air quality, and energy systems. The objectives of these five sessions were to:

- Discuss how well research is meeting the needs of decisionmakers
- Describe development and application of resources to support adaptive management and climate policy development
- Identify program needs and gaps.

Participants provided positive feedback on the opportunity to learn about CCSP's activities and exchange information with other scientists and decisionmakers. CCSP will use insights from the workshop to guide current and future CCSP programs, and intends to provide additional forums for communication about this aspect of the program in the future. A brief summary of key points raised during the workshop is available at www.climatescience.gov/workshop2005. This site also contains copies of workshop presentations and posters.

DECISION-SUPPORT RESOURCES GOAL 1: SCIENTIFIC SYNTHESIS AND ASSESSMENTS

The *CCSP Strategic Plan* defines "assessments" as "processes that involve analyzing and evaluating the state of scientific knowledge (and the associated degree of scientific certainty) and, in interaction with users, developing information applicable to a particular set of issues or decisions." Assessments are an effective means for integrating

and analyzing CCSP research results with other knowledge, and communicating useful insights in support of a variety of applications for decision support. Assessments also help identify knowledge gaps and thus provide valuable input to the process of focusing research.

A primary activity within CCSP is the development of 21 synthesis and assessment products to support informed decisionmaking on climate variability and change by a broad group of stakeholders, including policymakers, resource managers, media, and the general public. The development of these products stems from the Global Change Research Act (GCRA) of 1990 (P.L. 101-606, section 106), which directs the program to “produce information readily usable by policymakers attempting to formulate effective strategies for preventing, mitigating, and adapting to the effects of global change” and to undertake periodic science “assessments.”The GCRA dictates that the



DESCRIPTION OF CCSP 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 changes.

SYNTHESIS AND ASSESSMENT PRODUCT 1.1

Temperature Trends in the Lower Atmosphere: Steps for Understanding and Reconciling Differences

Temperature change is a fundamental measure of climate change. This product, which is the first to be completed, addresses temperature changes from the surface through the lower stratosphere and our understanding of the causes of these changes. It assesses progress made since the reports by the National Research Council (2000) and the Intergovernmental Panel on Climate Change (2001) and highlights differences between the individual temperature records determined by components of the existing observational and modeling systems and documents the potential causes of these differences. See the Atmospheric Composition chapter for a summary of this report’s conclusions.

SYNTHESIS AND ASSESSMENT PRODUCT 1.2

Past Climate Variability and Change in the Arctic and at High Latitudes

The Arctic and the high latitudes have warmed more rapidly than almost any other region on Earth over at least the last millennium. This warming has been accompanied by a decrease in sea-ice cover and thickness and a decrease in ocean salinity. In addition, significant changes in the permafrost active layer are now being detected. Impacts on humans and ecosystems that are associated with these changes have recently been reported in the *Arctic Climate Impact Assessment*, which was partially funded by CCSP-participating agencies. The present synthesis and assessment product on the Arctic and high latitudes will focus on the state of knowledge concerning past changes in the physical climate of this region and the implications of this record of past changes for current and future change. This information is vital since high-latitude regions are projected to continue to experience the greatest warming in the future.

SYNTHESIS AND ASSESSMENT PRODUCT 1.3

Re-Analysis of Historical Climate Data for Key Atmospheric Features: Implications for Attribution of Causes of Observed Change

A re-analysis is a detailed, retrospective study of the state of the atmosphere using a consistent numerical model of the dynamics of the system and based on observations for the time period of the study. This product will provide an assessment of the capability and limitations of state-of-the-art climate re-analysis to describe past and current climate conditions, and the consequent implications for scientifically interpreting the causes of climate variations and change. The product will be in the form of a report that summarizes the present status of national and international climate re-analysis efforts, and discusses key research findings on the strengths and limitations of current re-analysis products for describing and analyzing the causes of climate variations and trends that have occurred during the time period of the re-analysis records (roughly the past half-century). The report will describe how re-analysis products have been used in documenting, integrating, and advancing our knowledge of climate system behavior, as well as in ascertaining significant remaining uncertainties in descriptions and physical understanding of the climate system.

Highlights of Recent Research and Plans for FY 2007

program's assessments should "analyze the effects of global change on the natural environment, agriculture, energy production and use, land and water resources, transportation, human health and welfare, human social systems, and biological diversity." The scope of some of the synthesis and assessment products was recently revised to make them as responsive as possible to the GCRA.

DESCRIPTION OF CCSP SYNTHESIS AND ASSESSMENT PRODUCTS (CONT.)

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

SYNTHESIS AND ASSESSMENT PRODUCT 2.1

A. Scenarios of Greenhouse Gas Emissions and Atmospheric Concentrations; and B. Global-Change Scenarios: Their Development and Use

This product consists of two components: (a) development of new scenarios of greenhouse gas emissions and atmospheric concentrations, and (b) a review of integrated scenario development and application. These two components are intended to contribute to and enhance the iterative international process of producing and refining climate-related scenarios and scenario tools. The first component will use several integrated assessment models as the foundation for a small group of new global emissions scenarios leading to long-term stabilization of greenhouse gas concentrations. The second component will review and evaluate how the science and stakeholder communities define, develop, implement, and communicate scenarios in the global climate change context, and how this process might be enhanced or improved. This will include a review of past scenario development and application efforts.

SYNTHESIS AND ASSESSMENT PRODUCT 2.2

North American Carbon Budget and Implications for the Global Carbon Cycle

This product will provide a synthesis and integration of the current knowledge of the North American carbon budget (including land, atmosphere, inland waters, and adjacent oceans) and its context within the global carbon cycle. In a format useful to decisionmakers, it will summarize our knowledge of carbon cycle properties and changes relevant to the contributions of, and impacts upon, the United States and the rest of the world; and provide scientific information for U.S. decision support focused on key issues for carbon management and policy. It will address carbon emissions; natural reservoirs and sequestration; rates of transfer; the consequences of changes in carbon cycling; effects of purposeful carbon management; effects of agriculture, forestry, and natural resource management; and socioeconomic drivers and consequences. The report will include an analysis of North America's carbon budget that will document the state of knowledge and quantify uncertainties.

SYNTHESIS AND ASSESSMENT PRODUCT 2.2

Aerosol Properties and their Impacts on Climate

Aerosols can cause a net cooling or warming within the climate system, depending upon their physical and chemical characteristics. In addition to these direct effects, aerosols can also have indirect effects on radiative forcing of the climate system by changing cloud properties. The first phase of development of this product is to produce major scientific reviews of the following three topics: dependence of radiative forcing by tropospheric aerosols on aerosol composition in the north Atlantic, Pacific, and Indian Ocean regions; measurement-based understanding of aerosol radiative forcing from remote-sensing observations; and model intercomparison to quantify uncertainties associated with indirect aerosol forcing. The second-phase product will draw upon the scientific information gathered by the development of the IPCC Fourth Assessment Report and the National Research Council review, "Radiative Forcing of Climate Change." These community-wide assessments of climate change (and the aerosol-climate topic inclusively) will be drawn upon when writing this synthesis and assessment product.

SYNTHESIS AND ASSESSMENT PRODUCT 2.4

Trends in Emissions of Ozone-Depleting Substances, Ozone Layer Recovery, and Implications for Ultraviolet Radiation Exposure and Climate Change

Measurements of ozone-depleting gases in the atmosphere have shown that the concentrations of these gases are declining in response to the agreements reached under the Montreal Protocol. This report will provide an update on trends in stratospheric ozone, ozone-depleting gases, and ultraviolet radiation exposure; progress in improving model evaluations of the sensitivity of the ozone layer to changes in tropospheric composition and climate; and relevant implications for the United States. This information is key to ensuring that international agreements to phase out production of ozone-depleting substances are having the expected outcome: recovery of the protective ozone layer. The report will derive most of its information from recent international assessments of stratospheric ozone, ozone-depleting substances, and climate.

HCR Research on Assessment and Decision-Support Methods

CCSP supports research and tool development to advance the components of assessments that focus on human behavior and socioeconomic trends. Assessments need to incorporate projections of social and economic change (e.g., population and technological change) as well as the effects of environmental change on communities and sectors (e.g., transportation, health, agriculture, etc.). Decision support also requires methods and tools to undertake comparative work across communities, regions, and sectors. Highlights of some of this work are provided below.



Highlights of Recent Activities and Research

Development of Population Scenarios. Population scenarios have been developed with CCSP funding that bridge the gap between the socioeconomic scenarios (including input to greenhouse gas scenarios) developed by the IPCC and socioeconomic conditions at U.S. State levels. Population scenarios at the State level are needed to assess the consequences of global change for water quality, air quality, human health, and aquatic ecosystems. A new approach was used to develop State-level population projections that are consistent with IPCC assumptions and projections. This method preserves knowledge of the age distribution of the population over time.

Assessments of Transportation-Related Issues. An assessment of the greenhouse gas emissions benefits of heavy-duty natural gas and diesel vehicles in the United States

DESCRIPTION OF CCSP SYNTHESIS AND ASSESSMENT PRODUCTS (CONT.)

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

SYNTHESIS AND ASSESSMENT PRODUCT 3.1

Climate Models: An Assessment of Strengths and Limitations for User Applications

The topics addressed by this product are the strengths and limitations of climate models at different spatial and temporal scales. Its purpose is to provide information on the results from climate models, in ways that will allow the potential user of the information to evaluate how best it may be applied. The product will focus on natural and human-caused factors influencing climate variability and change during the period from 1870 to 2000. It will characterize sources of uncertainty in climate models and their implications for estimating future climate change. This product will be limited to models and their sensitivity, feedbacks, strengths, and limitations, rather than making specific future projections.

SYNTHESIS AND ASSESSMENT PRODUCT 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

This product will have two distinct components. The first will be to produce climate projections for research and assessment based on greenhouse gas emissions scenarios and atmospheric concentrations as reported in Synthesis and Assessment Product 2.1a. The second will be to produce climate projections for research and assessment based on emissions scenarios for methane and short-lived gaseous and particulate species developed by a number of global change research groups.

Highlights of Recent Research and Plans for FY 2007

was undertaken to help improve the understanding of the potential for greenhouse gas emissions reduction through use of these vehicles. By evaluating existing CO₂ and other transportation-related greenhouse gas emissions data, this study identified future research and data needs to determine the emissions benefits of alternative-fueled heavy-duty vehicles. The study, *Assessment of Greenhouse Gas Emissions Benefits of Heavy Duty Natural Gas Vehicles in the U.S.*, can be found at <climate.dot.gov/papers.html>. In addition, an assessment of long-range transportation planning initiatives in northeastern states was conducted. This study examined the climate and energy benefit plans of northeastern States and assessed how transportation and long-range transportation planning fit into the development of State policy approaches to climate change. It addresses the status of State climate change programs, the inclusion of transportation in the programs, and how State departments of transportation could be more effective. This study, *Assessing State Long-Range Transportation Planning Initiatives in the Northeast for Climate and Energy Efficiency Benefits*, can be found at <climate.volpe.dot.gov/docs/final-bbg.pdf>.

Tools to Support Different-Place Collaboration of Climate Change Researchers.^{10,13} Collaboratories are virtual places where teams of geographically distributed scientists engage in collaborative research. The NSF-, NOAA-, and USGS-supported Human-Environment Regional Observatory (HERO) project has been developing a collaboratory tool to support work by scientists studying the local- and regional-scale impacts of climate variation and change. The HERO toolkit includes

DESCRIPTION OF CCSP SYNTHESIS AND ASSESSMENT PRODUCTS (CONT.)

CCSP Goal 3 (continued)

SYNTHESIS AND ASSESSMENT PRODUCT 3.3

Weather and Climate Extremes in a Changing Climate

The impact of climate extremes can be severe and wide-ranging. There is evidence that the economic impact of weather and climate extremes in the United States has increased over the past several decades, but the evidence for increases in extreme weather and climate events varies, depending on the event of interest. These events may be related to temperature parameters (severe freezes, heat waves), precipitation (wet spells, heavy precipitation events, droughts, ice and hail, snow cover and depth), or tropical and extra-tropical storm frequency. Identifying recent changes and trends in such parameters will be a focus of the report, as will be identifying what can be said about future changes. Since extreme weather and climate events on a global scale are regularly addressed in international assessments, this synthesis and assessment product will focus on weather and climate extremes primarily across Canada, Mexico, and the United States.

SYNTHESIS AND ASSESSMENT PRODUCT 3.4

Abrupt Climate Change

The paleoclimate record reveals that Earth's climate can change rapidly and strongly between different stable states. Various scenarios portray future abrupt climate change large enough to pose a significant challenge to society. The goal of this product is to review and synthesize our current understanding of abrupt climate change and to identify gaps in our knowledge. The report will integrate information from the paleoclimate record, the instrumental record, and numerical model-based studies at various spatial scales. Key identified risks, such as changes in ocean thermohaline circulation and alteration of terrestrial hydrologic conditions (e.g., the location or amount of precipitation), will receive special attention because the potential impacts on society are large.

web and other Internet-based methods and tools to enable same-time (synchronous) and different-time (asynchronous) different-place collaboration. The toolkit supports same-time distributed meetings, including video links and shared visual display of geospatial information; different-time perspective-comparison and consensus-building activities; and long-term information sharing and knowledge development. Examples include an e-Delphi tool that supports the sharing and comparing of expert opinions, and a web portal that provides a personal workspace, mechanisms for forming groups and accessing group resources, and methods for encoding information with geographic referencing.

Highlights of Plans for FY 2007

The program’s highest-priority activities in FY 2007 under its decision-support goal are the synthesis and assessment products. Illustrative highlights of other plans for FY 2007 are given below.



Knowledge Systems for Sustainable Development. In FY 2007, the final results of a multi-institutional study on Knowledge Systems for Sustainable Development will be communicated to a broad audience through a special, invited

DESCRIPTION OF CCSP SYNTHESIS AND ASSESSMENT PRODUCTS (CONT.)

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

SYNTHESIS AND ASSESSMENT PRODUCT 4.1

Coastal Elevations and Sensitivity to Sea-Level Rise

This product will examine the vulnerability of coastal areas in the U.S. mid-Atlantic states to sea-level change. Specific questions to be addressed include identifying which areas are low enough to be inundated by tides, how floodplains would change due to a changing climate, which areas might be subject to erosion, and locations where wetlands will be able to migrate inland versus locations where shores will be protected. The product will examine the implications of sea-level rise, including impacts on population and economic activity in vulnerable areas, costs of shore protection, ecological effects, flood damages, public access to modified shore areas, cases where sea-level rise justifies policy changes, options being considered by conservancies and governments, and lessons from the unfolding consequences of the 2005 hurricanes in the Gulf Coast region.

SYNTHESIS AND ASSESSMENT PRODUCT 4.2

State-of-Knowledge of Thresholds of Change that Could Lead to Discontinuities in Some Ecosystems and Climate-Sensitive Resources

There is a body of ecosystems research that focuses on enhancing understanding of climate change impacts on ecosystems (and vice versa) and developing the capability to predict potential impacts of future climate change. Increasing emphasis is being placed on climate-related thresholds that could result in discontinuities or sudden changes in ecosystems and climate-sensitive resources. Discontinuities in responses of ecosystems and resources are difficult to predict, and may significantly affect human societies that depend on ecosystem goods and services. Improved understanding of such sudden changes is essential to managing ecosystems and resources in the face of climate change. This report will synthesize the present state of scientific understanding regarding thresholds of change that trigger sudden changes in ecosystems and climate-sensitive resources. The report will develop a conceptual framework for characterizing sudden changes, and synthesize peer-reviewed studies that provide the best available evidence for defining circumstances that trigger discontinuities in response to climate change.



DESCRIPTION OF CCSP SYNTHESIS AND ASSESSMENT PRODUCTS (CONT.)

CCSP Goal 4 (continued)

SYNTHESIS AND ASSESSMENT PRODUCT 4.3

The Effects of Climate Change on Agriculture, Biodiversity, Land, and Water Resources

This report will address the effects of climate change on agriculture, forestry, land and water resources, and biodiversity. Temperature, precipitation, and related climate variables are fundamental regulators of biological processes. For this reason human-induced climate change has the potential to affect the condition, composition, structure, and function of ecosystems. Such changes may also alter the linkages and feedbacks between ecosystems and the climate system. Additionally, ecosystems produce a wide array of goods and services valued by humans. Climate-related changes in ecosystems and other key resources could have impacts on human communities and economic conditions.

SYNTHESIS AND ASSESSMENT PRODUCT 4.4

Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources

Climate is a dominant factor influencing the distribution, abundance, structure, and function of, and services provided by, ecosystems. Many ecosystems are thus vulnerable to future changes in climate. The goal of adaptation is to reduce these risks of adverse ecological outcomes through management activities that increase the resilience of these systems to climate change. Resilience is defined here as the magnitude of disturbance that can be absorbed by a system before it shifts from one stable state (or stability domain) to another and the speed of return of a system to equilibrium after a disturbance has occurred. This report will provide a review and synthesis of information on adaptation options for selected climate-sensitive ecosystems in order to aid in designing management strategies that facilitate adaptation, provide examples of how to implement strategies in specific places, and identify issues and challenges associated with implementation of adaptation options.

SYNTHESIS AND ASSESSMENT PRODUCT 4.5

Effects of Climate Change on Energy Production and Use in the United States

This product will summarize the current knowledge base concerning the possible effects of global change on energy production and use in the United States. It will survey and assess the available literature, paying attention to research findings on the implications of climate variability for energy production and use; identify and consider relevant studies carried out in connection with CCSP, CCTP, and other programs of CCSP agencies (e.g., DOE's Energy Information Administration); and consult stakeholders (e.g., the electric utility and energy industries, environmental NGOs, and academia) to determine what analyses have been conducted and what reports have been issued. Besides addressing questions of possible direct effects of climate change on energy consumption and production in the United States, the product will also consider how climate change might affect various factors that indirectly shape energy production and consumption, such as energy technology choices, energy institutional structures, regional economic growth, energy prices, energy security, and environmental emissions.

SYNTHESIS AND ASSESSMENT PRODUCT 4.6

Analyses of the Effects of Global Change on Human Health and Welfare and Human Systems

The goal of this product is to examine linkages across physical, biological, and human systems in three separate assessments of the impacts of environmental change (climate variability and climate and land-use change) on human health and well-being. The assessment of human health will focus on the impacts of extreme heat and cold and extreme weather events, health effects of air pollution, water- and food-borne diseases, and vector- and rodent-borne diseases. The assessment of human welfare will consider the non-market welfare impacts on quality of life and on other valuations of aesthetics and human amenities. The assessment of human systems will examine the impacts of climate and land-use change on human settlements, including, for instance, the vulnerability of urban infrastructure to flooding; the potential impacts on water supplies resulting from warming, droughts, and flash floods; the dangers posed to human settlements by wildfire; and the effect of heat waves on fluctuations in energy demand in urban population centers.

SYNTHESIS AND ASSESSMENT PRODUCT 4.7

Impacts of Climate Variability and Change on Transportation Systems and Infrastructure: Gulf Coast Study

This product will address potential effects of climate variability and change on transportation infrastructure and systems in the central Gulf Coast of the United States. The purpose of this study is to increase the knowledge base regarding the risks and sensitivities of transportation infrastructure to climate variability and change, the significance of these risks, and the range of adaptation strategies that may be considered to ensure a robust and reliable transportation network. Implications for all transportation modes—surface, marine, and aviation—will be addressed. The three-phase study will focus on the Gulf Coast, and will assess the significant risks to transportation, develop methodology to be applied in other geographic locations, identify potential strategies for adaptation, and develop decision-support tools to assist decisionmakers in incorporating climate-related trend information into transportation system planning, design, engineering, and operational decisions.

issue of the Proceedings of the National Academies of Science (PNAS). The Knowledge Systems project seeks to understand and promote the design of effective systems to harness research-based knowledge for sustainability. The project considers “knowledge systems” to be networks of linked actors, organizations, and objects that perform a number of knowledge-related functions (e.g., research, innovation, development, demonstration, deployment, and adoption) involved in linking knowledge with action. This work is particularly relevant to CCSP, given its emphasis on decision support. Prior to the special PNAS issue, findings of the project are being extended and evaluated through a series of workshops run in collaboration with the Roundtable on Science and Technology for Sustainability (see <www7.nationalacademies.org/sustainabilityroundtable/Sustainability_Roundtable_Homepage.html>).

This activity will address Questions 9.2 and 9.3 of the CCSP Strategic Plan, and will support Decision Support Objective 1.1.



DESCRIPTION OF CCSP SYNTHESIS AND ASSESSMENT PRODUCTS (CONT.)

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

SYNTHESIS AND ASSESSMENT PRODUCT 5.1

Uses and Limitations of Observations, Data, Forecasts, and Other Projections in Decision Support for Selected Sectors and Regions

This product will focus on characterizing a subset of the observations from remote-sensing and *in situ* instrumentation that are of high value for decisionmaking. The product will characterize observational capabilities that are currently or could potentially be used in decision-support tools, catalog a subset of ongoing decision-support activities that use these capabilities, and evaluate a limited number of case studies. The detailed evaluation of decision-support activities and demonstration projects will provide information to agencies and organizations responsible for developing, operating, and maintaining selected decision-support processes and tools. The evaluation will also provide information on the nature of interactions between users and producers of climate science information, approaches for accessing science information, and assimilation of scientific information in the decisionmaking process. The product will include an on-line catalog of decision-support demonstration projects with interactive links, which will be updated as additional experiments are conducted and new approaches to incorporating and benchmarking application of observations and other global change research products evolve.

SYNTHESIS AND ASSESSMENT PRODUCT 5.2

Best Practice Approaches for Characterizing, Communicating, and Incorporating Scientific Uncertainty in Climate Decisionmaking

This product will address the issue of uncertainty and its relationship to science, assessment, and decisionmaking. Specifically, the product is intended to help improve the quality and consistency of information about scientific uncertainty presented to decisionmakers and other users of CCSP reports by identifying “best practice” options recommended in the literature on this subject; improve communication between scientists and users of the products by providing a simple “users’ guide” on interpreting information about uncertainty contained in the reports; and provide a brief overview of the literature on approaches for taking account of uncertainty in decisionmaking.

SYNTHESIS AND ASSESSMENT PRODUCT 5.3

Decision-Support Experiments and Evaluations Using Seasonal-to-Interannual Forecasts and Observational Data

This product will concentrate on the water-resource management sector. It will describe and evaluate current forecasts, assess how forecasts are being used in decision settings, and evaluate decisionmakers’ level of confidence in these forecasts. The participants in the development of this product (primarily consisting of government officials, researchers, and users) will evaluate forecasts as well as their delivery, to identify options for improving partnerships between the research and user communities. It will inform decisionmakers about the experiences of others who have experimented with the use of seasonal and interannual forecasts and other observational data; climatologists and social scientists about how to advance the delivery of decision-support resources that use the most recent forecast products, methodologies, and tools; and science managers as they plan for future investments in research related to forecasts and their role in decision support.

Highlights of Recent Research and Plans for FY 2007

Decisionmaking under Uncertainty Program. The increased knowledge generated by recent scientific research on the causes and consequences of climate change and variability has led to a growing need to better understand how decisionmakers can use this knowledge to make wiser choices. Five interdisciplinary research teams are studying important aspects of climate-related decisions under uncertainty over a 5-year period (see <www.nsf.gov/news/news_summ.jsp?cntn_id=100447&org=SBE>). Research centers are located at Arizona State, Carnegie-Mellon, and Columbia universities. Other interdisciplinary teams are conducting research at the University of Colorado at Boulder and Rand Corporation in California. Overviews of the activities of three of these centers follow.

- The Rand Center is conducting fundamental research on two key questions important to the design and use of decision tools for supporting climate change decisionmaking: What are the best ways to represent uncertainty for decisionmakers? What tools and methods work best in practice in providing these representations to decisionmakers? The project (see <www.rand.org/ise/projects/improvingdecisions/about.html>) strengthens the scientific foundations of robust decisionmaking, a promising new approach to computer-assisted support for decisions under conditions of “deep uncertainty” (e.g., when the likelihoods of different futures or the exact connection between policy actions and their effects is poorly understood). This research draws on interactions with decisionmakers in two policy areas: long-term planning for the management of water supplies by the California Department of Water Resources, and the design of scientific observation systems that could provide actionable warning of abrupt climate change.
- The Climate Decision Making Center at Carnegie-Mellon University (<cdmc.epp.cmu.edu>) is conducting research on limits in the understanding of climate change and its impacts. They are developing and demonstrating methods to characterize these irreducible uncertainties, focusing on uncertainties about climate and technologies for mitigation. They will also create, illustrate, and evaluate

decision strategies and tools for policymakers that incorporate such uncertainties. The center’s research focuses on the real-world problems of the following stakeholder groups:

- Insurance managers who face financial risks from climate change and low-carbon technologies
- Forest, fisheries, and ecosystem managers in the Pacific Northwest and Canada
- Arctic-region decisionmakers trying to balance cultural lifestyles with economic development
- Electric utility managers facing large capital-investment decisions in the face of climate risks.



In addition, the center will advance the current understanding of new low- or zero-carbon energy technologies that may be required by climate policy.

- The Center for Science Policy Assessment and Research on Climate (SPARC) at the University of Colorado (<sciencepolicy.colorado.edu/sparc>) examines the effectiveness of the relationship between science policy decisions and climate policy decisions. “Science policy decisions” are defined as those concerned with governing the climate science research enterprise. The Center distinguishes such decisions from “climate policy decisions,” which are those made in anticipation of or in response to climate change. The relationship between science policy decisions and climate policy decisions has not been systematically examined. The SPARC research agenda will focus on two themes: reconciling supply and demand for climate research, which involves examining how research agendas are developed and how user demand for research is assessed; and sensitivity analysis, which involves examining how specific research issues are prioritized given the multiple causes of global environmental change. There are currently four SPARC research projects:
 - Climate Science Policy in the Regional Integrated Science and Assessment Program
 - Reconciling Supply and Demand – Carbon Cycle Science Activities
 - Ecosystem Function Sensitivity Analysis Activities
 - Extreme Events and Climate Change Sensitivity Analysis Activities.

This activity will address Question 9.1 of the CCSP Strategic Plan, support Decision Support Objectives 3.1 and 3.2, and applies to Synthesis and Assessment Product 5.2.

The National Research Council’s Committee on the Human Dimensions of Global Change. As described above, this committee provides broad scientific expertise to CCSP. Additional soon-to-be completed studies relevant to CCSP include:

- *Public Participation in Environmental Assessment and Decision Making.* This major study was begun in 2001 to evaluate and summarize the state of knowledge about how to combine broadly based deliberation with scientific analysis to inform environmental decisions. A report is expected in mid-2007.
- *Confidentiality Issues Arising from Linking Remotely Sensed and Self-Identifying Data:* This study seeks ways to reconcile the conflicting needs for confidentiality and open access to data that are creating barriers to scientific efforts to gain knowledge by linking remotely sensed and self-identifying data. A report is expected in 2007.

This activity will address Question 9.1 of the CCSP Strategic Plan, and support Decision Support Objectives 2.2 and 3.1.





DECISION-SUPPORT RESOURCES GOAL 2: ADAPTIVE MANAGEMENT / PLANNING DECISIONS

A number of efforts are underway to support adaptive management and planning decisions (operational decisions for managing resources, societal response mechanisms, and long-term infrastructure planning). These activities include analyses for many sectors, including agriculture, forestry, water supply, and fisheries. Some of the main climate challenges being addressed for these sectors are drought and variations in the frequency of temperature extremes, severe precipitation, and runoff. Progress is being made to engage stakeholders at local and regional levels in an effort to bring information about the impacts of climate variability and change to bear on their management and planning decisions. Stakeholders include Governors' offices, State and Federal water management agencies, agricultural extension specialists, farmers, fisheries councils, wildland fire managers, and many others. Bringing climate science to these decisionmakers, analyzing the impacts of climate on their decisions, and collaborating with them to produce new knowledge and tools are all key parts of this component of CCSP. The following are some examples of progress in this area.

Highlights of Recent Activities and Research

Global Data Sources for Estimating Crop Production.⁸ A report was published in 2005 documenting the initial steps toward improving estimates of crop production using next-generation space-borne Earth observation sensors. The Production Estimates and Crop Assessment Division (PECAD) of the USDA Foreign Agricultural Service uses NASA Earth science data products to improve the decisionmaking process through their analysis of monthly global crop production estimates of select agricultural commodities. The results of PECAD's global analyses of select commodities are communicated to the World Agricultural Board.

Sistema Regional de Monitoreo y Visualización (SERVIR) – The Mesoamerican Visualization and Monitoring System. On 1 February 2005, SERVIR, a regional monitoring and visualization system, was inaugurated for environmental and disaster decision support within Mesoamerica. It intensively utilizes satellite imagery, models, and other geoscience information that can be interactively used by scientists, educators, policymakers, students, and the general public to monitor and forecast ecological changes and respond to disasters such as forest fires, drought, and volcanic eruptions (see Figure 41). The tool includes space-based observations and predictive capabilities along with other geospatial data sets, interactive on-line maps, thematic decision-support tools, and three-dimensional interactive visualizations. The

computational architecture of SERVIR also hosts data from other regional initiatives such as the Inter-American Biodiversity Information Network, and the United Nations Environmental Programme’s Global Resource Information Database for Latin America and the Caribbean. The system is headquartered at the Water Center for the Humid Tropics of Latin America and the Caribbean in the City of Knowledge, Panama. A fully functional rapid prototyping center and test bed for the SERVIR facility is located at NASA’s Marshall Space Flight Center in Huntsville, Alabama. The SERVIR functional capabilities are

accessible online at servir.nsstc.nasa.gov.

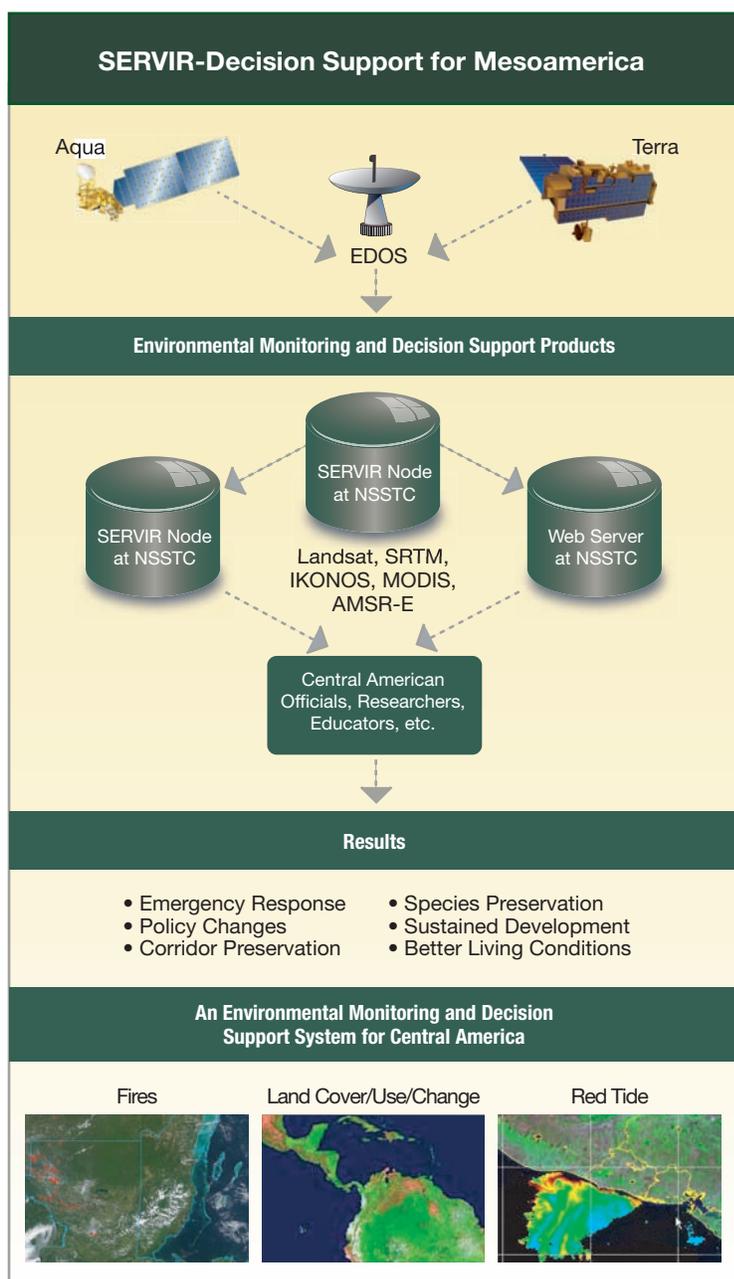
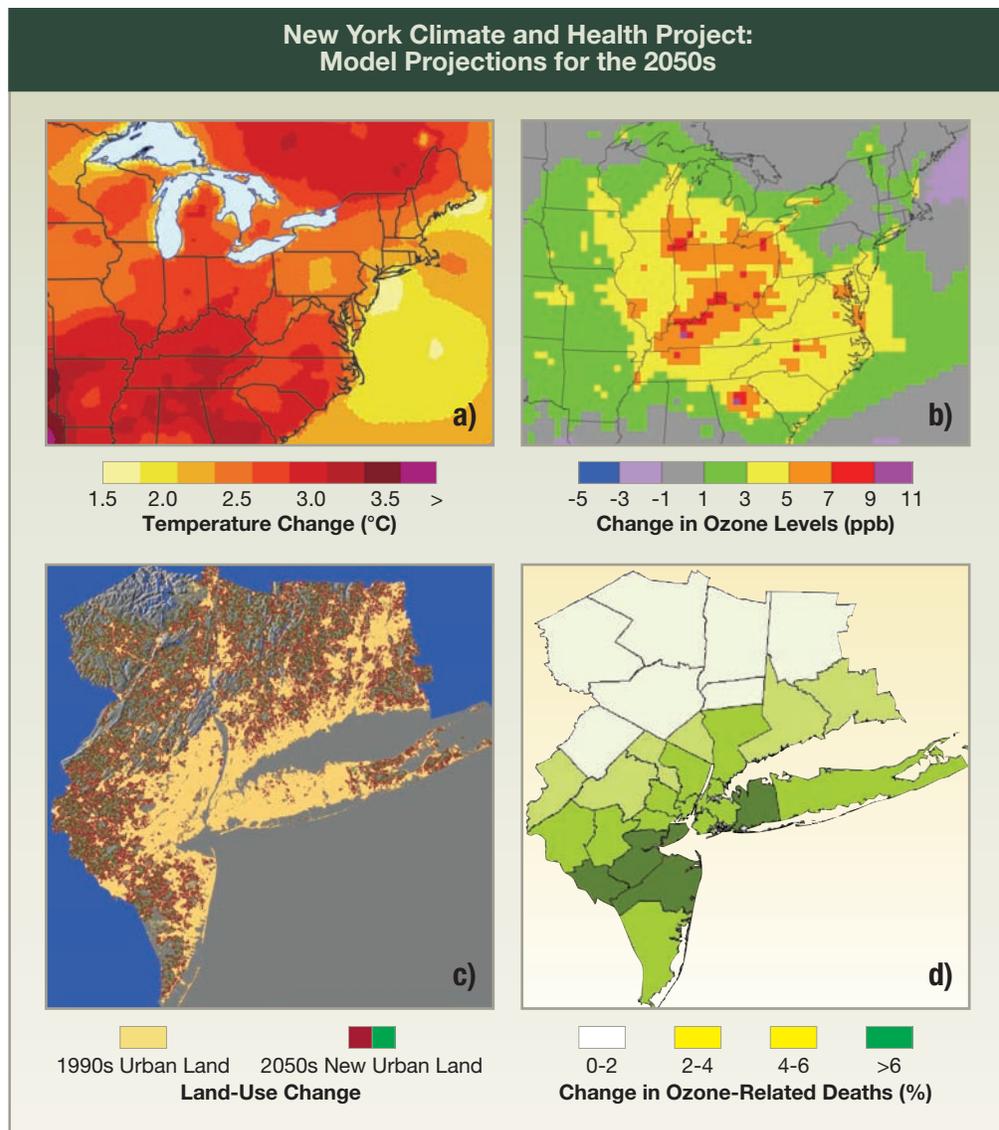


Figure 41: SERVIR – Decision Support for Mesoamerica. This schematic illustrates the components of SERVIR environmental and disaster support for Mesoamerica. Credit: NASA/Science Mission Directorate.

Highlights of Recent Research and Plans for FY 2007

New York Climate and Health Project.⁹ A team of climate and health scientists funded by NOAA, EPA, and NASA has been conducting interdisciplinary research on climate variability, climate change, land use, air quality, and human health in the New York Metropolitan Region. They have developed an integrated modeling system for assessing potential public health impacts related to heat stress and ground-level ozone. In particular, they linked a global climate model to regional climate models and a regional atmospheric chemistry model to produce downscaled heat and ozone estimates for the 1990s and the 2020s, 2050s, and 2080s under fast-growth and slower growth socioeconomic and climate scenarios and downscaled land-use scenarios (see Figure 42). A health risk assessment of mortality impacts was conducted at the county level with



these multi-model simulations of future environmental conditions. As part of this effort, more recent research has focused on providing improved understanding of climate and health vulnerability for stakeholders in support of decisionmaking in the New York region. This in-depth climate-health research is providing improved tools for decisionmakers in the region regarding public health risks due to potential heat and air quality changes.

Using Climate Change Information in Natural Resource Management: Considerations of Natural Resource Managers.⁷ This research explored how resource managers and agencies are developing management activities to potentially address resource management under a changing climate. In listening to over 70 natural resource managers and professionals in the western United States, it was found that an understanding of climate variability and change was often an important consideration in the development of their management activities. Natural resource managers from Federal agencies, State agencies, and nongovernmental organizations are bringing the consideration of climate into the management arena through current institutional processes such as assessment, monitoring, focused research, education, planning, field-based activities, and mitigation. Natural resource managers tended to give greater consideration to climate change when scientifically accepted quantitative relationships between climate and a specific natural resource (e.g., water) were available and also when applications were available that could easily be used within the manager's current planning or management framework. Managers benefiting from partnerships with climate-focused organizations, extension staff, and/or scientists within their geographic areas were able to incorporate consideration of climate variability and change into the management planning processes.

Translating Climate Science for Natural Resource Management.¹¹

New information from climate sciences, including paleoecology, brings a new paradigm about natural vegetation dynamics and informs our ability to develop mitigation and adaptation strategies in light of future climate variability and potential change. Most of this has been inaccessible to natural resource managers. Approaches have been developed to translate scientific conclusions relevant to resource conservation and management so that resource professionals are able to use this information in local and regional planning. One example of this is a rethinking of concepts of sustainability and restoration targets as well as approaches to future adaptation and restoration. Rather than restoring historic, "pre-human-disturbance" conditions, many species may persist better in the future by managing species populations so that they are realigned with current and anticipated future conditions, as well as through the provision of resource management options to cope with uncertain and highly variable futures.



AGCLIMATE: A PROTOTYPE DECISION-SUPPORT SYSTEM FOR USING CLIMATE INFORMATION TO REDUCE RISKS IN AGRICULTURE

Research conducted by the NOAA- and USDA-supported Southeast Climate Consortium (SECC) has found that in some cases more than merely publishing climate forecasts is required if farmers and other decisionmakers are to use that information effectively. It is important for decisionmakers to have alternative response options. Crop simulation models, developed and tested during more than 30 years of research, allow the testing of both the effects of climate variability and potential crop management practices that can help reduce risks of crop or economic losses to extreme climate events. Using crop models and climate forecasts, the SECC released *AgClimate*, a prototype web-based decision-support system designed to help reduce the risks to agriculture that arise from climate variability (see <agClimate.org>)]. In addition to background information on climate and its role in agricultural systems, *AgClimate* includes a climate risk tool that can help users understand how the El Niño Southern Oscillation phase affects the temperatures and rainfall of their county; crop risk tools for peanut, tomato, and potato that can help farmers understand how climate affects these crops in their county and possible mitigation strategies for extreme climate events; a wildfire risk tool for foresters; and quarterly regional outlooks for climate and the application of climate forecasts to specific crops, which are developed and disseminated in cooperation with commodity extension specialists from the three states.

Refer to chapter references 1,2,4,5,6 for more detail.

New Research Products Developed to Better Support Western Water Management Decisionmaking.¹⁴ CCSP-supported researchers through the Western Water Assessment (WWA) have developed a regularly updated web-based product, the “Intermountain West Climate Summary,” available at <wwa.colorado.edu/products/forecasts_and_outlooks/intermountain_west_climate_summary>. This product has two main purposes: to provide climate information, in the form of graphics, current conditions, forecasts, verifications, and focus articles, to stakeholders in the water community in a format that is easy to read, understand, and access; and to improve the level of knowledge and understanding of forecasts and climate phenomena by potential users so that WWA researchers and operational providers can engage users in a more productive dialog to better understand their need for climate information and improve climate services.

In a separate effort, new tree-ring collections have been used to update reconstructions of Colorado River flows first generated in the 1970s, allowing for a longer calibration period for the reconstruction models. Multiple modeling approaches were used to test model sensitivity to differences in reconstruction methodology, and confirm the robustness of the final reconstructions. The reconstruction for the Lees Ferry gauge, which measures flow for the entire Upper Colorado River, a key source of water for seven states and parts of Mexico, indicates a higher long-term mean than seen in previous reconstructions. However, the long-term flow is considerably less than the baseline used to allocate Colorado River water resources in the 1922 Colorado River Compact. Additionally, more severe and persistent droughts than those found in the instrumental record have occurred in prior centuries. When the severe drought of 2000 to 2004 is compared to other 4-year droughts in the past, the reconstruction indicates that the severity of this drought was exceeded as recently as the mid-19th century. The recent drought rigorously tested the resiliency of Colorado

River Basin water-supply systems, and water managers are now more closely considering how this paleoclimatic information maybe be applied to drought planning and water resources management.

Famine Early Warning System Network. CCSP supports the innovative application of science to alleviate risks related to existing climate variability or the potential for climate change through the Famine Early Warning System Network (FEWS NET; see <www.fews.net>). FEWS NET provides decisionmakers with timely information to respond effectively to drought and food insecurity by analyzing remote-sensing data and ground-based meteorological, crop, and rangeland observations to identify early indications of potential famine. Through its programs, FEWS NET also supports capacity building in the developing world for climate forecasting and early warning network development. FEWS NET operates in 20 countries in Africa, three countries in Central America, and in Haiti and Afghanistan. In 2005, in addition to providing warnings of acute and emerging food crises, FEWS NET also provided analyses of long-term climate trends for decision support related to potential climate change impacts. For example, FEWS NET recently produced a special report detailing how warming in the Indian Ocean and changes in the monsoonal circulation pattern could reduce rainfall in Ethiopia. This information will allow development agencies and regional and local institutions to direct appropriate resources and support toward strengthening the adaptive capacity of affected food production systems.



Highlights of Plans for FY 2007

In FY 2007, CCSP-participating agencies will sponsor research to develop decision-support resources for adaptive management and planning for responding to climate variability and change, and develop collaborations to apply these research-based resources in operational settings. Selected examples follow.



Coping with Drought through Research and Regional Partnership. CCSP plans to launch a focused analysis of the social and economic impacts of drought. The work includes an analysis of the use of information about near-term climate variability and longer term climate trends to aid decisionmakers coping with drought. This effort is congruous with the Western Governors' Association's recommendation for a National Integrated Drought Information System (NIDIS); the strategic plan for NIDIS spells out the need for social and economic impacts research and the need for improved climate information. Research will focus on the development of methods, models, and mechanisms for evaluating the social and economic ramifications of drought and the policymaking and decisionmaking processes in the face of drought.

Highlights of Recent Research and Plans for FY 2007

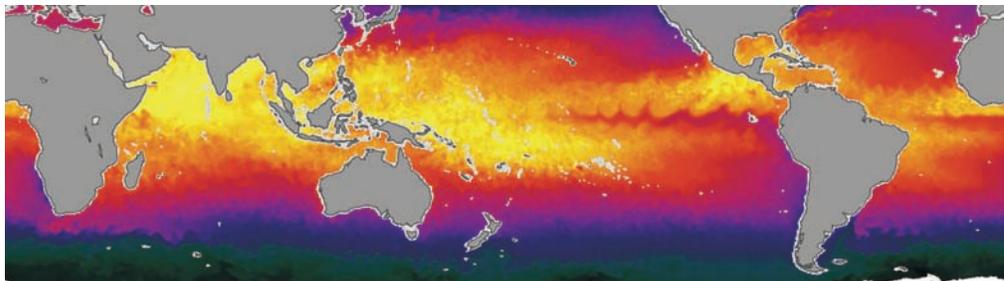
Potential climate information includes paleoclimatic and observed records of climate and its impacts, predictions based on seasonal-to-interannual climate variability, recent trends, and future projections of decadal variability and climate change. Social and economic impacts analyses will consider historical perspectives and near-term trends (e.g., projections of water conflicts, water demand, population changes, land-use shifts from rural to urban). Through this initiative, cutting-edge research on climate variability and change will be combined with in-depth analyses of the decisions made by the public and private sectors regarding drought. This effort will be conducted primarily through universities with strong partnerships among Federal and State agencies in drought-affected regions.

This activity will address Questions 9.2 and 9.4 of the CCSP Strategic Plan, and support Decision Support Objectives 2.1 and 2.2.

Adaptive Strategies for Transportation. The program is conducting various studies on adaptive management strategies for transportation to respond to climate change. One is a study of the effects of sea-level rise on national transportation infrastructure in order to identify specific infrastructure at risk. A series of studies, in cooperation with the Transportation Research Board of the National Academies, will focus on a reexamination of the role of design standards for transportation infrastructure in light of potential impacts from climate change, operational responses to potential climate change impacts, approaches to decisionmaking under uncertainty, and a case study of the transportation sector's response to and recovery from Hurricanes Katrina and Rita. These studies will be completed by early 2007.

This activity will address Question 9.2 of the CCSP Strategic Plan, support Decision Support Objectives 1.1, 2.1, and 3.1, and relate to Synthesis and Assessment Product 4.7.

Famine Early Warning System Network (FEWS NET). In 2007, FEWS NET (see <www.fews.net> and description above) plans to further analyze long-term climate trends in the Horn of Africa, building on their work in Ethiopia. Similar studies will be conducted in Somalia, Kenya, and Uganda. These studies will detail the relationship between temperature changes in the Indian Ocean and terrestrial temperature and precipitation changes across the Horn of Africa, and will analyze



changes in the supply and demand for water based on changes in the precipitation regime of the region. In 2007, FEWS NET also plans to expand its network to Nigeria, conducting drought and food security analyses for that country and providing early warning of potential famine.

This activity will address Question 9.2 of the CCSP Strategic Plan, and support Decision Support Objective 2.2.

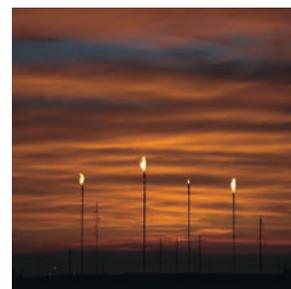
Transition of Research to Applications. The NOAA Climate Transition Program (NCTP) supports proposals for the transition of experimentally mature climate tools, methods, and processes from research to sustained operational delivery of useful climate information, products, and services to local, regional, national, and international decisionmakers and policymakers. NCTP seeks both to support implementation of these tools and to learn how better to accomplish transition technologies to support decisionmaking needs. NCTP supports well-defined partnerships between researchers, operations staff, decisionmakers, prototype developers, and extension, outreach, or education elements. In FY 2005, NCTP provided support for four projects (www.climate.noaa.gov/index.jsp?pg=../cpo_pa/cpo_pa_index.jsp&pa=nctp&sub=3).

This activity will address Questions 9.2 and 9.3 of the CCSP Strategic Plan, and support Decision Support Objective 2.2.

DECISION-SUPPORT RESOURCES GOAL 3: METHODS TO SUPPORT CLIMATE POLICYMAKING

Climate is a primary or significant factor in a range of policy considerations including options for reducing greenhouse gas emissions, long-term ecosystem management, infrastructure planning in the public and private sectors, and science and technology research. CCSP, in collaboration with CCTP, is providing useful information related to these issues. For example, CCSP's carbon cycle research is exploring the permanence of various options for sequestering carbon. The program's ecosystem research is exploring the potential impacts of climate change on managed ecosystems and is assessing the potential efficacy and implications of options for managing ecosystems in the face of climate change. The program's water cycle research is examining ongoing changes in water availability in the western United States and options for coping with potential future changes in supply and demand. These and other policy-relevant research areas, many of which are discussed in earlier chapters, are part of CCSP's efforts to develop information useful for policymaking.

CCSP also supports the development of integrated modeling frameworks that are useful for exploring many dimensions of climate and global change. Integrated analysis



Highlights of Recent Research and Plans for FY 2007

of climate change is essential for bringing together research from many contributing disciplines and applying it to gain comparative insight into policy-related questions. Full integration of information including research on human activities, greenhouse gases and aerosol emissions, land-use and land-cover change, cycling of carbon and other nutrients, climatic responses, and impacts on people, the economy, and resources is necessary for analysis of many important questions about the potential economic and environmental implications of changing greenhouse gas concentrations and various technology portfolios. Development and use of techniques for scenario and comparative analysis are useful for exploring the implications of different hypothetical policies for curbing emissions growth or encouraging adaptation. Answers from integrated analysis can only reflect the existing state-of-knowledge in component studies, but it is important to develop frameworks and resources for integration, exercise them, and learn from analysis of the results. CCSP is encouraging innovation and development of approaches to integrated analysis.

An integrated assessment of climate change analyzes the human (including economic), physical, and biological aspects of climate change, from the forces that give rise to greenhouse gas emissions or land-cover/land-use change (such as economic activity, demographic change, and technological advance), through emissions, to impacts (such as changes in unmanaged ecosystems, sea-level rise, and altered growing conditions for crops). The primary emphasis in an integrated assessment is to represent all three aspects in such a way that the costs and benefits of climate change can be evaluated. Integrated assessments are commonly based on scenarios simulated using a computer model. Integrated assessment models are used to evaluate, for example, specific climate change policy options, including those for reducing greenhouse gas emissions.

Highlights of Recent Activities and Research



Determinants of Residential Water Consumption.³ Decision Center for a Desert City, a Decision Making Under Uncertainty Center supported by NSF, has been studying water consumption. Municipal water records at the census tract level were obtained from the City of Phoenix and related to information from other sources about lot size, the presence of pools, household size, and landscaping style. Least-squares regression was used to identify the determinants of single-family residential water use in Phoenix in 2000 and geographically weighted regression to determine whether the behavior of nearby areas affects local water demand. Results substantiate the significance of household characteristics (size), urban design features (lot size and pools), and landscaping practices (mesic vegetation) on residential water demand and point to a strong spatial bias in water consumption. Households tend to

use water at a level comparable to their neighbors, irrespective of their demographic and urban design features. Thus, planning decisions may have different effects in different parts of the city. Model parameters will be used to estimate demand under different urban-growth and planning scenarios. The results of this study, in conjunction with analyses of climate variability and change, are being used to assess the relationships between climate and water consumption in an arid metropolitan region.

Comparing the Potential Effect of Cap-and-Trade Policies on Sectors with Existing Tax Regimes in the United States and the European Union.¹² One of CCSP's decision-support approaches is to conduct "If... , then..." analyses of climate change response options. Recent research has included an explicit representation of existing tax regimes in a quantitative analysis of potential strategies for reducing greenhouse gas emissions. The household transportation sector is among the more rapidly growing energy users, and fuel inputs are often taxed at much higher rates in transportation than in other areas of the economy. In addition, policies directed toward energy use and environmental control generally have given special treatment to the transportation sector (particularly the automobile). The European Union, for example, excludes the transportation sector from the 2005-2007 trial period of its emissions trading system. In the absence of pre-existing tax distortions, as is the case in the United States, exemption of transportation sectors would imply increased carbon tax rates for other sectors and higher costs for the economy as a whole. For the European Union, on the other hand, the exemption of the already highly taxed transport sector may actually decrease the estimated cost of meeting a carbon constraint, even when the capped sectors are required to cut further to make up for the sector exemptions.

Highlights of Plans for FY 2007

Comparison of Policy Assessments with Different Types of Economic Models. A comparison of the effectiveness of economic instruments, such as the costs of national cap-and-trade measures predicted by integrated assessment models, often reveals significant differences among models. One source of divergence is the way models represent expectations for future developments—that is, whether a model is forward-looking (current decisions are based on future as well as current prices) or recursive dynamic (each time period is analyzed independently). Forward-looking models sometimes show higher costs during initial control periods, apparently because solutions result in larger reductions in consumption early in anticipation of a future tightening of the constraint. Resolution of these differences in results is difficult because these varying models, developed by different groups, have substantial differences



Highlights of Recent Research and Plans for FY 2007

in structure, assumptions, and the way expectations are modeled. The Massachusetts Institute of Technology Joint Program on the Science and Policy of Global Change will complete development of a multi-sector, multi-region economic model (specifically, a computational general equilibrium model) that can be run in either forward-looking or recursive-dynamic mode. Carefully controlled simulations with this model will provide a basis for explaining the origin of the differences among model types and explain some of the existing variation in predicted costs.

This activity will address Question 9.1 of the CCSP Strategic Plan, support Decision Support Objectives 2.1 and 3.1, and relate to Synthesis and Assessment Product 2.1.

Emissions Analysis of Freight Transport Comparing Land- and Water-Side Short-Sea Routes: Development and Demonstration of a Decision

Modeling Tool. The goal of this study is to develop a methodology and tools to compare greenhouse gas and other emissions from land- and water-side freight transport alternatives. Current efforts to investigate and promote the use of short-sea shipping alternatives (inland and coastal waterways used to move commercial freight from major domestic ports closer to final destinations) will benefit from additional information that compares emissions of greenhouse gases and other pollutants among freight modes. The tools and methodology that come out of this study will contribute to developing best practices for greenhouse gas mitigation in the multi-modal freight sector. Completion is expected in early 2007.

This activity will address Questions 9.1 and 9.3 of the CCSP Strategic Plan, support Decision Support Objectives 2.1, 2.2, and 3.2, and relate to Synthesis and Assessment Product 4.7.

Transportation-Focused Studies. Outside of Synthesis and Assessment Product 4.7, DOT is conducting the following two studies to support informed discussion of the relationships between transportation and climate change. In light of President Bush's goal for an 18% reduction in greenhouse gas intensity by 2012, a study will be completed in 2006 aimed at quantifying transportation's current contributions to overall U.S. greenhouse gas intensity. In addition, in FY 2007, a comparative analysis of emissions from aviation, automobile, marine, and diesel transport will be undertaken. This study will compare emissions data sets from aviation, heavy-duty diesel, automobile, and marine vehicles and analyze the similarities and differences across the transportation modes. The final report will determine how the analyzed data can be added to existing emissions inventories and used in quantifying contributions to local and regional air quality and climate change.

This activity will address Question 9.1 of the CCSP Strategic Plan, support Decision Support Objective 1.1, and relate to Synthesis and Assessment Products 2.1 and 4.7.

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