



National Research Council Review of  
the *Strategic Plan* for the Climate  
Change Science Program



**Overview of the Strategic Plan  
and Responses to Comments**

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US Climate Change  
Science Program  
[www.climatechange.gov](http://www.climatechange.gov)



# Impetus for a New Strategic Plan

- Substantial scientific progress over the past decade
- Opportunities afforded by a wealth of new observations, and those to come from both research and operational systems
- Maturing capabilities to conduct scientific assessments
- Needs of policy-makers for timely and sound scientific information, and for the federal global change research community to mobilize to provide it
- Capture advice from the NRC on research, observations, and computational modeling provided over the past few years



# U.S. Climate Change Science Program–Principles

- Goal and question-oriented strategic plan
- Integration of USGCRP and CCRI
- Combined scientific community and stakeholder review
- Policy relevant and policy neutral standards
- Transparency and comprehensiveness standards in assessment and decision support
- Reporting of degree of certainty in findings

# Strategic Plan Development Process

- Ongoing research, observations, implementation, and reporting
- Discussion Draft of Strategic Plan, November 2002
- Broad community review of Discussion Draft of Strategic Plan at workshop, December 2002
- Individual comments received on website until January 18, 2003
- First National Research Council (NRC) Report issued, February 25, 2003
- Completion of Strategic Plan, July 2003
- Second NRC review will commence late-August
- Ongoing implementation, evaluation, and revision



# Challenges in Revising the Plan

- Reconciling divergent comments
- Meeting the needs of multiple audiences, from decisionmakers to technical
- Responding to calls for prioritization
- Clarifying time lines for milestones and deliverables

# NRC First Report– *Overarching Recommendations*

- Clarify vision, goals, and priorities of the CCSP and CCRI
- Fill needs for climate and global change information
- Describe a strategy for achieving an integrated observing system
- Enhance efforts to support decision making
- Improve program management description



# Extensive Revisions to Discussion Draft—Main Points

- Concerted effort to be responsive
- Development of program vision, mission, and goals
- Identification of key near-term products
- Integration of USGCRP, CCRI and CCSP
- Clarification of process for developing decision support
- More detail on observations, data management, and modeling

# Contents, November 2002 Draft

- Chapter 1. Introduction
- **Part I. The CCRI**
- Overview
- Chapter 2. Research Focused on Key Climate Change Uncertainties
- Chapter 3. Climate Quality Observations, Monitoring, and Data Management
- Chapter 4. Decision Support Resources
- **Part II. The USGCRP**
- Overview
- Chapter 5. Atmospheric Composition
- Chapter 6. Climate Variability and Change
- Chapter 7. Water Cycle
- Chapter 8. Land Use/Land Cover Change
- Chapter 9. Carbon Cycle
- Chapter 10. Ecosystems
- Chapter 11. Human Contributions and Responses to Environmental Change
- Chapter 12. Grand Challenges in Modeling, Observations, and Information Systems
- **Part III. Communication, Cooperation, and Management**
- Chapter 13. Reporting and Outreach
- Chapter 14. International Research and Cooperation
- Chapter 15. Program Management and Review



# Contents, Final CCSP Strategic Plan

Chapter 1. Introduction

Chapter 2. Integrating Climate and Global Change Research

Chapter 3. Atmospheric Composition

Chapter 4. Climate Variability and Change

Chapter 5. Water Cycle

Chapter 6. Land-Use/Land-Cover Change

Chapter 7. Carbon Cycle

Chapter 8. Ecosystems

Chapter 9. Human Contributions and Responses to Environmental Change

Chapter 10. Modeling Strategy

Chapter 11. Decision Support Resources Development

Chapter 12. Observing and Monitoring the Climate System

Chapter 13. Data Management and Information

Chapter 14. Communications

Chapter 15. International Research and Cooperation

Chapter 16. Program Management and Review

# NRC First Report– *Overarching Recommendations*

1. Clarify vision, goals, and priorities of the CCSP and CCRI
2. Fill needs for climate and global change information
3. Enhance efforts to support decision making
4. Describe a strategy for achieving an integrated observing system
5. Improve program management description





# 1. Clarifying Vision and Goals





# Guiding Vision for the CCSP



A nation and the global community empowered with the science-based knowledge to manage the risks and opportunities of change in the climate and related environmental systems.





# CCSP Mission



Facilitate the creation and application of knowledge of the Earth's global environment through research, observations, decision support, and communication



# Core Approaches

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- Scientific Research
- Observations & Data Management
- Decision Support
- Communications



# Five Integrated Goals for the U.S. Climate Change Science Program

**Goal 1:** Improve knowledge of the Earth's past and present climate and environment, including their natural variability, and improve understanding of the causes of observed variability and change

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

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

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

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

## 2. Meeting Information Needs for Climate and Global Change Information

**US Climate Change  
Science Program**  
[www.climatescience.gov](http://www.climatescience.gov)





# CCSP will continue long-term discovery-driven and “applied” research

- Atmospheric Composition
- Climate Variability and Change
- Global Water Cycle
- Land-Use/Land-Cover Change
- Global Carbon Cycle
- Ecosystems
- Human Contributions and Responses to Environmental Change

# Attributes of long-term research activities

- Extramural and intramural research supported by participating Agencies
- Large number of deliverables
- Incubator for knowledge that is then used in decision support resource development
- Interactions with users in research mode
- Coordinated through interagency working groups with external guidance and review
- Challenge: balance long-term Earth system research with focus on climate uncertainties



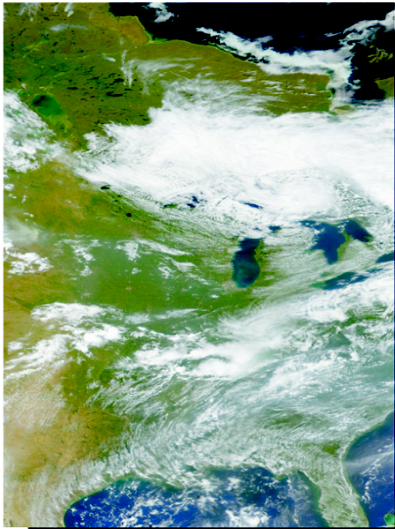
# Near term emphasis on three sets of scientific uncertainties:

- Atmospheric distributions and effects of aerosols
- Climate feedbacks and sensitivity
- Carbon sources and sinks, focusing particularly on North America

# CCSP Synthesis and Assessment Products

- More than 20 products over next 4 years
- Topics identified during plan development and span all five CCSP goals
- Will constitute CCSP assessment effort as mandated in 1990 GCRA
- Detailed specification of questions and approach on case-by-case basis with stakeholder input
- Process underway to designate agency leads and contributions

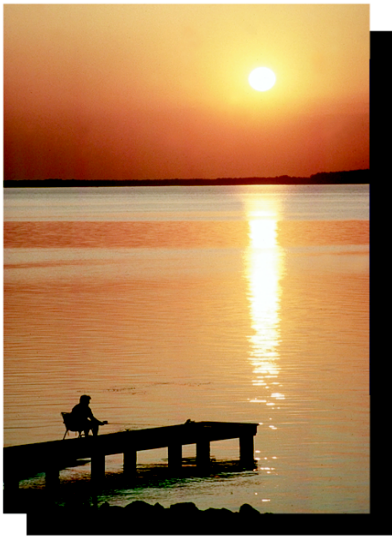




# GOAL 1

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.

TOPICS FOR PRIORITY CCSP SYNTHESIS PRODUCTS	SIGNIFICANCE	COMPLETION
Temperature trends in the lower atmosphere—steps for understanding and reconciling differences.	Inconsistencies in the temperature profiles of different data sets reduce confidence in understanding of how and why climate has changed.	within 2 years
Past climate variability and change in the Arctic and at high latitudes.	High latitudes are especially sensitive and may provide early indications of climate change; new paleoclimate data will provide long-term context for recent observed temperature increases.	within 2 years
Reanalyses of historical climate data for key atmospheric features. Implications for attribution of causes of observed change.	Understanding the magnitude of past climate variations is key to increasing confidence in the understanding of how and why climate has changed and why it may change in the future.	2-4 years



## GOAL 2

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

TOPICS FOR PRIORITY CCSP SYNTHESIS PRODUCTS	SIGNIFICANCE	COMPLETION
Updating scenarios of greenhouse gas emissions and concentrations, in collaboration with the CCTP. Review of integrated scenario development and application.	Sound, comprehensive emissions scenarios are essential for comparative analysis of how climate may change in the future, as well as for analyses of mitigation and adaptation options.	within 2 years
North American carbon budget and implications for the global carbon cycle.	The buildup of CO <sub>2</sub> and methane in the atmosphere and the fraction of carbon being taken up by North America's ecosystems and coastal oceans are key factors in estimating future climate change.	within 2 years
Aerosol properties and their impacts on climate.	There is a high level of uncertainty about how climate may be affected by different types of aerosols, both warming and cooling, and thus how climate change might be affected by their control.	2-4 years
Trends in emissions of ozone-depleting substances, ozone layer recovery, and implications for ultraviolet radiation exposure and climate change.	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).	2-4 years

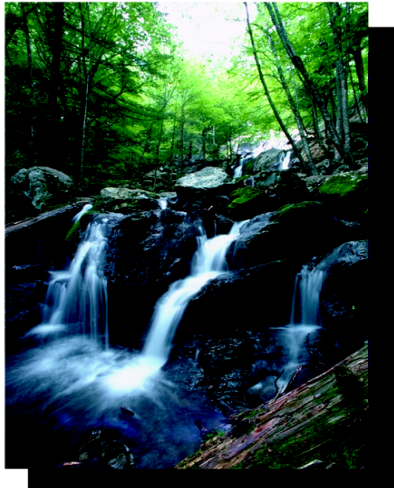




## GOAL 3

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

TOPICS FOR PRIORITY CCSP SYNTHESIS PRODUCTS	SIGNIFICANCE	COMPLETION
Climate models and their uses and limitations, including sensitivity, feedbacks, and uncertainty analysis.	Clarifying the uses and limitations of climate models at different spatial and temporal scales will contribute to appropriate application of these results.	within 2 years
Climate projections for research and assessment based on emissions scenarios developed through the CCTP.	Production of these projections will help develop modeling capacity and will provide important inputs to comparative analysis of response options.	2-4 years
Climate extremes including documentation of current extremes. Prospects for improving projections.	Extreme events have important implications for natural resources, property, infrastructure, and public safety.	2-4 years
Risks of abrupt changes in global climate.	Abrupt changes have occurred in the past and thus it is important to evaluate what we know about the potential for abrupt change in the future.	2-4 years



## GOAL 4

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

TOPICS FOR PRIORITY CCSP SYNTHESIS PRODUCTS	SIGNIFICANCE	COMPLETION
Coastal elevation and sensitivity to sea level rise.	Evaluation of how well equipped society is to cope with potential sea level rise can help reduce vulnerability.	within 2 years
State-of-knowledge of thresholds of change that could lead to discontinuities (sudden changes) in some ecosystems and climate-sensitive resources.	This approach seeks to determine how much climate change natural environments and resources can withstand before being adversely affected.	2-4 years
Relationship between observed ecosystem changes and climate change.	Earlier blossoming times, longer growing seasons, and other changes are being observed, and this report will explore what is known about why these events are happening.	2-4 years
Preliminary review of adaptation options for climate-sensitive ecosystems and resources.	Understanding of adaptation options can support improved resource management—whether change results from natural or human causes—and thus helps realize opportunities or reduce negative impacts.	2-4 years
Scenario-based analysis of the climatological, environmental, resource, technological, and economic implications of different atmospheric concentrations of greenhouse gases.	Knowing how well we can differentiate the impacts of different greenhouse gas concentrations is important in determining the range of appropriate response policies.	2-4 years
State-of-the-science of socioeconomic and environmental impacts of climate variability.	This product will help improve application of evolving ENSO forecasts by synthesizing information on impacts, both positive and negative, of variability.	2-4 years
Within the transportation sector, a summary of climate change and variability sensitivities, potential impacts, and response options.	Safety and efficiency of transportation infrastructure—much of which has a long lifetime—may be increased through planning that takes account of sensitivities to climate variability and change.	2-4 years





## GOAL 5

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

TOPICS FOR PRIORITY CCSP SYNTHESIS PRODUCTS	SIGNIFICANCE	COMPLETION
Uses and limitations of observations, data, forecasts, and other projections in decision support for selected sectors and regions.	There is a great need for regional climate information; further evaluation of the reliability of current information is crucial in developing new applications.	within 2 years
Best-practice approaches to characterize, communicate, and incorporate scientific uncertainty in decisionmaking.	Improvements in how scientific uncertainty is evaluated and communicated can help reduce misunderstanding and misuse of this information.	within 2 years
Decision support experiments and evaluations using seasonal to interannual forecasts and observational data.	Climate variability is an important factor in resource planning and management; improved application of forecasts and data can benefit society.	within 2 years

# Challenges of Synthesis and Integration

- CCSP synthesis and assessment products will synthesize information from diverse sources
- Additional integration challenges:
  - Critical dependencies
  - Integration across multiple elements (e.g., methane)
  - Coordination of research and supporting elements
  - Integration between and among agencies





# 3. Enhance Efforts to Support Decision Making

**US Climate Change  
Science Program**  
[www.climatechange.gov](http://www.climatechange.gov)



# Overview of decision support resources development

- Prepare scientific syntheses and assessments
- Develop resources to support adaptive management and planning, and transition these resources from research to application
- Develop and evaluate methods to support policymaking and demonstrate these methods with case studies





# Guidelines for decision support

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- Analyses structured around specific questions
- Early and continuing involvement of stakeholders
- Explicit treatment of uncertainties
- Transparent public review of analysis questions, methods, and draft results
- Evaluate ongoing CCSP analyses and build on the lessons learned



# Additional considerations

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- Development of decision support resources will be done in a cross-cutting fashion, working with the research elements to develop new products and applications
- Continued development of approaches for integrated assessment and initial case studies will be developed jointly with the Climate Change Technology Program (CCTP)





4. Describe a strategy for achieving an integrated observing system



# Strategy for Achieving an Integrated Observing System

The Plan emphasizes the important features

- Science-driven requirements based on the need for climate-quality data products, including
  - Adherence to climate monitoring principles
  - Use of climate models to assist in observing system design
  - Protocols for validation of data assimilation and reanalysis
- Stabilizing and extending observing capabilities
  - Research to operations transition for satellites
  - Completing, maintaining, and updating in situ networks
  - New capabilities for new observations (e.g., ecosystems) and to integrate existing components
- Accelerating the deployment of pieces needed for decision support
  - Those associated with the near-term CCRI priorities and goals
- International collaboration



# International Collaboration in Earth Observation

- Earth Observation Summit
  - Hosted by the U.S. Government in Washington, DC, on July 31, 2003
  - Senior international government and non-government leaders in climate science, technology and environment from 34 nations
  - To obtain international support for a system of integrated space-borne, airborne, and in situ observations, to help understand and address global, environmental and economic concerns ([www.earthobservationsummit.gov](http://www.earthobservationsummit.gov))
- Initiated a year-long development of a decadal plan for Earth observation
  - US participation led by the NOAA Administrator



# 5. Improve Program Management Description

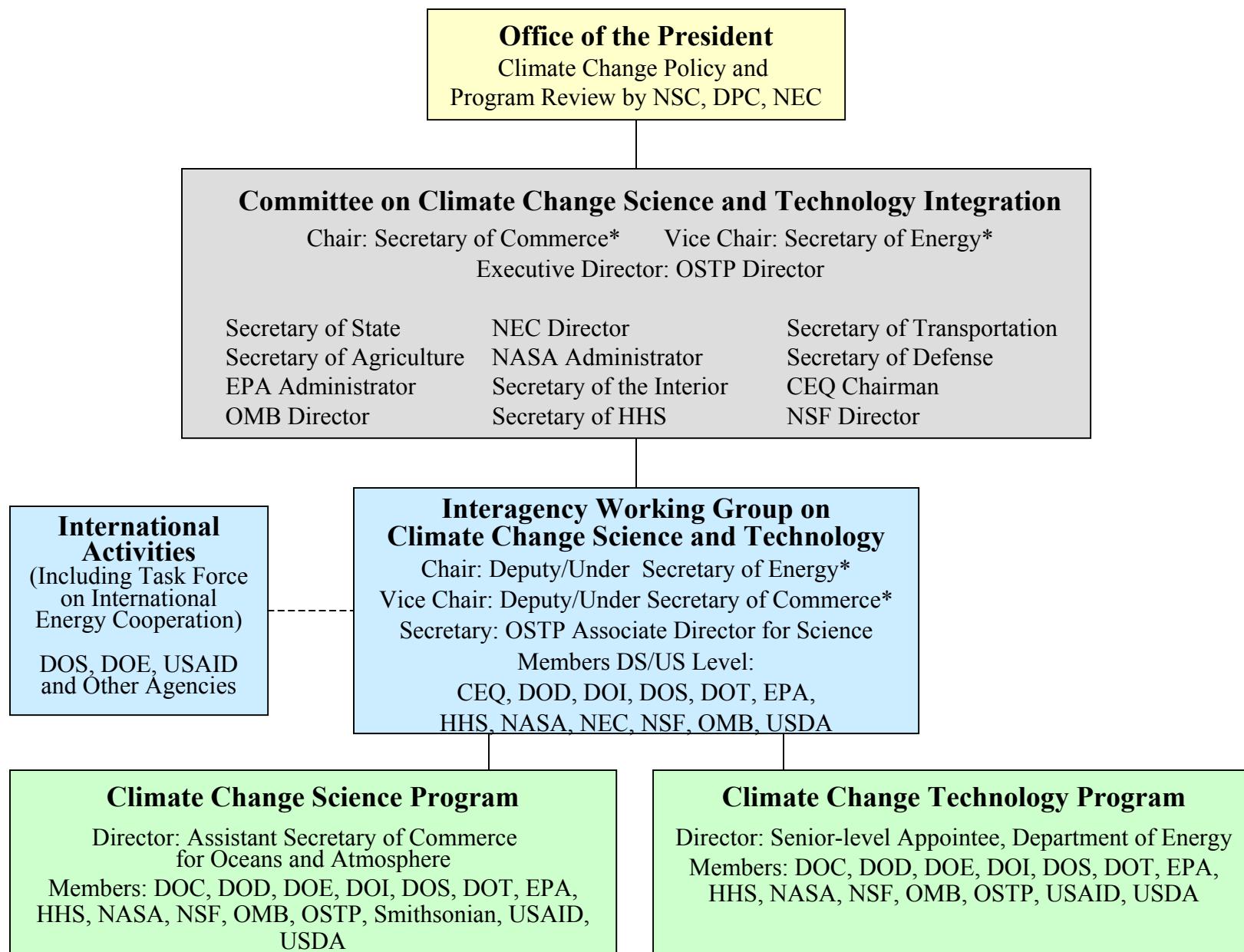


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# Climate Science and Technology Management Structure



\*Chair and Vice Chair of Committee and Working Group rotate annually



# Management Mechanisms

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- Executive direction by cabinet-based management, including priority setting, review, and accountability
- Implementation by CCSP agencies
- Coordination through interagency groups
- External interactions for guidance, evaluation, and feedback
- Support from an interagency office





# Priority setting

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- Research priorities are assessed on an annual basis using multiple information sources
- Near-term priorities are reflected in the CCRI
- Initially, the following issues will receive priority
  - Three research issues identified by NRC (aerosols, feedbacks, and carbon sources/sinks)
  - Observing systems
  - Decision support resources development
- New initiative in FY 05/06 consistent with established priorities



# Program criteria

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- Scientific or technical quality
- Relevance to reducing uncertainties and improving decision support tools
- Track record of consistently good past performance and identified metrics for evaluating future progress
- Cost and value



# Next steps in program development

- Designate responsibilities and schedules for near-term CCSP deliverables
- Continue to develop coordination mechanisms with CCTP
- Annual implementation for research elements and other cross-cutting areas
- Follow through and implementation planning following Earth Observing Summit

# Capacity Building – Accomplishments and a Future Challenge

## Human Capital

- Thousands of PI's and their Co-I's & students
  - Education programs and tools, e.g., fellowships and curricula support
  - Science community leaders trained to contribute to interdisciplinary research and assessments, e.g. IPCC contributors
- Research Assets
  - New generation of space-based, suborbital and surface-based observing systems
  - Information systems to process, archive and distribute data and information
  - Essential elements of the needed computational capacity
- Future challenges require building on this success





# Concluding Remarks

**US Climate Change  
Science Program**  
[www.climatechange.gov](http://www.climatechange.gov)





# A Sound Basis for Progress

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- Created an end-to-end process for research, observation, modeling, and decision support
- Identified products and schedules to address the highest priority areas of uncertainty
- Planned assessment products with an “act - learn - act” approach toward decision support, commensurate with the scientific process itself
- Periodic review and revision of Strategic Plan to reflect new knowledge



# Focus of the Second NRC Review

*The participating Agencies believe the CCSP Vision and Strategic Plan documents are a significant accomplishment and a sound basis for moving forward. The NRC's views on the content and process are essential to confirming or adjusting the course ahead.*

- Plan Content

- The challenge was to prioritize, integrate, and organize Federal global and climate change research to deliver useful scientific information; the Plan has goals, integrating and organizing constructs and deliverables with timelines

- Plan Development Process

- The challenge was to engage the broader scientific and stakeholder communities, and address their comments in a coherent and timely product; over 1600 authors, reviewers and workshop participants involved