Welcome to the CCSP "Town Hall"

Topics and Participants:

Overview and Management—Jack Kaye (NASA)
Atmospheric Composition—Phil DeCola (NASA)
Climate Variability/Change—Ming Ji (NOAA)
Carbon Cycle—Nancy Cavallaro (USDA)
Water Cycle—Jared Entin (NASA)
Observations—Bob Cahalan (CCSPO/NASA)
Decision Support—Richard Moss (CCSPO/UMd)

****Feedback and Discussion****

US Climate Change Science Program
www.climatescience.gov

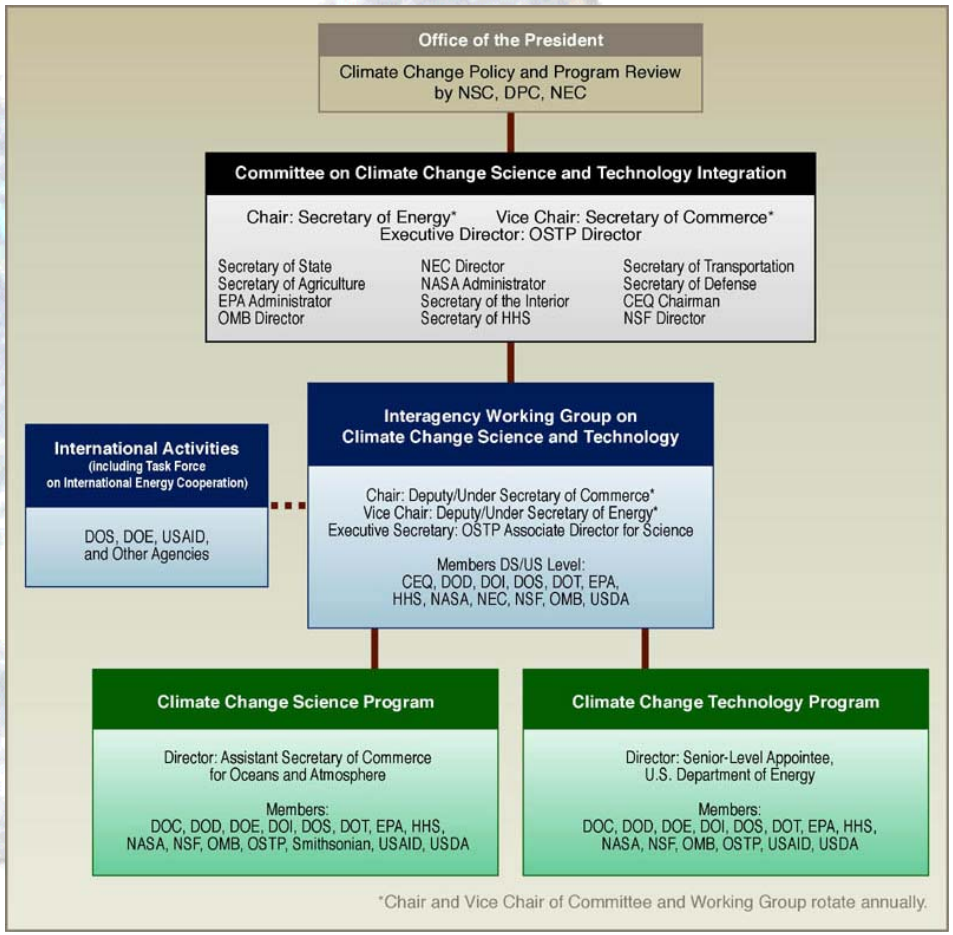
Climate Change Science Program Overview and Management

Jack Kaye
Director, Research Division
NASA Office of Earth Science

US Climate Change Science Program
www.climatescience.gov

CCSP Incorporates Long-Term Global Change and Focused Climate Change Research

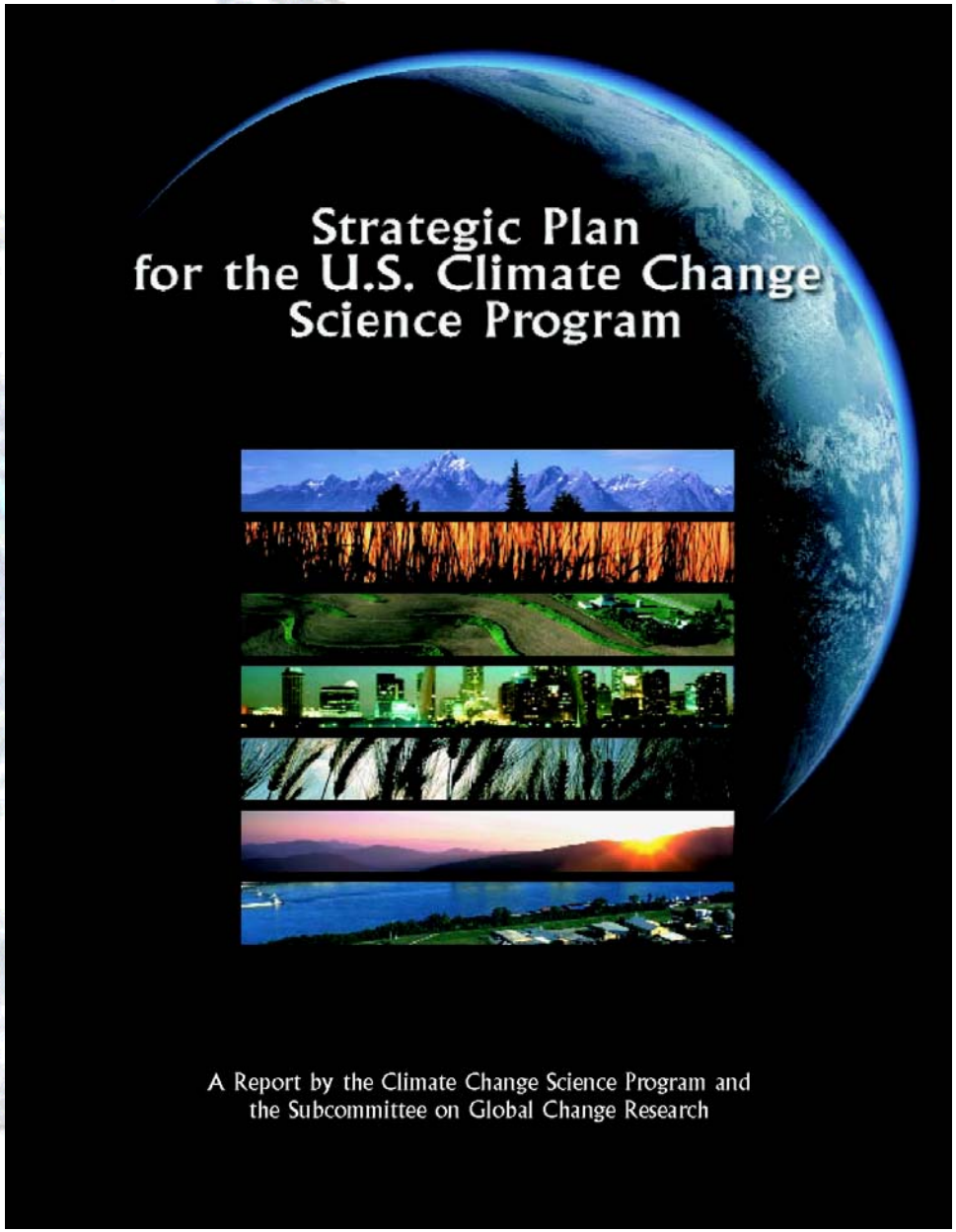
- 13 Federal Agencies/ Departments coordinate their activities through the Climate Change Science Program (CCSP)
- Works with university-based and Federal scientists
- Close coordination with energy technology programs



Strategic Plan for the U.S. Climate Change Science Program

Based on:

- Previous planning efforts (e.g., *Pathways* and other reports)
- Comments during workshop (1300 participants)
- 270 sets of comments during an open comment period
- Review by the NRC
- Government review



CCSP Strategy Includes:

- Five overarching climate-focused goals with related long-term research foci and near-term deliverables (21 “Synthesis and Assessment Products”)
- Four key approaches
  - Research in 7 core science elements
  - Observations
  - Decision support
  - Communications

CCSP Goals Will Integrate Information from USGCRP and CCRI on Climate Change

CCSP 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

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

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

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

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

CCSP Will Continue Long-term Discovery-Driven and "Applied" Research (USGCRP)

- 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

CCSP Will Be Managed to Facilitate Synthesis and Integration

- CCSP synthesis and assessment products will synthesize climate change related information from core research elements
- Additional integration challenges are also addressed in the Strategic Plan:
  - "Critical dependencies"
  - Integration across multiple elements (e.g., methane)
  - Coordination of research and supporting elements
  - Integration between and among agencies

Management Mechanisms: How CCSP Agencies Will Work Together

- 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

Ongoing activities: budget coordination update and use of strategic plan in Agency planning

Priority Setting

- 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

Program Criteria

- 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
  - Synthesis and assessment reports are important but not exclusive focus
- Continue to develop coordination mechanisms with the Climate Change Technology Program (CCTP)
- Annual implementation for research elements and other cross-cutting areas
- Follow through and implementation planning for the Earth Observing Summit

IWGEO Structure

IWGEO
(Co-Chairs)

Executive Secretariat

Planning & Integration Team

Architecture Team

Data Utilization Team

User Requirements & Outreach Team

Capacity Building Team

International Cooperation Team

Atmospheric Composition

Phil DeCola
NASA Office of Earth Science

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Atmospheric Composition Overarching Questions

How do changes in atmospheric composition alter and respond to the energy balance of the climate system? What are the interactions between the climate system and stratospheric ozone? What are the effects of regional pollution on the global atmosphere and the effects of global climate and chemical change on regional air quality?

How is the composition of the global atmosphere, as it relates to climate, ozone depletion, ultraviolet radiation, and pollutant exposure, altered by human activities and natural phenomena? How quantitative is the knowledge of the major sources of emissions to the atmosphere? What are the atmospheric composition changes that could affect human health and natural ecosystems?

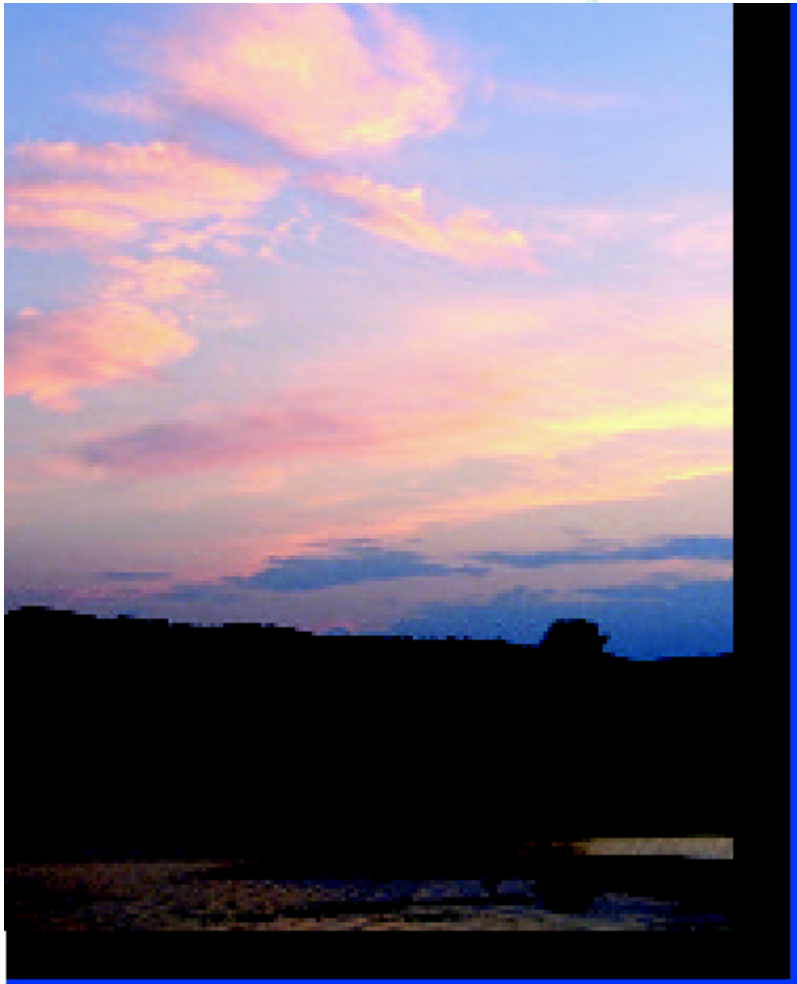
Atmospheric Composition

- The Earth's Ozone Shield is fundamental to protecting all life.
- The Earth's Air Quality is fundamental to public health.
- The Earth's Climate is affected by changes in greenhouse gases and aerosols.

"America and the world share this common goal: we must foster economic growth in ways that protect our environment. We must encourage growth that will provide a better life for citizens, while protecting the land, the water, and the air that sustain life. In pursuit of this goal, my government has set two priorities: we must clean our air, and we must address the issue of global climate change."

President George W. Bush, February 14, 2002

Atmospheric Composition



Question 3.1: What are the climate-relevant chemical, microphysical, and optical properties, and spatial and temporal distributions, of human-caused and naturally occurring aerosols?

Question 3.2: What are the atmospheric sources and sinks of the greenhouse gases other than CO_2 and the implications for the Earth's energy balance?

Question 3.3: What are the effects of regional pollution on the global atmosphere and the effects of global climate and chemical change on regional air quality and atmospheric chemical inputs to ecosystems?

Question 3.4: What are the characteristics of the recovery of the stratospheric ozone layer in response to declining abundances of ozone-depleting gases and increasing abundances of greenhouse gases?

Question 3.5: What are the couplings and feedback mechanisms among climate change, air pollution, and ozone layer depletion, and their relationship to the health of humans and ecosystems?

CCSP Plan Chapter 3: Atmospheric Composition

Question 3.1: What are the climate-relevant chemical, microphysical, and optical properties, and spatial and temporal distributions, of human-caused and naturally occurring aerosols?

Question 3.2: What are the atmospheric sources and sinks of the growing suite of chemically active greenhouse gases and the implications for the Earth's energy balance?

Question 3.3: What are the effects of regional pollution on the global atmosphere and the effects of global climate and chemical change on regional air quality and atmospheric chemical inputs to ecosystems?

Question 3.4: What are the time scale and other characteristics of the recovery of the stratospheric ozone layer in response to declining abundances of ozone-depleting gases and increasing abundances of greenhouse gases?

Question 3.5: What are the couplings and feedback mechanisms among climate change, air pollution, and ozone layer depletion, and their relationship to the health of humans and ecosystems?

Aerosol Research Objectives: The Next 10 years

- Characterize the separate contributions of human activities (industry, land-use change, etc.) and natural sources (volcanoes, wildfires, desert dust, etc.) to regional-to-global aerosol distributions
- Characterize the processes by which emissions are linked to global distributions
- Characterize the global distributions of aerosols and their variation over time
- Establish the net sign and magnitude of the radiative-forcing from aerosols that absorb solar radiation, such as carbonaceous aerosols and mineral dust aerosols
- Reduce the uncertainty bounds of aerosol-related effects in clouds

CCSP Goals

CCSP Goal 1 ***Improve knowledge of the Earth's past and present climate and environment, including its natural variability, and improve understanding of the causes of observed variability and change***
CCSP Goal 2 ***Improve quantification of the forces bringing about changes in the Earth's climate and related systems***
CCSP Goal 3 ***Reduce uncertainty in projections of how the Earth's climate and environmental systems may change in the future***
CCSP Goal 4 ***Understand the sensitivity and adaptability of different natural and managed ecosystems and human systems to climate and related global changes***
CCSP Goal 5 ***Explore the uses and identify the limits of evolving knowledge to manage risks and opportunities related to climate variability and change***

CCSP Deliverables

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

Updating scenarios of greenhouse gas emissions and concentrations, in collaboration with the CCTP. Review of integrated scenario development and application.

North American carbon budget and implications for the global carbon cycle.

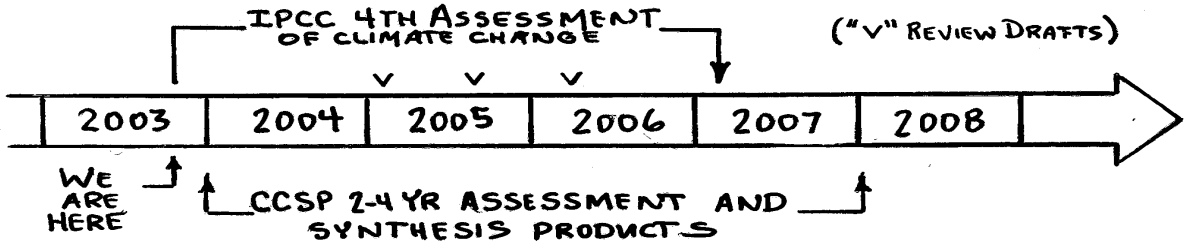
Aerosol properties and their impacts on climate.

Trends in emissions of ozone-depleting substances, ozone layer recovery, and implications for ultraviolet radiation exposure and climate change.

CCSP Aerosol-Climate Synthesis Product: An Approach

- **Factors**
  - > CCSP-identifiable product needs.
  - > Time impositions on the researchers.
  - > Other similar activities, IPCC.

- **Timescales / Activities**



- **Aerosol-Climate**

Phase I

- > CCSP-instigated scientific "nuggets."
- > Stand-alone products, e.g., review papers.
- > Example: Aerosol – cloud indirect effects.

Phase II

- > CCSP-instigated focus of community-wide understanding on explicit decision-support tools & info.
- > Examples: ◦ North American inflow-outflow.
  ◦ Transportation sector – diesel vis-a-vis gasoline.

- **Appealing Aspects**
  - > Avoids parallel assessments (and the burden on researcher implied)
  - > Complimentary to IPCC: input to & later use of.

Next steps:
- Broader input (e.g., research community) to possible Phase I topics.
- And soon.

(NASA/NOAA 18 Nov 2003)

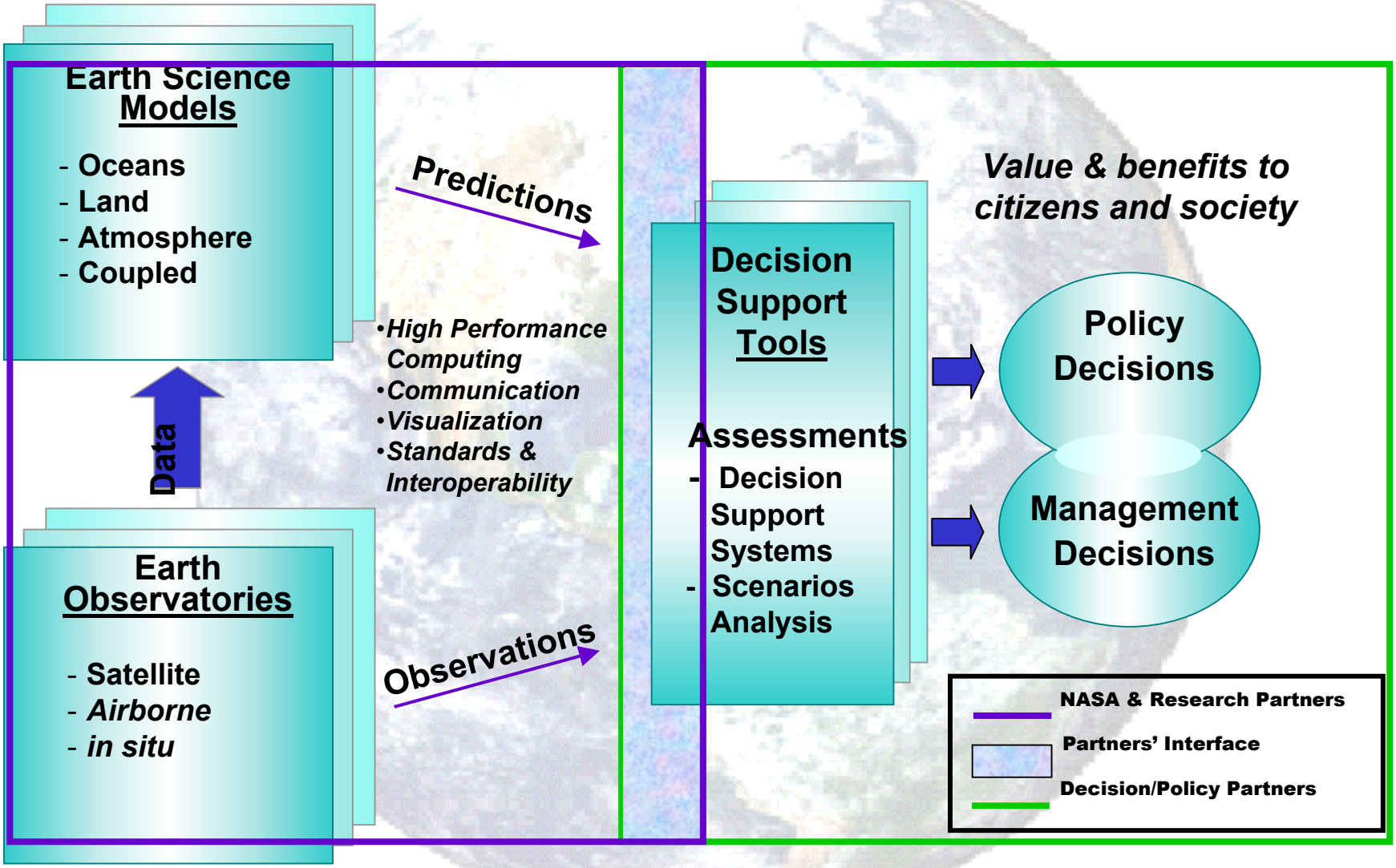
Synthesis Products

- A review of the understanding of the chemical composition and radiative forcing by tropospheric aerosols in the North Atlantic, North Pacific, and North Indian Ocean based on in-situ observations
- A review of the understanding of aerosol sources, distributions and radiative forcing derived from satellite remote-sensing of aerosols and radiation
- An update of the understanding of the radiative forcing due to background and aviation-induced cirrus
- A model comparison that includes a few critical tests against observations to take stock of and push forward our understanding of aerosol-climate interactions

Atmospheric Composition 2002-2003 Highlights

- Global aerosol measurements of distinct sources
- New techniques for aerosol measurements
- Scientific assessment of ozone-layer depletion
- Splitting of the 2002 Antarctic ozone hole
- Observations and modeling of Asian pollution outflow
- Effects of regional pollution on the global atmosphere
- Anthropogenic emissions in megacities
- Cirrus cloud study

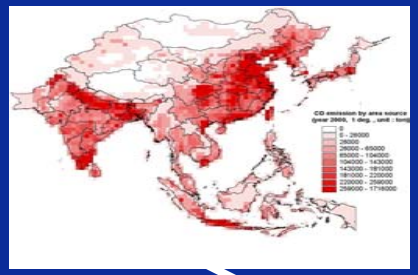
Integrated Systems Solutions: Science to Decision Support



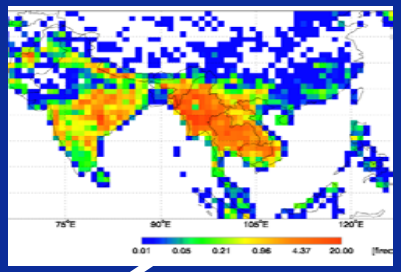
INTEGRATION OF TRACE-P, MOPITT, AND GEOS-CHEM TO QUANTIFY CARBON MONOXIDE SOURCES FROM ASIA

A PRIORI EMISSIONS (customized for TRACE-P)

Fossil and biofuel (bottom-up stats)



Daily biomass burning (satellite fire counts)



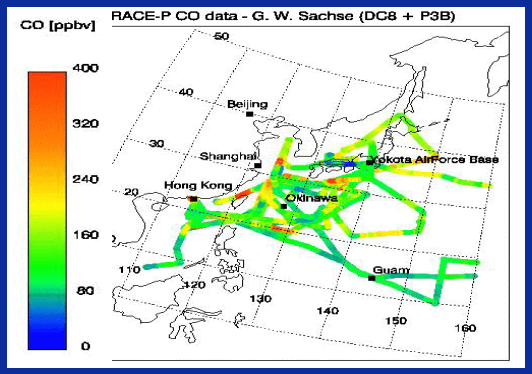
GEOS-CHEM CTM

chemical forecasts

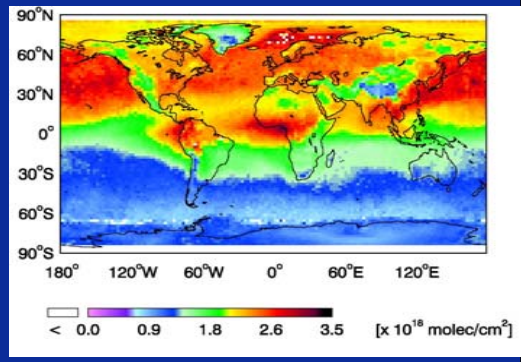
top-down constraints

INVERSE ANALYSIS

TRACE-P CO DATA



validation



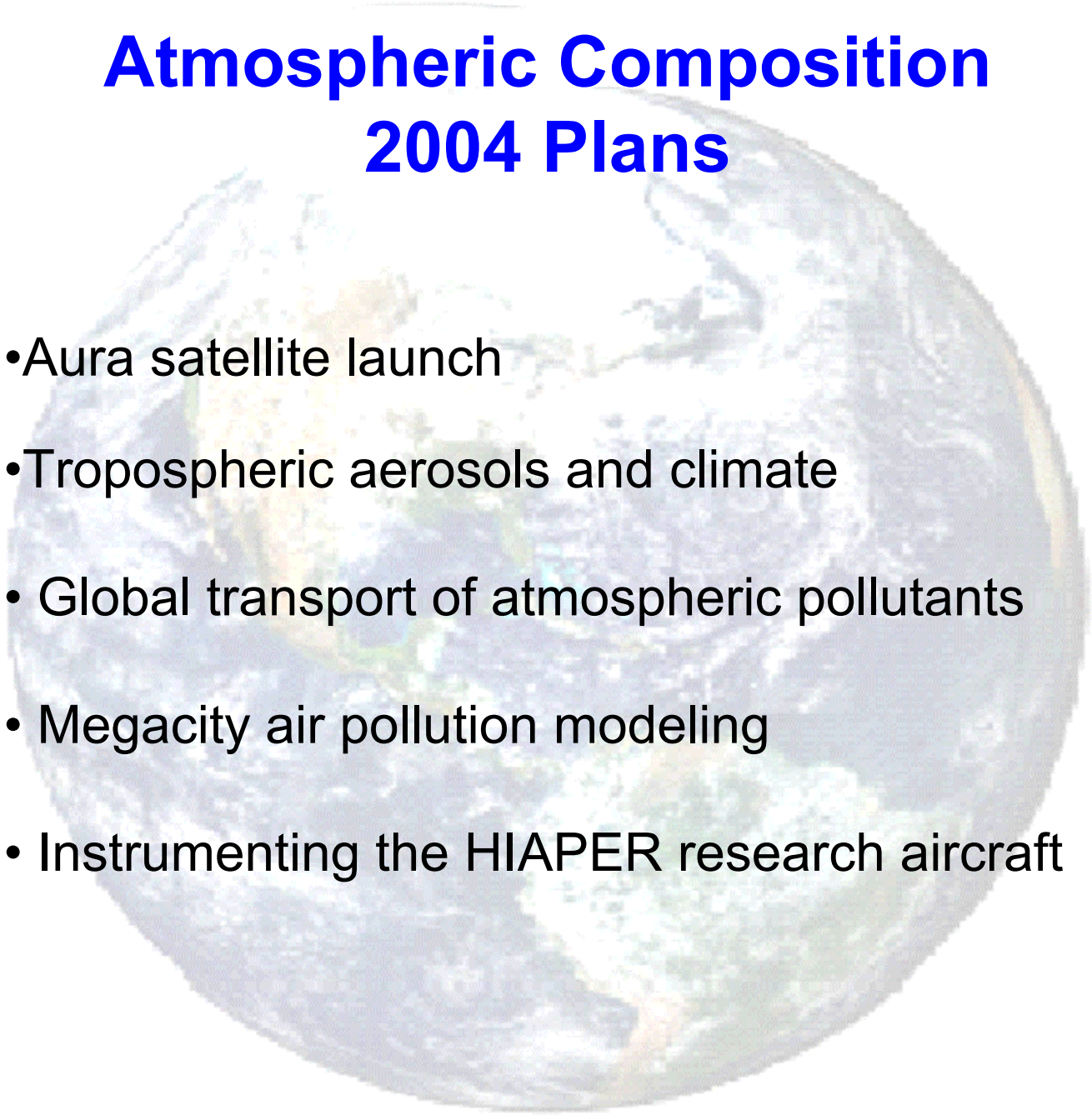
MOPITT CO March-April 2001

- **A priori Chinese emissions too low by 50% (domestic fuel)**
- **A priori SE Asian biomass burning emissions too high by 60%**
- **Japan, Korean emissions correct within 20%**

DECISION SUPPORT: improved estimates of

- **domestic fuel emissions (air pollution control policy)**
- **Asian carbon outflow (climate policy)**

Atmospheric Composition 2004 Plans



- Aura satellite launch
- Tropospheric aerosols and climate
- Global transport of atmospheric pollutants
- Megacity air pollution modeling
- Instrumenting the HIAPER research aircraft

Climate Variability and Change

Ming Ji
NOAA Office of Global Programs

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Climate Variability and Change Overarching Questions

How are climate variables that are important to human and natural systems affected by changes in the Earth system resulting from natural processes and human activities?

How can emerging scientific findings on climate variability and change be further developed and communicated in order to better serve societal needs?

Climate Variability and Change

Question 4.1: To what extent can uncertainties in model projections due to climate system feedbacks be reduced?

Question 4.2: How can predictions of climate variability and projections of climate change be improved, and what are the limits of their predictability?

Question 4.3: What is the likelihood of abrupt changes in the climate system such as the collapse of the ocean thermohaline circulation, inception of a decades-long mega-drought, or rapid melting of the major ice sheets?

Question 4.4: How are extreme events, such as droughts, floods, wildfires, heat waves, and hurricanes, related to climate variability and change?

Question 4.5: How can information on climate variability and change be most efficiently developed, integrated with non-climatic knowledge, and communicated in order to best serve societal needs?

CVC Research Priorities

- **Improving climate models**
- **Improving accuracy of predictions and credibility of projections**
- **Understanding the risk of abrupt change**
- **Attribution for extreme events**
- **Developing application products and services**

Highlights of Initial Multi-Agency Implementation

- Improving climate models
- Detection and Attribution
- Improving understanding on variability, change, and predictability

Highlights of Initial Multi-Agency Implementation (1)

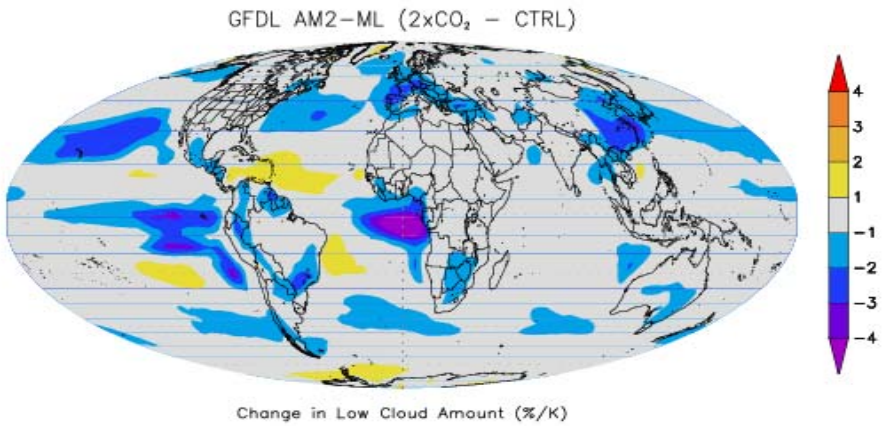
- **Improving climate models**
  - **Climate Process and Modeling Teams (CPTs)**
- Detection and Attribution
- Improving understanding on variability, change, and predictability

CPT Approach

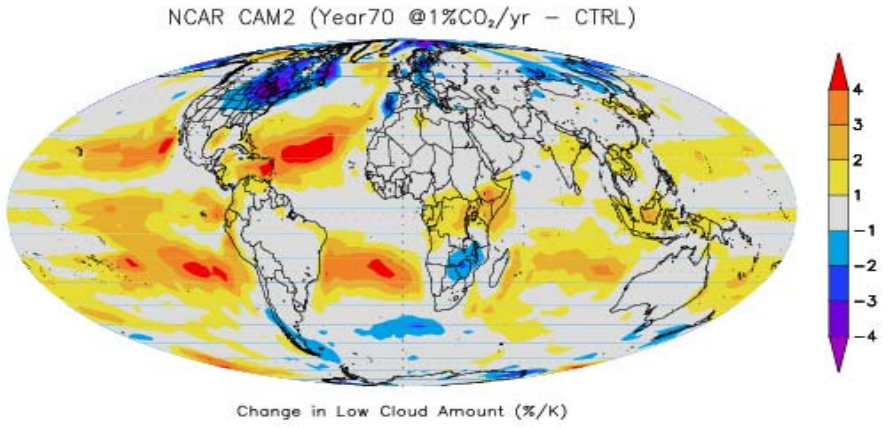
- Provide resources to small teams of observationalists, diagnostic scientists, process modelers, and (one or more) developers of climate models:
  - Focus on interaction & deliverables (not manuscripts) that lead to demonstrated improvement in climate models
  - Establish collaborative efforts between the research community and modeling centers
  - Encourage active long-term mechanisms
  - Management mechanisms (Institutional and programmatic commitment)

Cloud Feedback

GFDL: Positive cloud feedback



NCAR: Negative cloud feedback



NSF-NOAA Pilot Phase CPTs

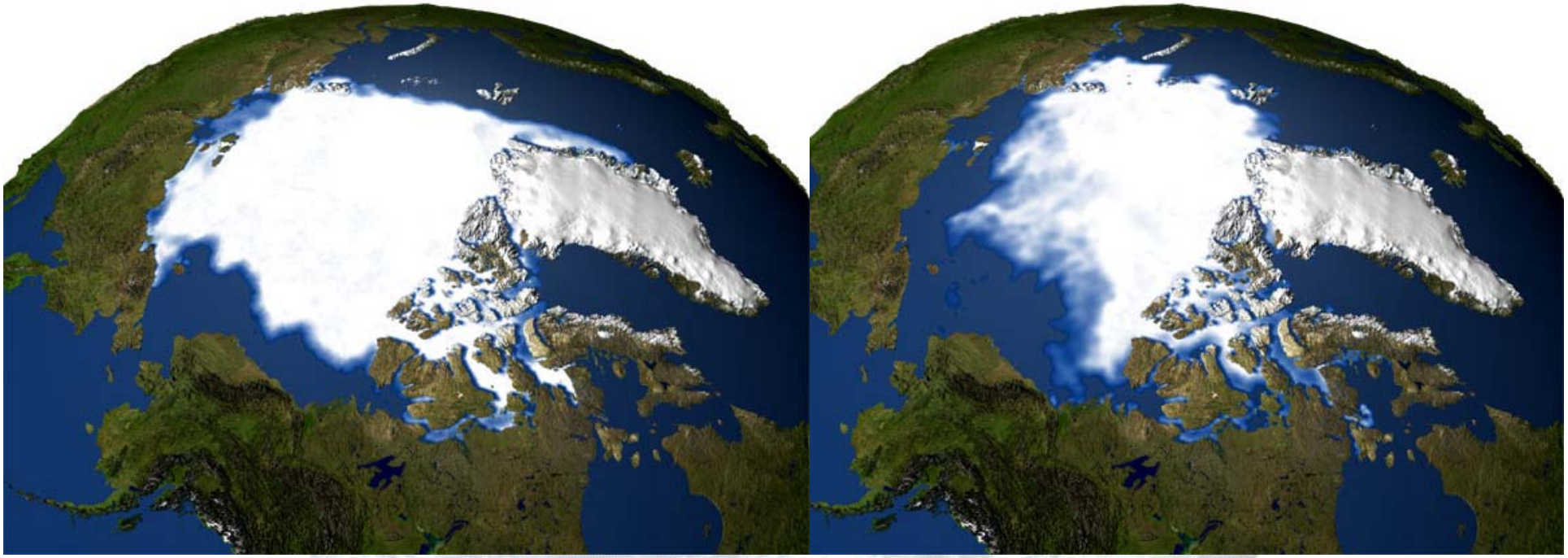
- **US CLIVAR developed concept and recommended scientific areas where rapid progress was likely**
- **Community and Interagency Planning**
  - **CCSM-GFDL workshop**
  - **CPT white paper**
  - **Tropical Bias workshop**
  - **Vetting with CCSM-SAB, CLIVAR-SSC/SSG, WCRP/JSC, NRC**
- **Joint NSF and NOAA announcement (2003: ~$2.5M per year) to address critical issues in IPCC class climate models**
- **Three Pilot CPTs established (2003) to demonstrate the concept:**
  - **Low-latitude cloud feedbacks on climate sensitivity**
  - **Ocean mixing in overflow regions (e.g. over steep topography)**
  - **Mesoscale eddy interaction with upper-ocean mixing**

Highlights of Initial Multi-Agency Implementation (2)

- Improving climate models
- **Attribution and Detection**
  - **Shrinking of perennial sea ice cover**
  - **Rate of 20th century sea level rise**
  - **Model simulations of late 20th century warming**
  - **Reconciling lower troposphere temperature trends**
- Improving understanding on variability, change, and predictability

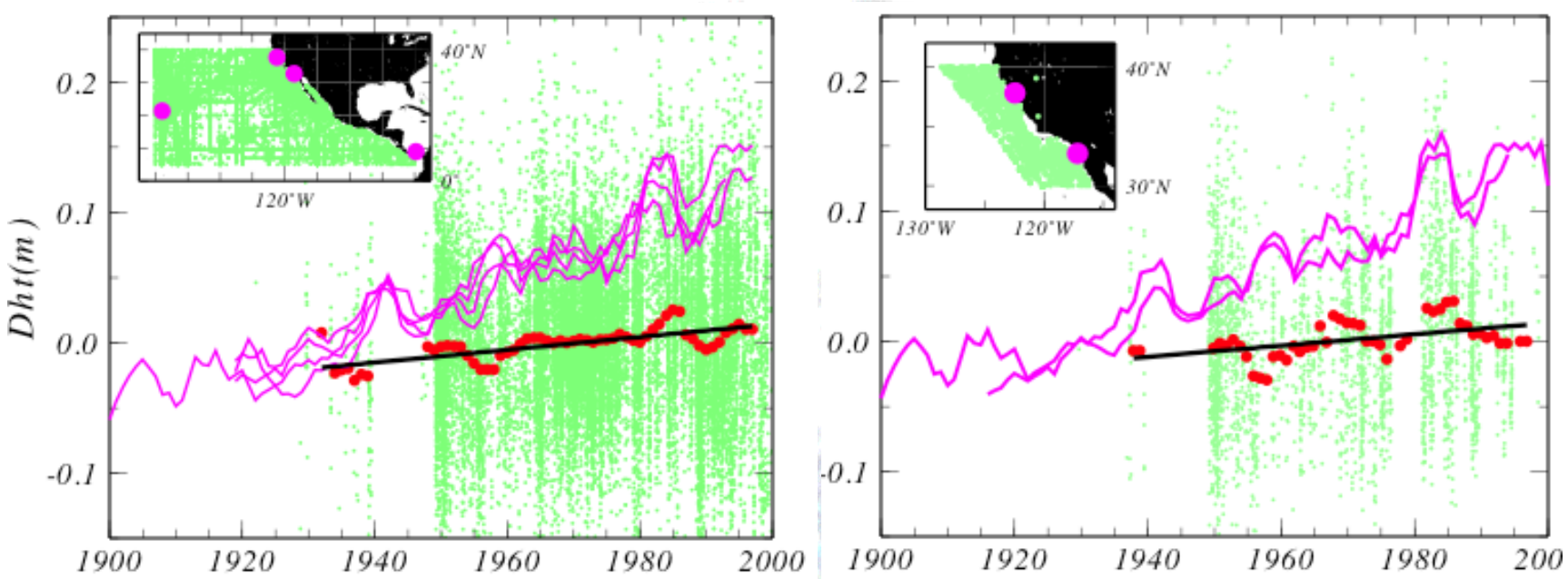
Shrinking of Perennial Sea Ice Cover

(NASA/GSFC)



1979 2003

Arctic perennial sea ice has been decreasing at a rate of 9% per decade. This is consistent with observed warming in the region. This rate is three times that of the reduction of total sea ice extent and is potentially more significant. (DMSP/SSMI)



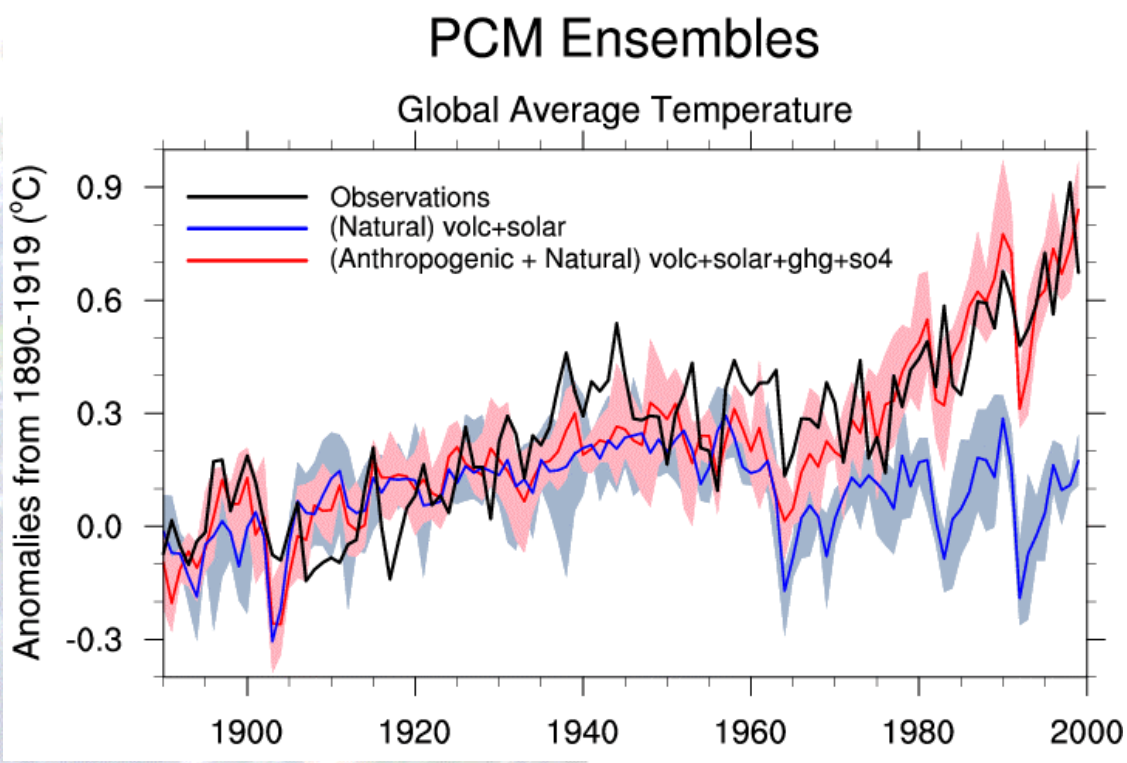
Left: **Eastern Pacific hydrographic profile observations of temperature and salinity converted into 1000 m dynamic height anomalies (green), their 5 year running means (red) and linear regression (black) compared with 5 year running mean relative sea levels from tide gauge observations at San Francisco, San Diego, Honolulu, and Balboa (purple).**

Right: **Hydrographic observations limited to 4400 km by 1100 km area adjacent to gauge sites at San Francisco and San Diego.**

Mass and Volume Contributions to 20th Century Global Sea Level Rise*, Miller and Douglas, *Nature

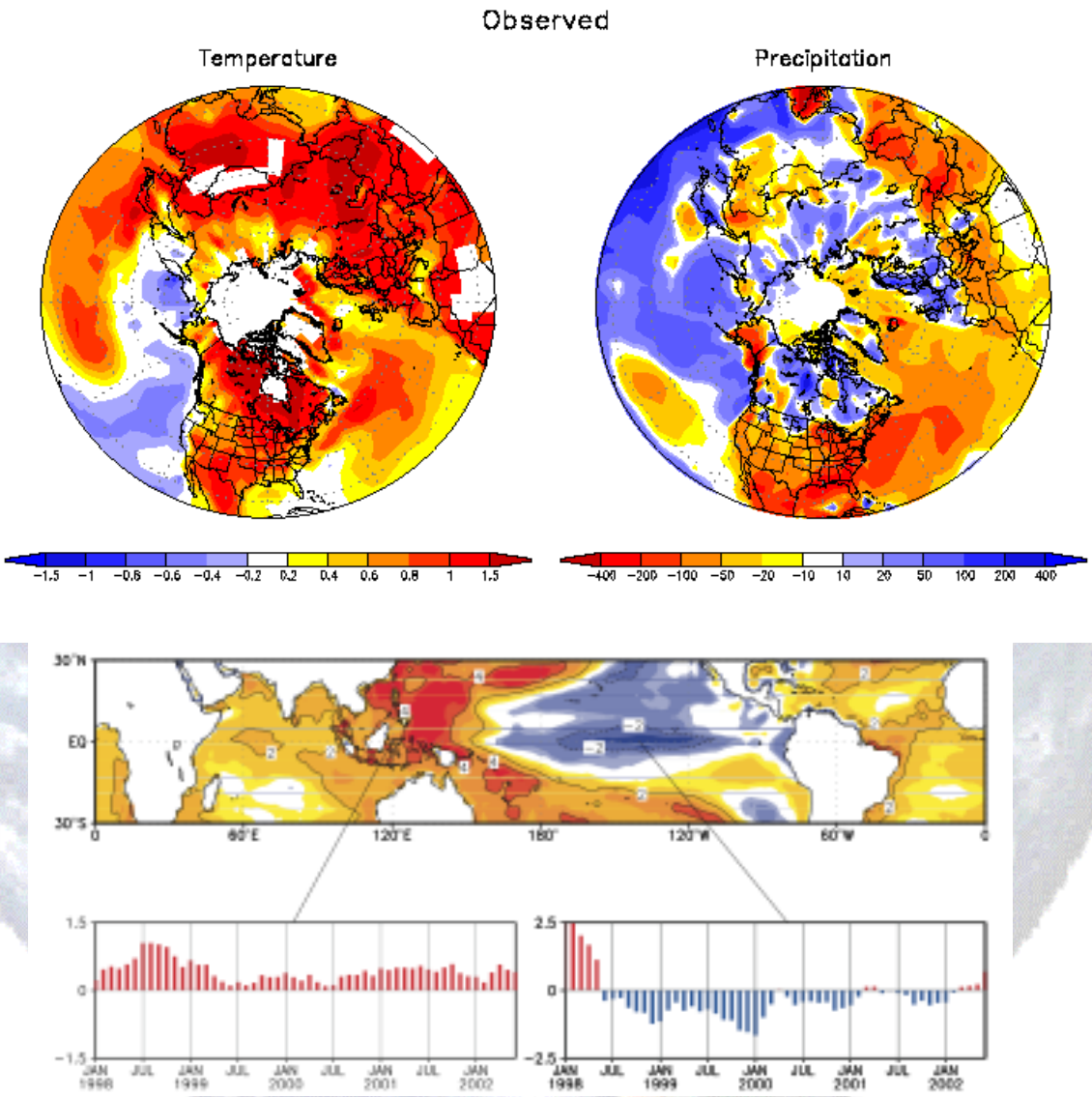
Natural forcings do not fully explain observed late 20th century warming

- **Climate models with only "natural" forcings (volcanic and solar) do not reproduce observed late 20th century warming**
- **When increases in anthropogenic greenhouse gases and sulfate aerosols are included, models are able to reproduce observed late 20th century warming**



Highlights of Initial Multi-Agency Implementation (3)

- Improving climate models
- Detection and Attribution
- **Improving understanding on variability, change, and predictability**
  - **Origins of recent severe droughts**
  - **Ongoing analysis of climate system (i.e., Reanalysis)**
  - **Intra-seasonal to interannual climate prediction products and services for resource management**
    - e.g., Fire Wx risks, Water resource management, Agriculture and Energy applications, National Drought Information System

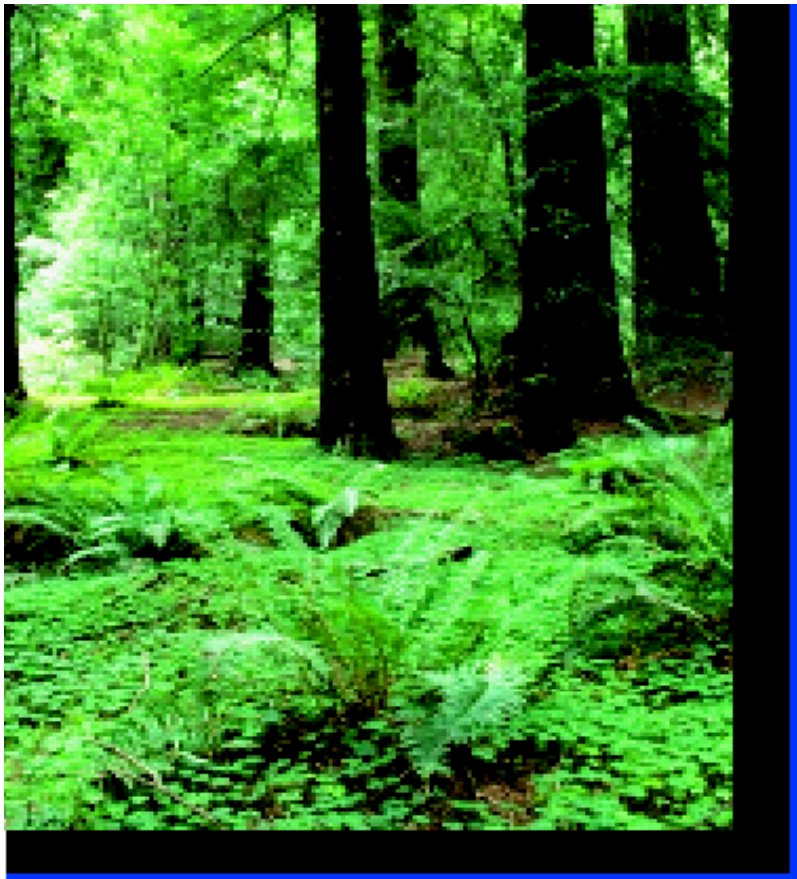


The Perfect Ocean for Drought*, Hoerling and Kumar, *Science

Carbon Cycle

Nancy Cavallaro
USDA

Carbon Cycle



Question 7.1: What are the magnitudes and distributions of North American carbon sources and sinks on seasonal to centennial time scales, and what are the processes controlling their dynamics?

Question 7.2: What are the magnitudes and distributions of ocean carbon sources and sinks on seasonal to centennial time scales, and what are the processes controlling their dynamics?

Question 7.3: What are the effects on carbon sources and sinks of past, present, and future land-use change and resource management practices at local, regional, and global scales?

Question 7.4: How do global terrestrial, oceanic, and atmospheric carbon sources and sinks change on seasonal to centennial time scales, and how can this knowledge be integrated to quantify and explain annual global carbon budgets?

Question 7.5: What will be the future atmospheric concentrations of carbon dioxide, methane, and other carbon-containing greenhouse gases, and how will terrestrial and marine carbon sources and sinks change in the future?

Question 7.6: How will the Earth system, and its different components, respond to various options for managing carbon in the environment, and what scientific information is needed for evaluating these options?

Carbon Cycle
2002-2003 Highlights

- Documented continuing increases in atmospheric greenhouse gases
  - •CO_2 accounts for >60% of calculated radiative forcing

- AmeriFlux measures terrestrial carbon sinks
  - •NEE of 2-4 t/ha for forests, ~1 for crops & grasslands

- Climate-driven increases in terrestrial productivity
  - •Increases attributed to increased T, solar radiation, changes in rainfall

- Conservation Reserve Program (CRP) Lands are Removing Greenhouse Gases from Atmosphere
  - •~1 t C/ha sequestered into soil/yr

Carbon Cycle
2002-2003 Highlights

- Ocean Color Calibration Refinement Improves Carbon Estimates
  - Global mean chlorophyll concentration estimates reduced
- Carbon On-Line Estimation (COLE)
  - A new computer tool for forest carbon estimates
- NACP PI meeting
  - Evaluate and make suggestions for science and implementation plans

Carbon Cycle
2004 Plans

- North American Carbon Program (NACP)
  - Flux and atmospheric CO_2 concentration measurements at selected AmeriFlux and AgriFlux sites
  - Atmospheric profiling and flux measurements by aircraft and tall (500 m) towers
  - Air-sea CO_2 exchange measurements in the North Atlantic and North Pacific Oceans
  - New Earth Observing System satellite data products
- Carbon storage by crop and range lands
- Carbon cycle modeling
- Greenhouse Gas Accounting Rules and Guidelines for Forest Systems and Agricultural Soils

Water Cycle

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NASA Office of Earth Science

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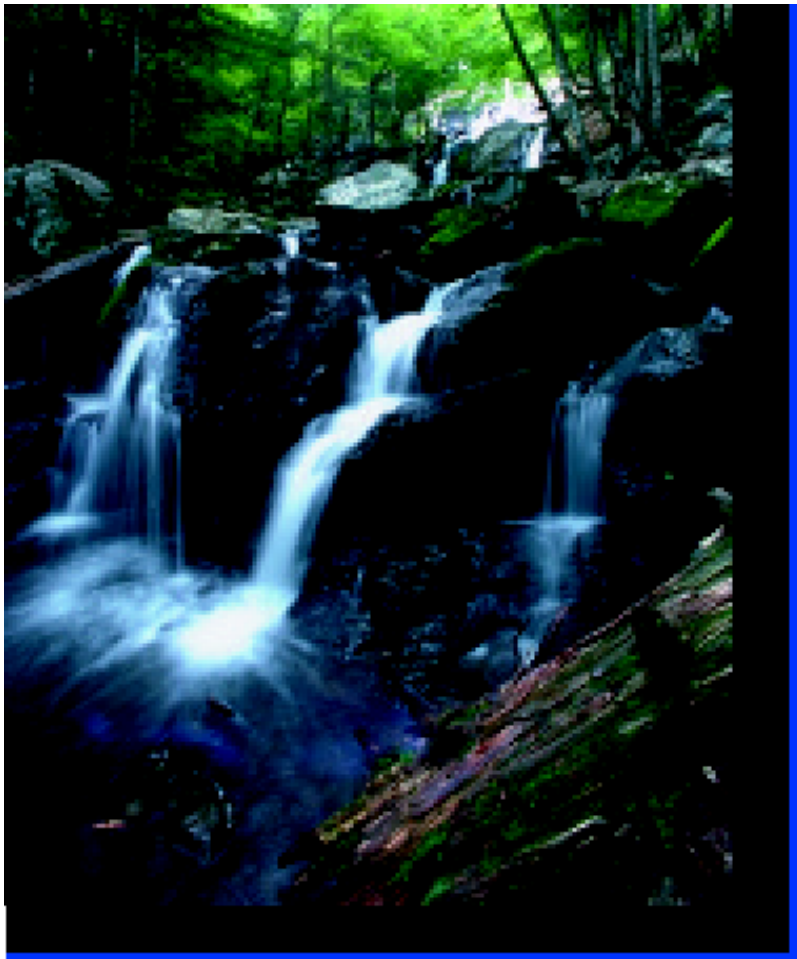
Global Water Cycle
Overarching Questions

How does water cycle variability and change caused by internal processes, climate feedbacks, and human activities influence the distribution of water within the Earth system, and to what extent is this variability and change predictable?

What are the potential consequences of global water cycle variability and change for society and the environment, and how can knowledge of this variability and change improve decisions dependent on the water cycle?

Global Water Cycle



Question 5.1: What are the mechanisms and processes responsible for the maintenance and variability of the water cycle; are the characteristics of the cycle changing and, if so, to what extent are human activities responsible for those changes?

Question 5.2: How do feedback processes control the interactions between the global water cycle and other parts of the climate system (e.g., carbon cycle, energy), and how are these feedbacks changing over time?

Question 5.3: What are the key uncertainties in seasonal-to-interannual predictions and long-term projections of water cycle variables, and what improvements are needed in global and regional models to reduce these uncertainties?

Question 5.4: What are the consequences over a range of space and time scales of water cycle variability and change for human societies and ecosystems, and how do they interact with the Earth system to affect sediment transport and nutrient and biogeochemical cycles?

Question 5.5: How can global water cycle information be used to inform decision processes in the context of changing water resource conditions and policies?

Global Water Cycle
2002-2003 Highlights

- Cloud feedback effects
- ICESat launched
- Enhanced sea ice observations
- Water cycle observation from space
- Water cycle-carbon cycle interactions
- Carbon export from land to ocean

Global Water Cycle
2002-2003 Highlights (continued)

- Modeling the global water and energy cycles and their regional components
- Prediction of warm season rain
- Evaluation of water cycle prediction products for decision support
- Support for climate model development
- Land data assimilation system (LDAS)

Global Water Cycle
2004 Plans

- Completion of regional reanalysis
- Initial integrated global observing system for water cycle variables
- Development of an experimental surface and subsurface moisture-monitoring product
- An experimental on-line decision support tool to provide users with a description of streamflow conditions
- Analysis of the hydrological impacts of global change on drinking water supplies and wastewater treatment
- Development of an integrated hydrologic data model

Observations and Data Management

Robert F. Cahalan
CCSPO and
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Radiation Branch

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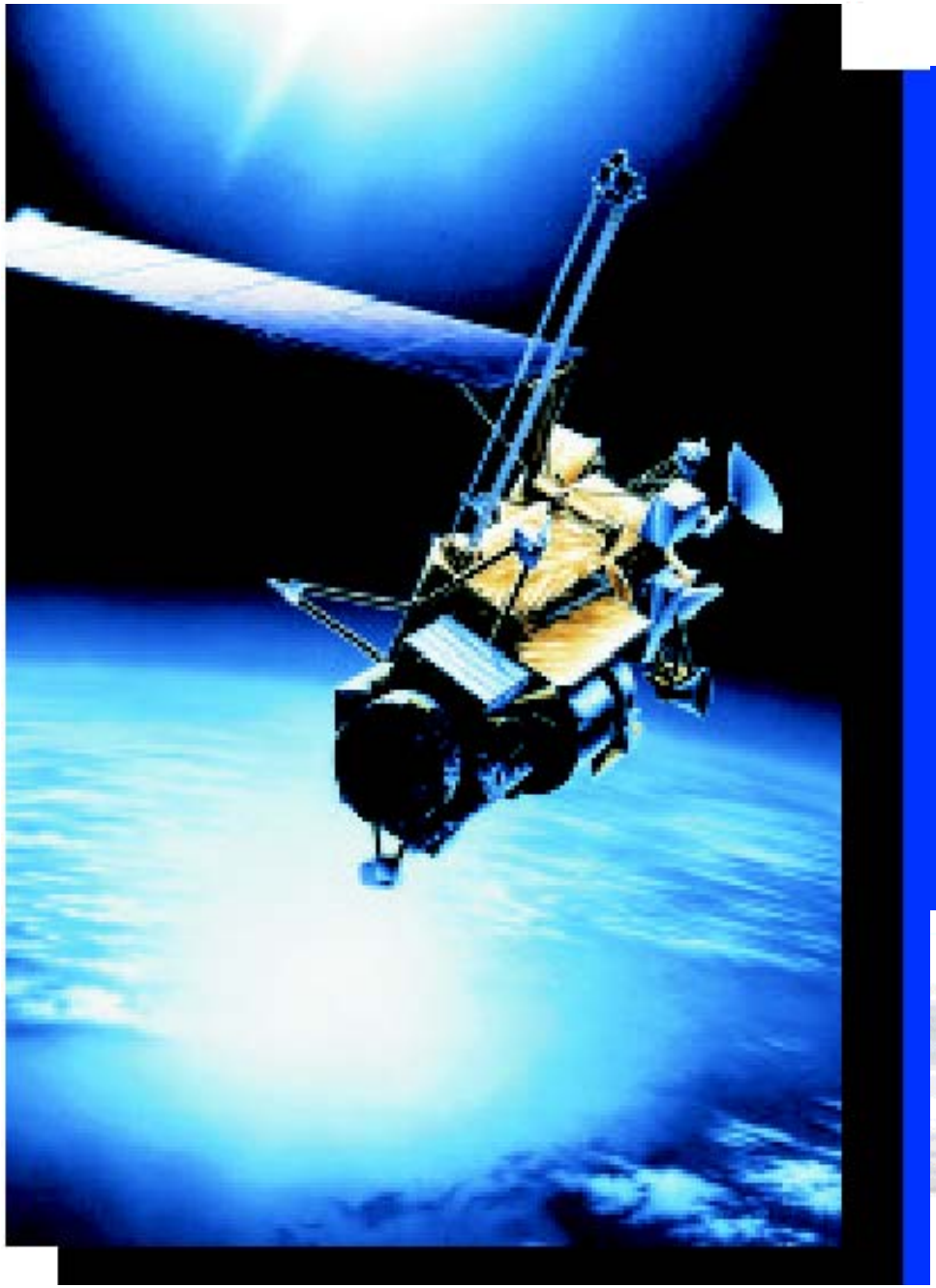
www.climatescience.gov

CCSP Observation Strategy



Goal 1: Design, develop, deploy, integrate, and sustain observation components into a comprehensive system.

Goal 2: Accelerate the development and deployment of observing and monitoring elements needed for decision support.

Goal 3: Provide stewardship of the observing system.

Goal 4: Integrate modeling activities with the observing system.

Goal 5: Foster international cooperation to develop a complete global observing system.

Goal 6: Manage the observing system with an effective interagency structure.

CCSP Observations *Challenge*

How can we provide active stewardship for an observation system that will

- *document the evolving state of the climate system,*
- *allow for improved understanding of its changes,and*
- *contribute to improved predictive capability for society*

?

Strategy for Achieving an Integrated Observing System

Base requirements on *science*, and 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

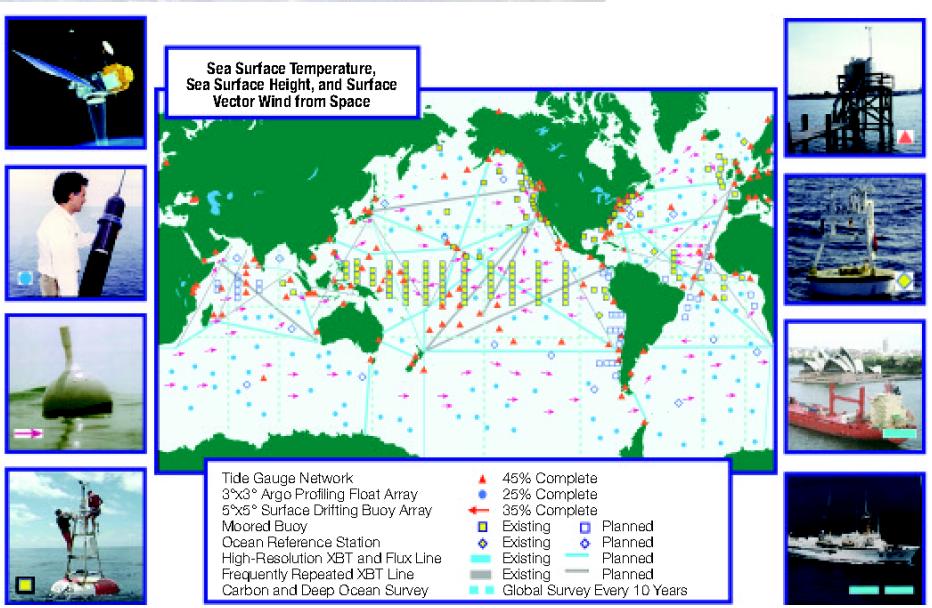
Stabilize and extend observing capabilities

- 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

Accelerate deployment of decision support tools

- Associated with near-term CCRI priorities and goals

Encourage international cooperation



Initial Implementation Steps

- **Consider how to**
  - *Maintain & Build* on current successes ?
  - *Design* a comprehensive, coordinated and sustained Earth observing system ?
  - *Organize and Coordinate* participation ?
  - *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)
- **Initiate** year-long development of a *decadal plan* for Earth observation, with
  - US participation led by the NOAA Administrator
- **Will Address**: Requirements, Inventory, Data Model, Gap Analysis, Innovation, Cost Alternatives, Mobilizing Resources

Data Management and Information

Goal 1: Collect and manage data in multiple locations.

Goal 2: Enable users to discover and access data and information via the Internet.

Goal 3: Develop integrated information data products for scientists and decisionmakers.

Goal 4: Preserve data.

Data Management and Information *Challenge*

How to provide seamless, platform-independent, timely, and open access to integrated data, products, information, and tools with sufficient accuracy and precision to address climate and associated global changes

?

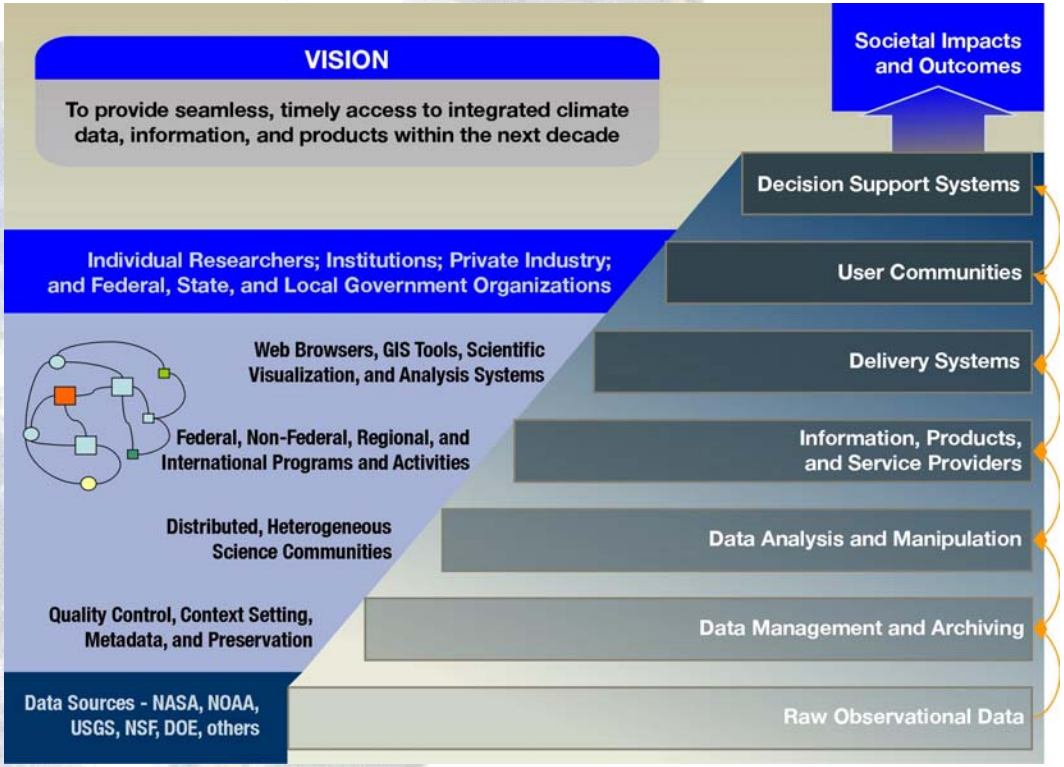
Guiding principles for CCSP Data Management plan

- The measure of success will be the ability of scientists and decisionmakers to access “integrated” data and information in a consistent and easily accessed format
- The value added will be *integration*—many types of climate data from different suppliers will be available in a manner consistent with user requirements.
- The methods used by data suppliers to deliver data to their “customers” will evolve with new technology.
- It will be easy for users to discover and access data.
- The system will be responsive to user feedback.
- The system will preserve irreplaceable data.
- There will be an open design and open standards process.
- Operations will be reliable, sustained, and efficient

Continuing efforts in data management

The CCSP continues to advocate nationally and internationally for:

- **Full, open, and timely sharing of data**
- Archiving of data in such a way as to allow easy access
- **National and International standards**
- Lowest possible cost



CCSP Decision Support Resource Development

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www.climatescience.gov

Motivation for "Decision Support"

- The USGCRP is directed to "produce information readily usable by policymakers…," and to undertake periodic assessments

  Global Change Research Act (1990)

- The President called for development of decision support resources in June 2001
  - "…the National Academy of Sciences study also recommends, 'research that couples physical, chemical, biological and human systems; improved capability of integrating scientific knowledge, including its uncertainty, into effective decision support systems; and an ability to conduct research at the regional or sectoral level that promotes analysis of the response of human and natural systems to multiple stresses.'"

  White House document accompanying the President's June 11, 2001 Statement on Climate Change

Three Objectives for Decision Support Resources Development

The Role of Decision Support

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

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.

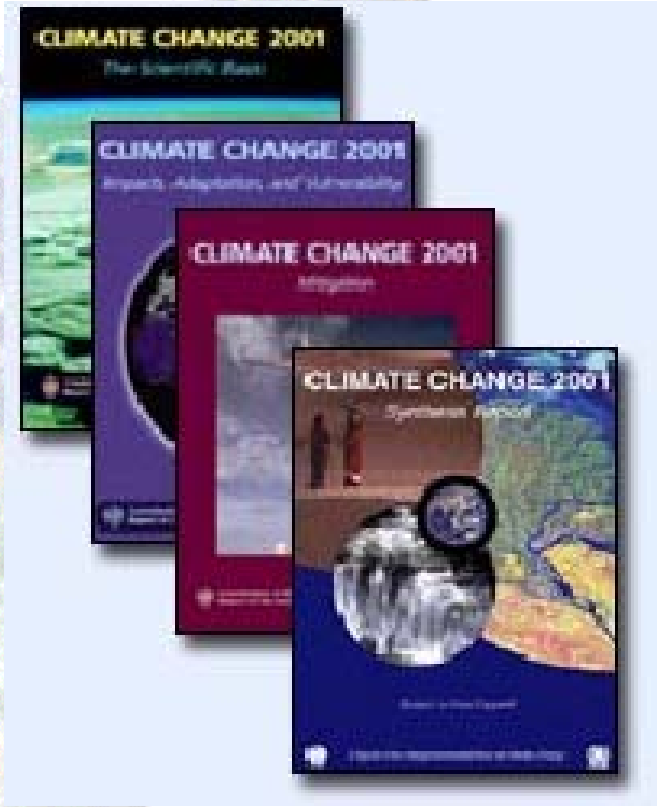
Goal 3: Develop and evaluate methods (scenario evaluations, integrated analyses, alternative analytical approaches) to support climate change policymaking and demonstrate these methods with case studies.

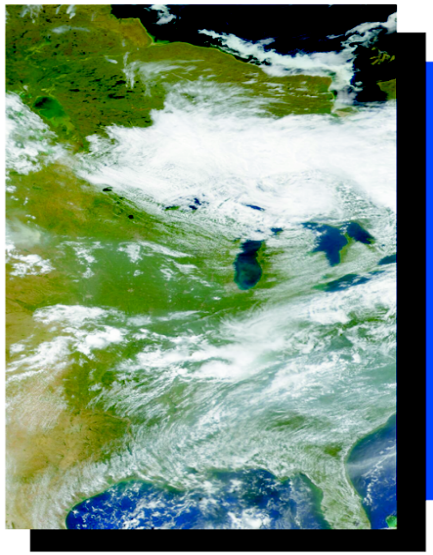
General Principles for Decision Support

- 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

Decision Support Objective 1: Synthesis and Assessment Products

- Continued participation in international assessments
- Preparation of approximately 20 synthesis and assessment products related to the 5 CCSP goals

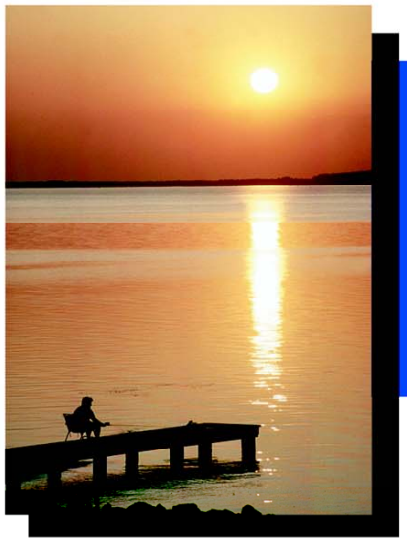




GOAL 1

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

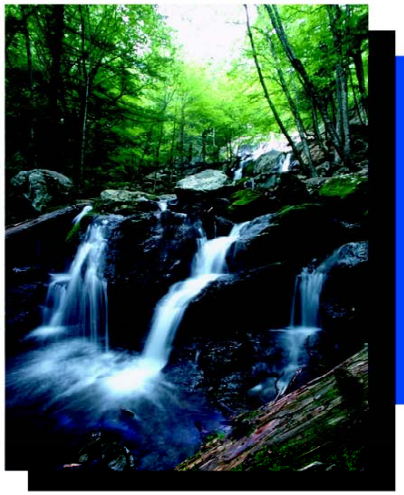
Improve quantification of the forces bringing about changes in the Earth's climate and related systems.

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_2 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.

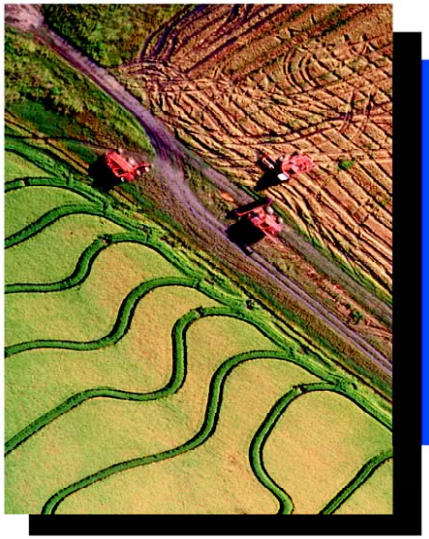
TOPICS FOR PRIORITY CCSP SYNTHESIS PRODUCTS	SIGNIFICANCE	COMPLETION
Climate models and their uses and limitations, including sensitivity, feedbacks, and uncertainty analysis.	Clarifying the uses and limitations of climate models at different spatial and temporal scales will contribute to appropriate 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

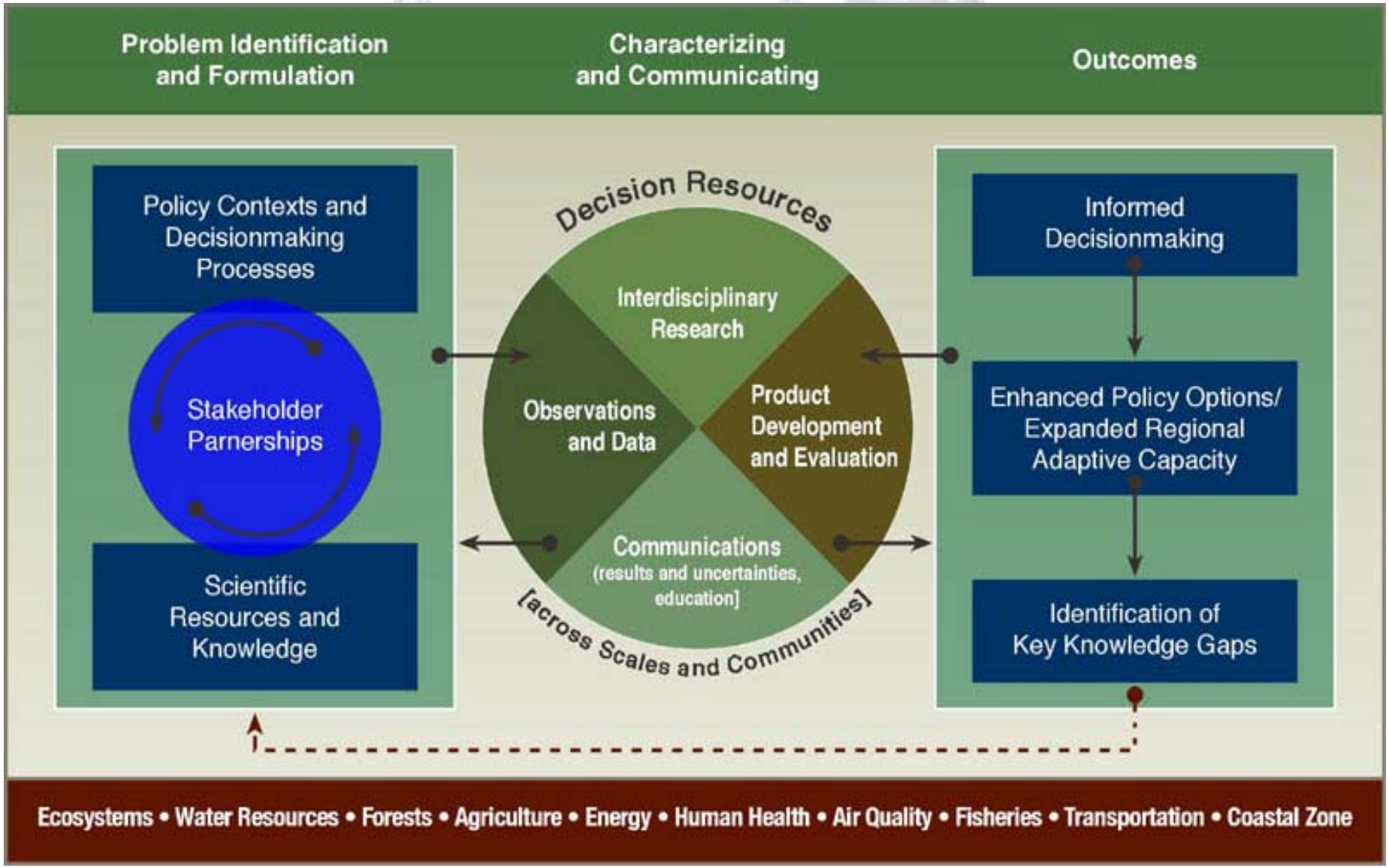
Common Misconceptions

- CCSP is promising “final” answers to questions that require long-term research
  - NO. Long-term nature is acknowledged. Products will provide updates on important and/or rapidly evolving scientific issues
- CCSP is competing with IPCC or other processes
  - CCSP products will focus on key sub-issues in phase 1 or follow-up with greater detail in phase 2 than is possible in the international assessments
- CCSP “approval” of science
  - Products will includes technical documents and policy summaries; open review process

Decision Support Objective 2: Support Adaptive Management and Planning

- Extend current and develop additional decision support resources
  - Crop and agricultural management
  - Water management (snowpack, precip, streamflow)
  - Fire management
  - Emergency preparedness (e.g., ENSO forecasts)
  - Urban and transportation planning/management
  - Environmental management (e.g., air quality)
  - …
- Learn by doing
- Interactions with stakeholders key
- Promote transition of resources from research to operations

Decision Support Framework



Decision Support Objective 3: Develop Resources for Policymaking

- Integrated frameworks for “if…, then…” analysis
- Limited number of evaluations as case studies in cooperation with CCTP
- Example: Technology scenario case study

Decision Support Status

- IPCC lead author nominations from U.S. under development
- Guidelines for preparation of Synthesis and Assessment Products to be released for public review
- Work beginning on specific CCSP deliverables
- Decision support management structure in process
- Workshop in planning stages

Overall CCSP Summary

- CCSP builds on input from science community provided over the last decade
- CCSP emphasizes development of useful information throughout the program
- Agencies are rapidly moving beyond planning to implementation in their own programs and in coordinated activities through the science working groups and cross-cutting activities
- CCSP is coordinating with other national and international activities

For Further Information

- Copies of the Strategic Plan are available on CD at the agency booths and in the meeting room!
- Climate Change Science Program
  - http://www.climatescience.gov
- US Global Change Research Program
  - *Our Changing Planet* annual report
  - http://www.usgcrp.gov
- Global Change Research Information Office
  - http://www.gcrio.org
- Intergovernmental Panel on Climate Change
  - http://www.ipcc.ch