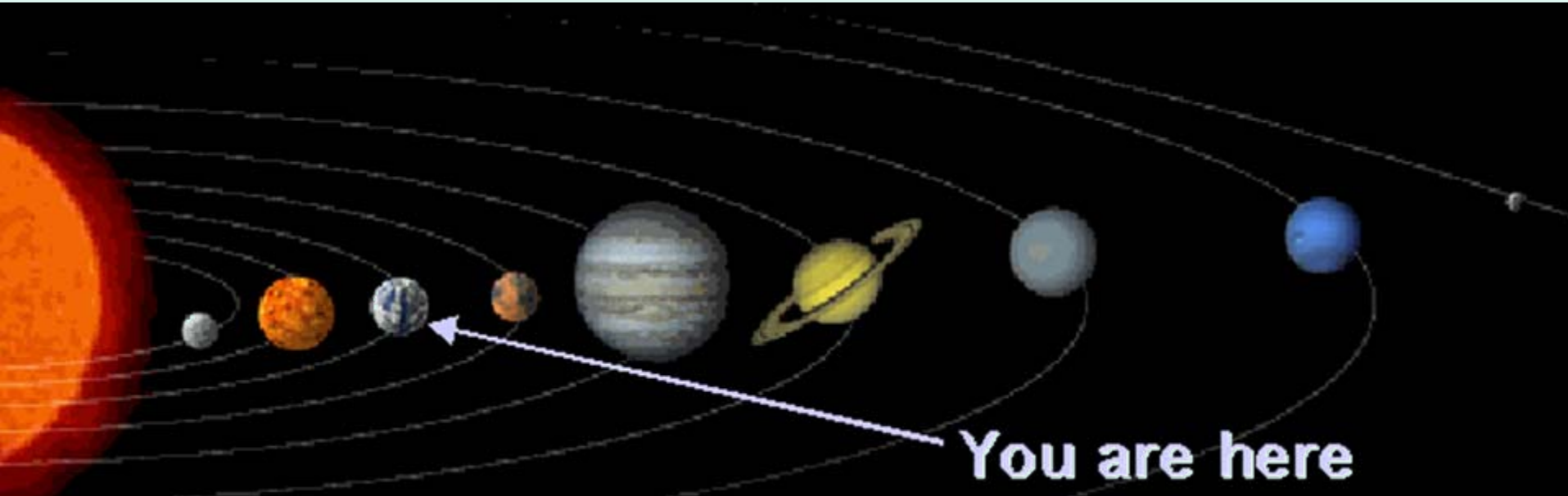
Research Needs of the Federal Government: A Perspective from the White House

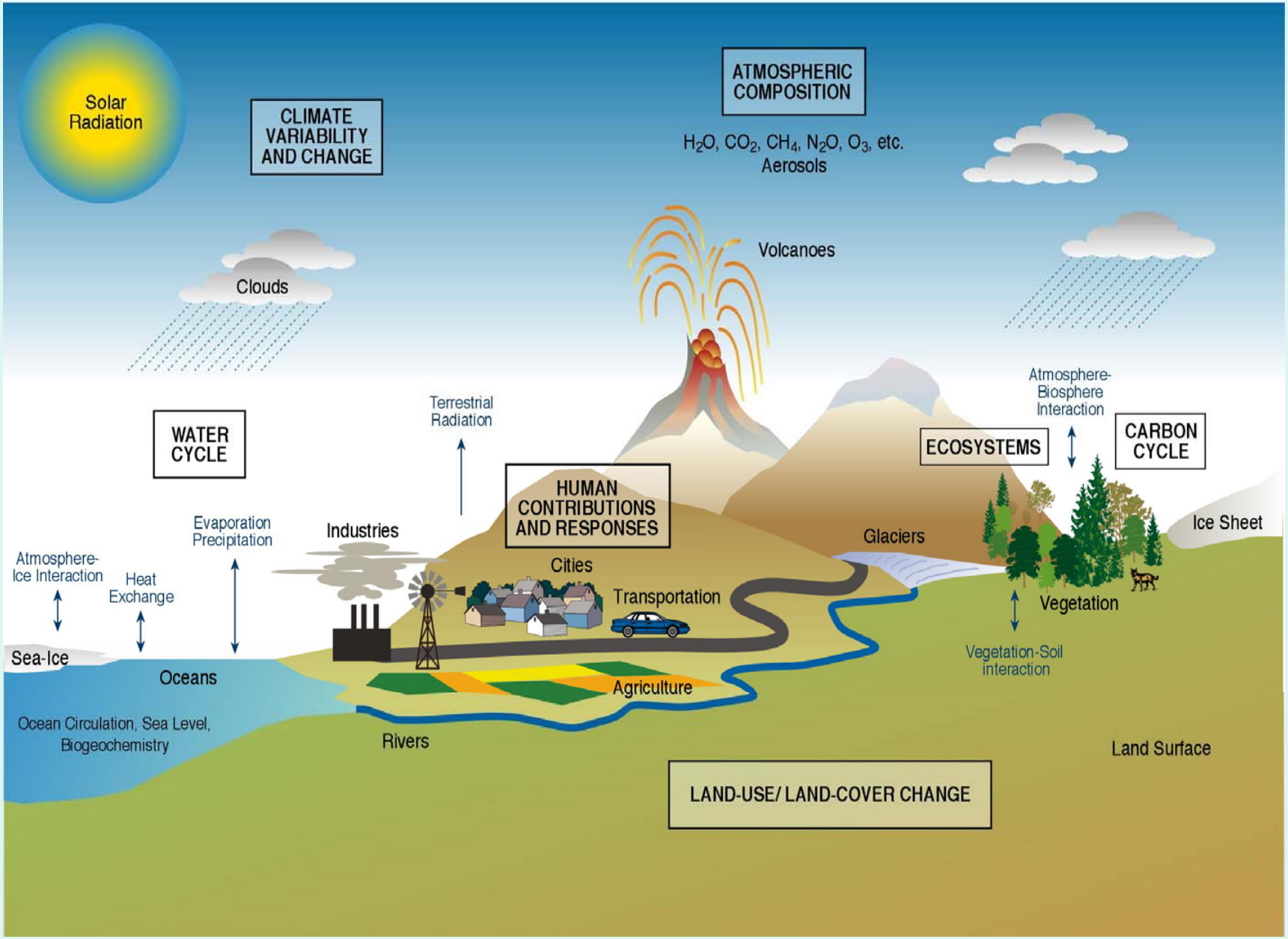
Dr. Teresa Fryberger
Assistant Director for Environment
Office of Science and Technology Policy
June 21, 2005



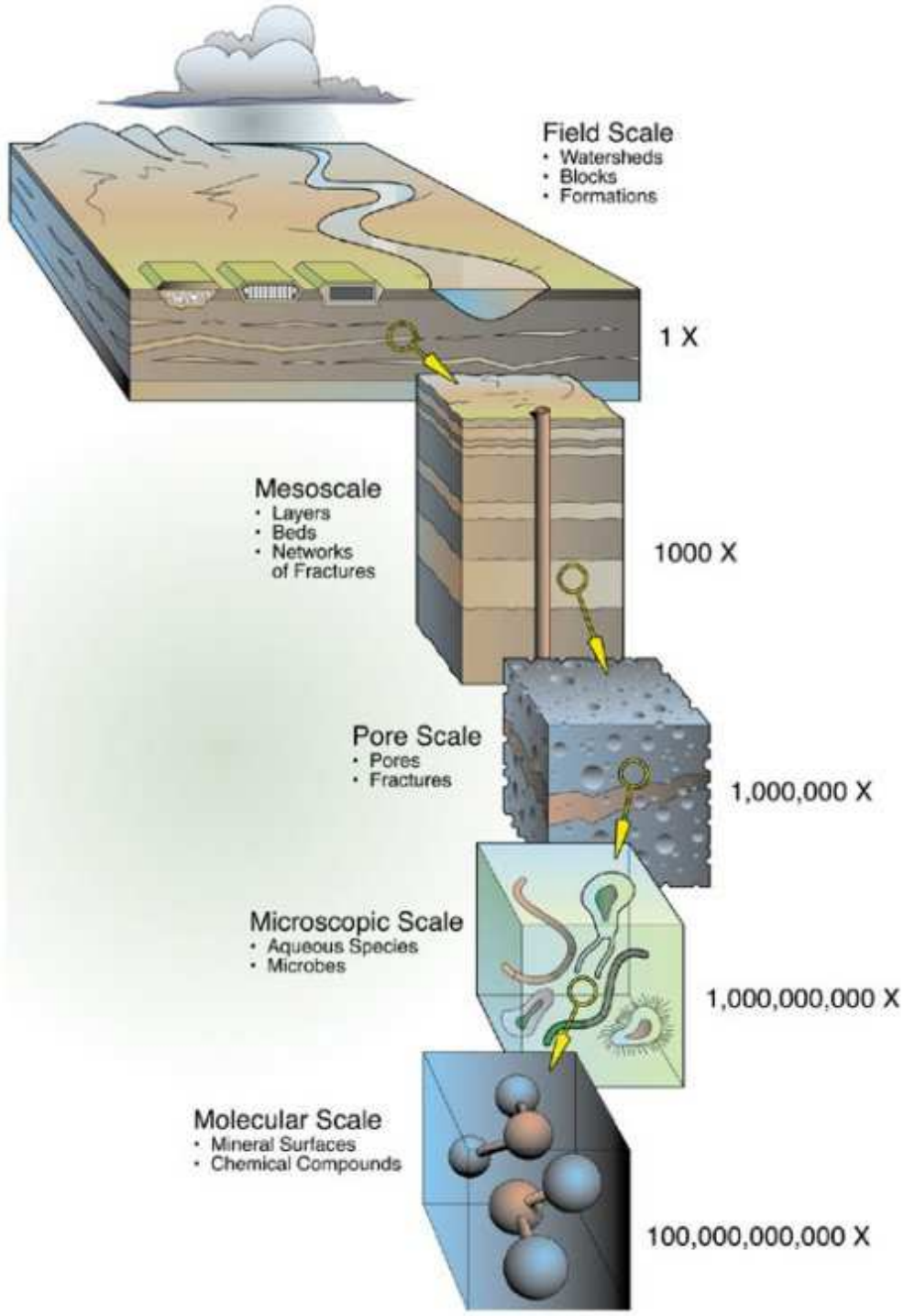
Contents

- Some general remarks
- Federal R&D Priorities
  - How does it work?
  - What does OSTP do?
- Examples
  - Global Earth Observations
  - Water Resources and Quality
  - Ecological Systems
  - Collections

Environment
is
Global



Environment is complex.



Environment is Complex

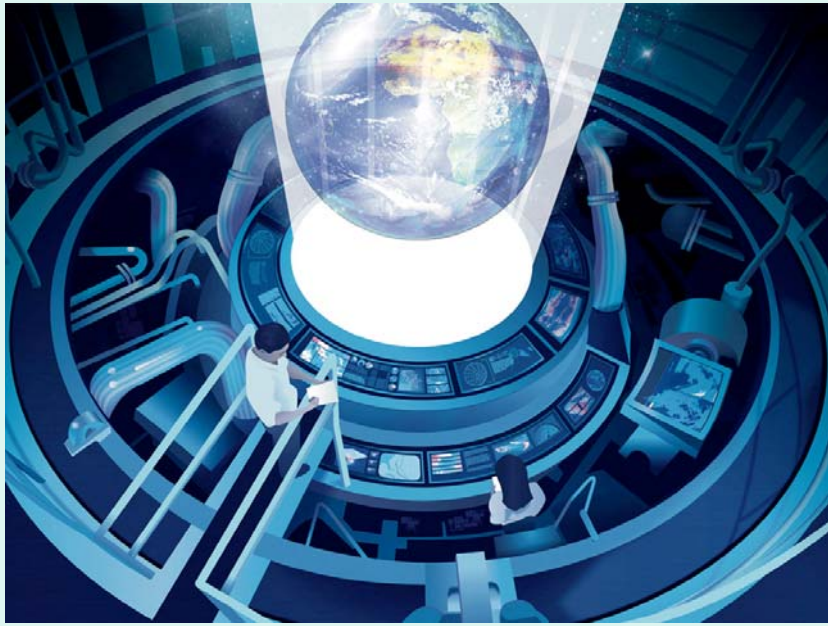
- Contaminants are often in complex mixtures of multiple fluids, multiple phases, and multiple reactive components
- Physically and chemically heterogeneous subsurface materials
- Complex interaction of multiple physical, chemical, and biological processes
- Limited characterization of field scale model parameters: uncertainty in properties parameters, boundary conditions
- *Scaling, scaling, scaling!!*

Environmental Sciences are Undergoing a Revolution….

Advances in Imaging Technology
Metal-reducing bacterium *Shewanella putrefaciens* on hematite (Fe_2O_3)

Advanced Tools

- Microscopy
- Supercomputing
- Synchrotron radiation
- Neutron Sources
- High field NMR
- Genomics
- Remote sensing...



....from the molecular to the global level

Earth Science and Society

The interaction of human activity with natural systems is a web of complex interactive and interdependent processes. If people or nature tugs on one part of the web, other parts of the web change, sometimes in unintended and unpredictable ways.

What can we hope to do?

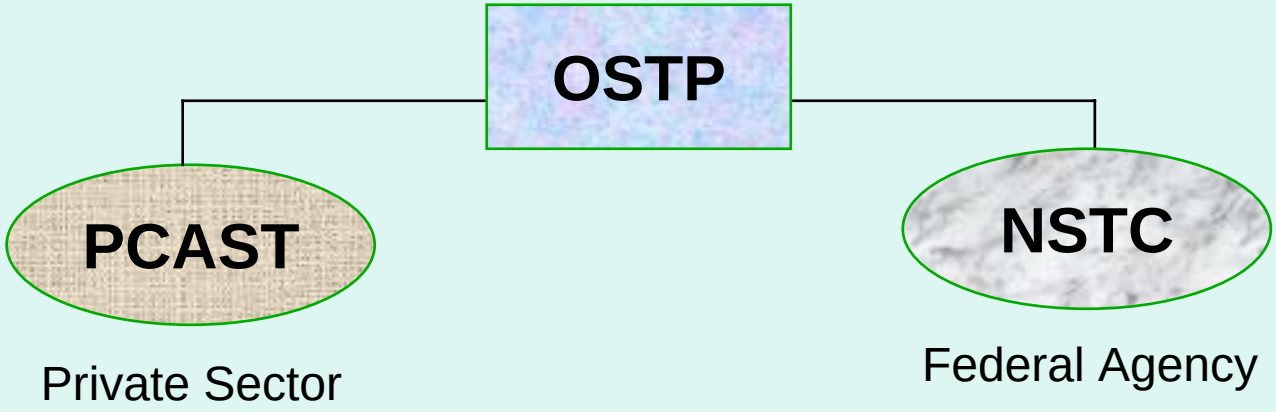
- Understand processes and their relationships
- Predict cause-effect relationships among processes
- Develop science-based strategies for avoiding and mitigating environmental damage and unintended consequences
- Communicate complex options to decision-makers

What are we doing in DC?

Role of White House Office of Science & Technology Policy (OSTP)

- Advise the President & Offices of the President
- ***Lead the interagency effort to develop S&T policies and budgets for all areas of science***
- Build strong partnerships among federal, state and local governments, other countries, industry, academia & scientific associations
- Develop clear, measurable goals and objectives for R&D programs
- Assess Federal investments relative to purposes of government

A Multi-Pronged Approach



- Executive branch coordination of advice and priority development involving both private sector and Federal agencies
- PCAST: *Sustaining the Nation's Innovation Ecosystem*
- NSTC: *Science for the 21st Century*

The President

Office of Management and Budget

Office of Science and Technology Policy

Other Boards, Councils, etc.

NSTC: Coordination of Federal Policy

- A Cabinet-level council of advisers to the President on Science and Technology
- Principal means to coordinate science and technology matters within the Federal research and development enterprise
- Means to establish clear national goals for Federal science and technology investments

Current NSTC Structure

April 2005

NSTC
Director, OSTP

Committee on Environment & Natural Resources

WH: Kathie Olsen
DOC: Conrad Lautenbacher
EPA: TBD

- Global Change Research
- Air Quality Research
- Disaster Reduction
- Ecosystems
- Toxics & Risks
- Water Availability & Quality
- IWG Earth Observations

Committee on Science

WH: Kathie Olsen
NSF: Arden Bement
NIH: Elias Zerhouni

- Research Business Models
- Education & Workforce
- Aquacu
- Human
- Universe
- lant Genome
- IWG Dom. Animal Genomics
- IWG Prion Science
- IWG Trans-boarder Samples
- IWG Multinational Orgs*
- R&D Investment Criteria**

Committee on Technology

WH: Richar
DOC:

- ation
- ogy
- noscale Science, Engineering & Technology
- Advanced Technologies For Education & Training
- Manufacturing Research & Development

Committee on Homeland and National Security

WH: Shana Dale
DOD: Michael Wynne
DHS: Charles McQueary

- National Security R&D
- International*
- WMD Medical Countermeasures
- Standards

International

- IWG on Dioxin
- Oceans S & T
- Collections*
- Biotechnology
- Infrastructure
- Aeronautics S& T
- Social, Behavioral & Econ.
- Export Controls for S&T
- Health and the Environment

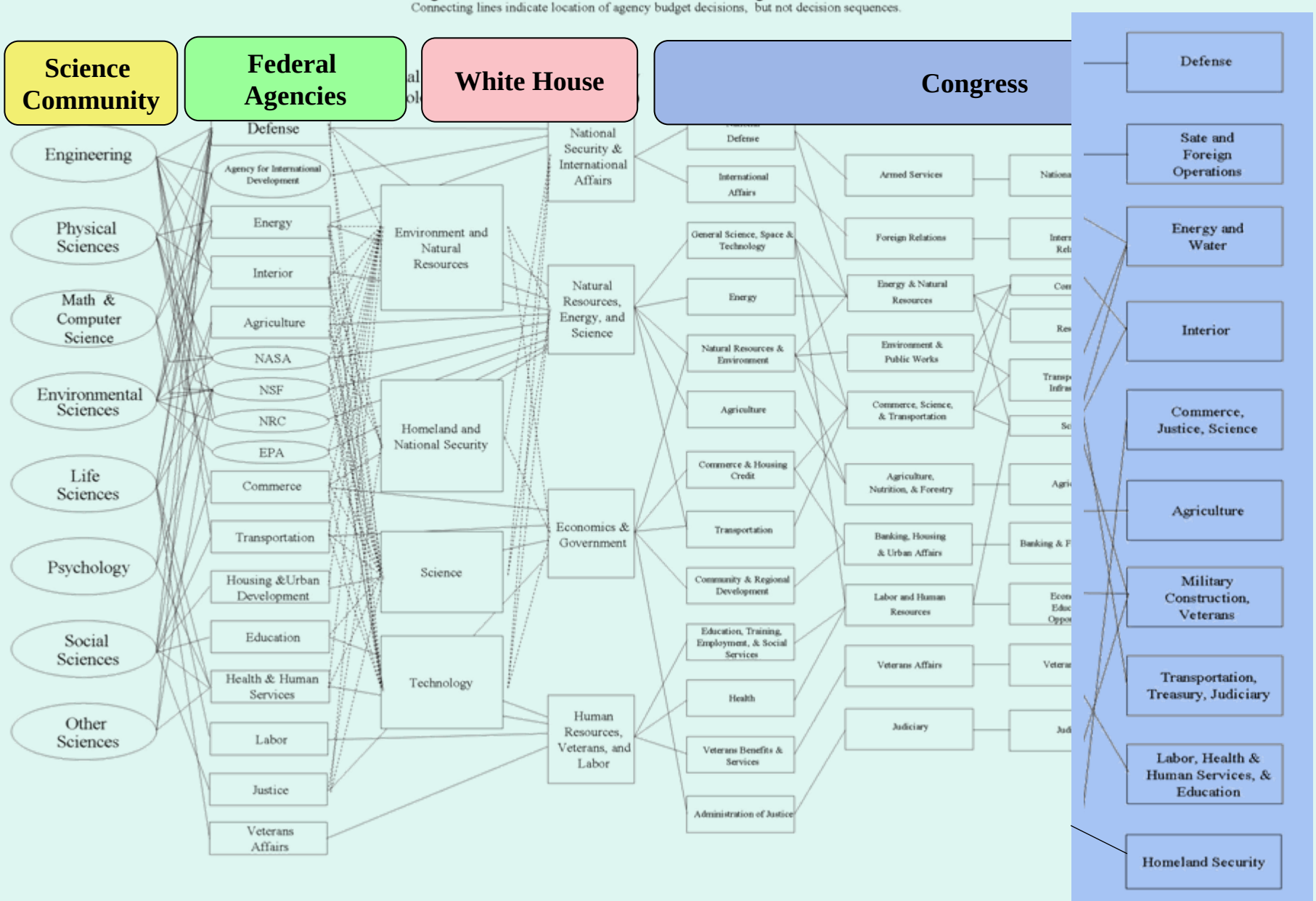
*in development
**Informal

Development of the Federal R&D Budget

Showing Fields of Science and Executive and Legislative Decision Units

Connecting lines indicate location of agency budget decisions, but not decision sequences.

Appropriations Reorganization for 109th Congress



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M-05-18

July 8, 2005

MEMORANDUM FOR THE HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES

FROM: JOHN H. MARBURGER, III
DIRECTOR, OFFICE OF SCIENCE AND TECHNOLOGY POLICY

JOSHUA B. BOLTEN
DIRECTOR, OFFICE OF MANAGEMENT AND BUDGET

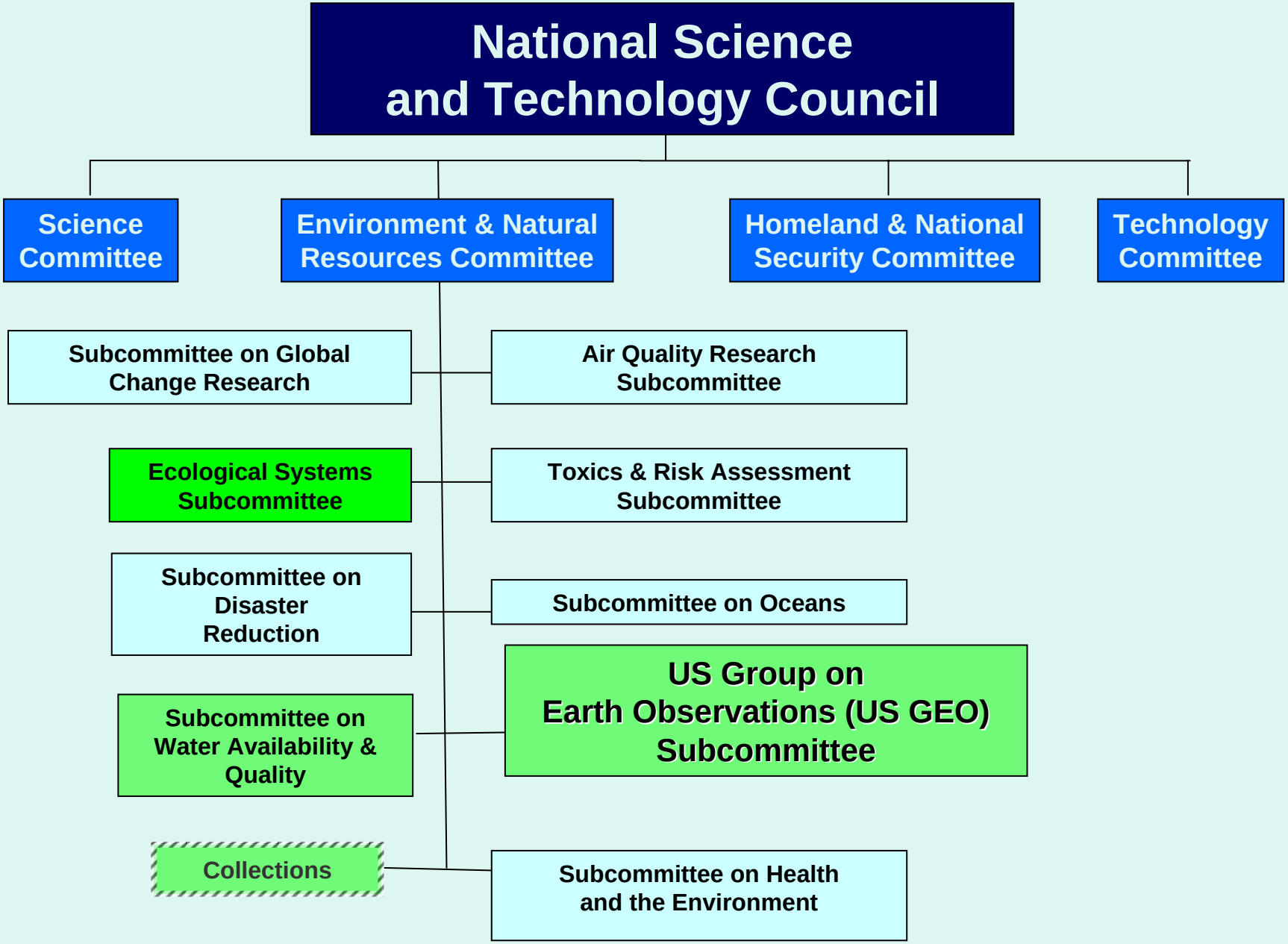
SUBJECT: FY 2007 Administration Research and Development Budget Priorities

This memo highlights the Administration's research and development (R&D) priorities and emphasizes improving management and performance to maintain excellence and leadership in science and technology. The memo provides general guidance for setting priorities among R&D programs, interagency R&D efforts that should receive special focus in agency budget requests, and reiteration of the R&D Investment Criteria that agencies should use to improve investment decisions for and management of their R&D programs. These updated R&D budget priorities reflect an extensive, continuous process of consultation with the President's Council of Advisors on Science and Technology (PCAST) and collaboration within the interagency National Science and Technology Council (NSTC).

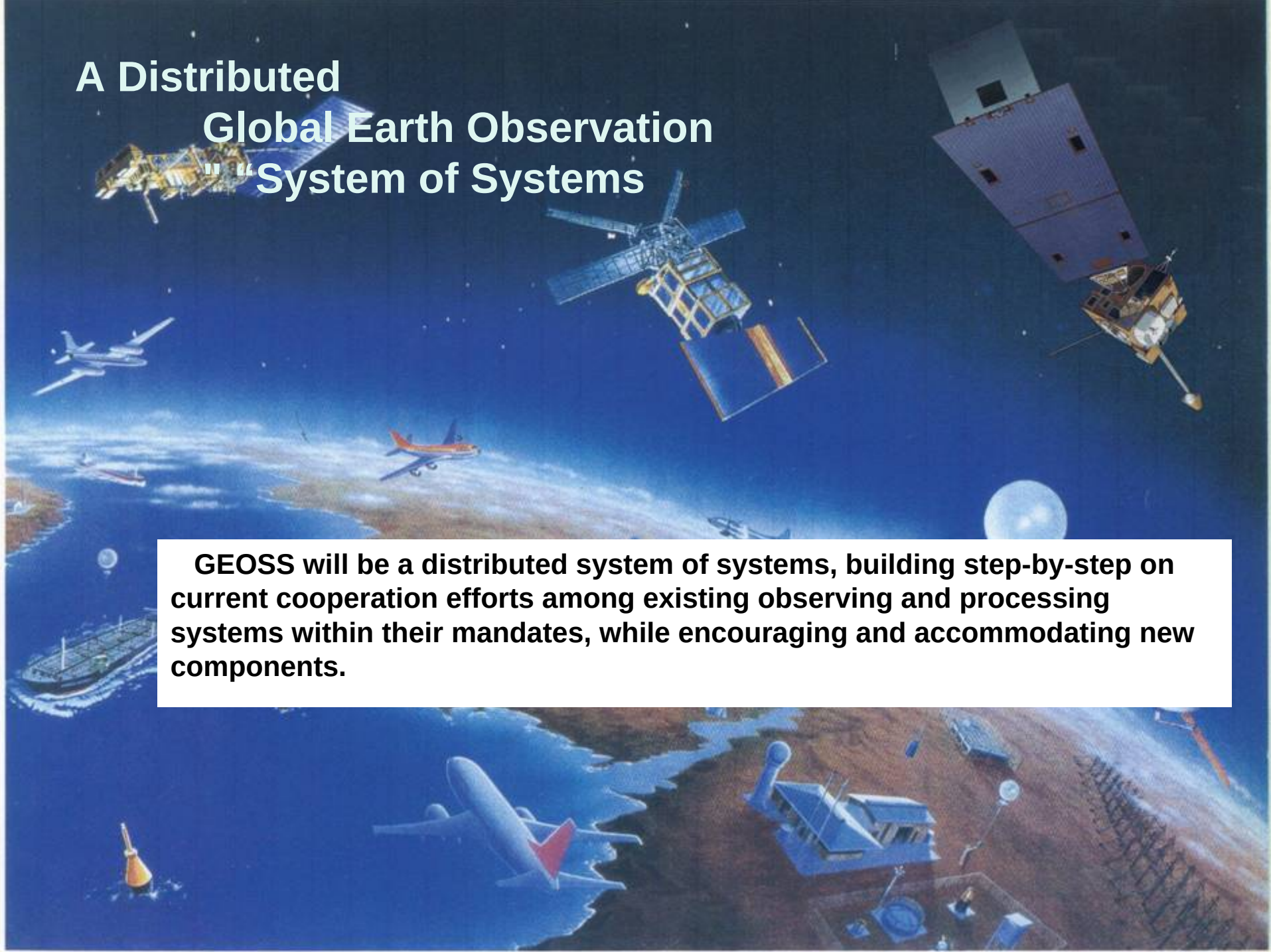
OSTP / OMB Guidance Memorandum for FY 07 R&D Priorities

- New Emphasis
  - **Collections**
  - Understanding R&D Investment Impacts
- Environment
  - ***Global Observations***
  - ***Water Availability and Quality***
  - Climate Change Science & Technology
- Biology of Complex Systems
- Physical Sciences
- R&D for Homeland Security
- Networking & Information Technology
- Nanotechnology

**Each Agency is required to request a budget that sustains the research important for its mission


National Science and Technology Council
Science Committee
Environment & Natural Resources Committee
Homeland & National Security Committee
Technology Committee
Subcommittee on Global Change Research
Air Quality Research Subcommittee
Ecological Systems Subcommittee
Toxics & Risk Assessment Subcommittee
Subcommittee on Disaster Reduction
Subcommittee on Oceans
US Group on Earth Observations (US GEO) Subcommittee
Subcommittee on Water Availability & Quality
Collections
Subcommittee on Health and the Environment

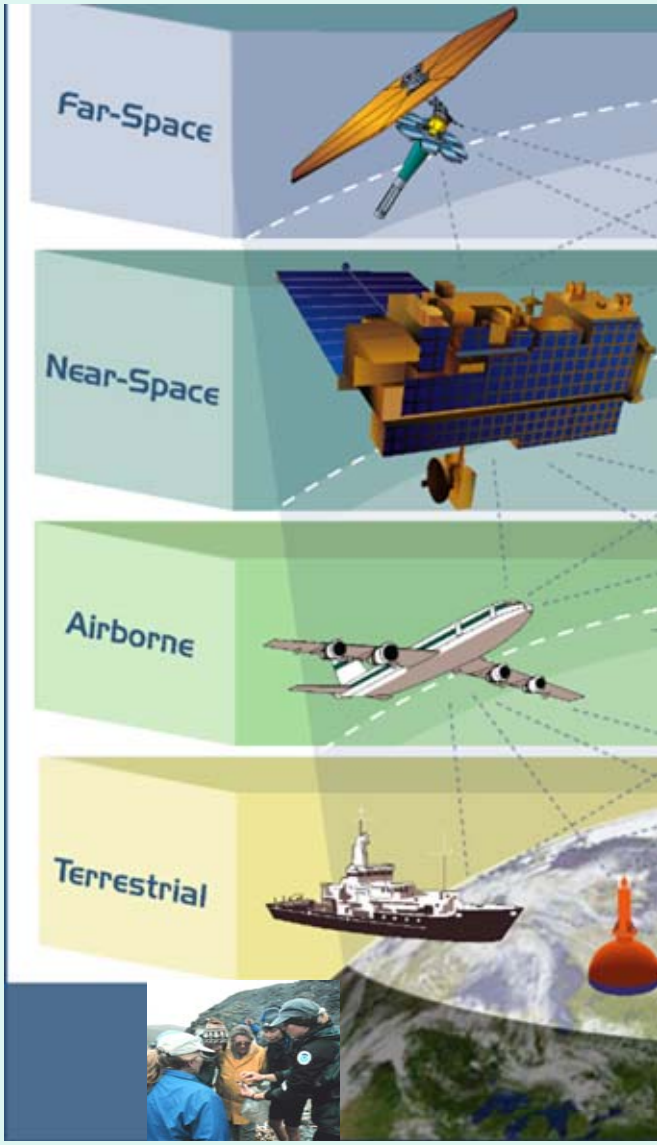
A Distributed Global Earth Observation System of Systems



GEOSS will be a distributed system of systems, building step-by-step on current cooperation efforts among existing observing and processing systems within their mandates, while encouraging and accommodating new components.

The Global Framework

- A distributed system of systems
  - Improves coordination of strategies and observation systems
  - Links all platforms: *in situ*, aircraft, and satellite networks
  - Identifies gaps in our global capacity
  - Facilitates exchange of data and information
  - Improves decision-makers' abilities to address pressing policy issues



WHY GEOSS??

GEOSS - Global System To Meet Societal Needs

- **Global collaboration is essential to understanding our environment**
- **No one organization or country can provide comprehensive capacity**

•Social, Economic, & Science Concerns

- More than half the world's population lives within 60 km of the shoreline, & this could rise to 3/4 by the year 2020
- More than 90% of natural disaster-related deaths occur in developing countries
- 25% of Earth's biological productivity & an estimated 80-90% of global commercial fish catch is concentrated in coastal zones
- Worldwide agricultural benefits of better El Niño forecasts are conservatively estimated at $450-$550M/year

•Basis for Sustainable Development

GEOSS History

- Earth Observation Summitt I
  - July 31, 2003, Washington, D.C.
  - 34 Countries and 20 International Organizations
- EOS II
  - April 25, 2004, Tokyo, Japan
  - 47 Countries and 26 International Organizations
- EOS III
  - February 2005, Brussels
  - Nearly 60 Countries and 40 International Organizations
  - 10-Year Implementation Plan
  - Commerce Secretary Gutierrez led the US delegation

EOS I

EOS II

EOS III

GEOSS Benefits Focus

Natural & Human Induced Disasters

Water Resources

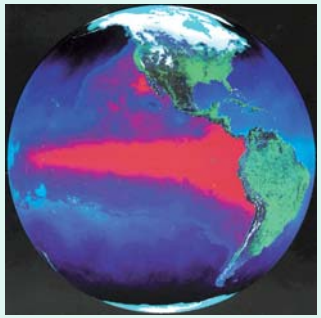
Ecosystems

Human Health & Well-Being

Energy Resources

Sustainable Agriculture & Desertification

Weather Information, Forecasting & Warning



Climate Variability & Change

Oceans

GEOSSArchitecture

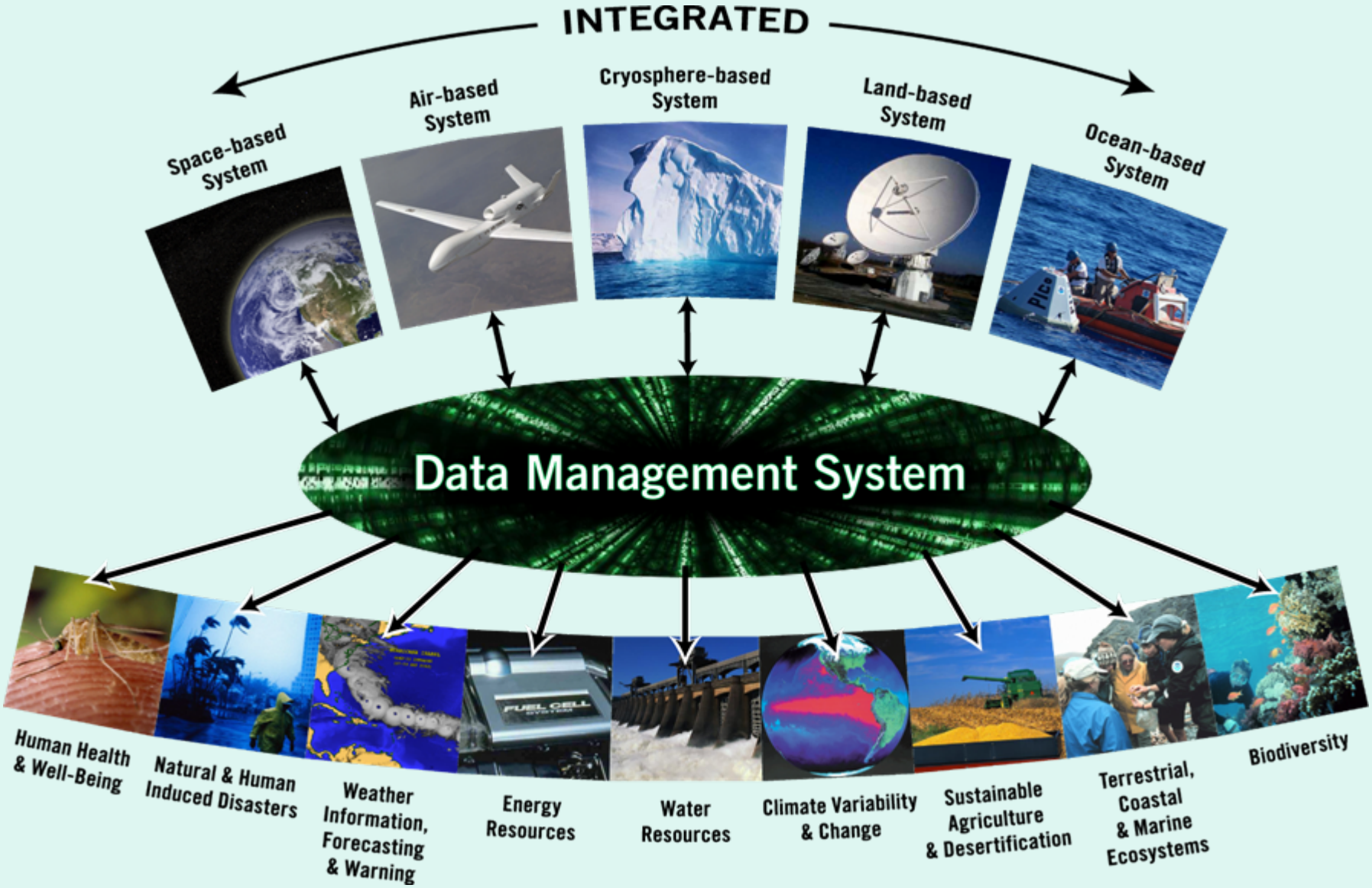
- Builds on existing systems
- Addresses planned, research and operational systems
- Capabilities interfaced through interoperability specifications
- Preserves continuity of observations

U.S. Contribution to GEOSS:
U.S. Group on Earth Observations (USGEO)

Co-chairs:
Greg Withee, NOAA
Ghassam Asrar, NASA
Teresa Fryberger, OSTP

Exec. Secretary:
Carla Sullivan, NOAA

Integrated Observations



US GEO Goals

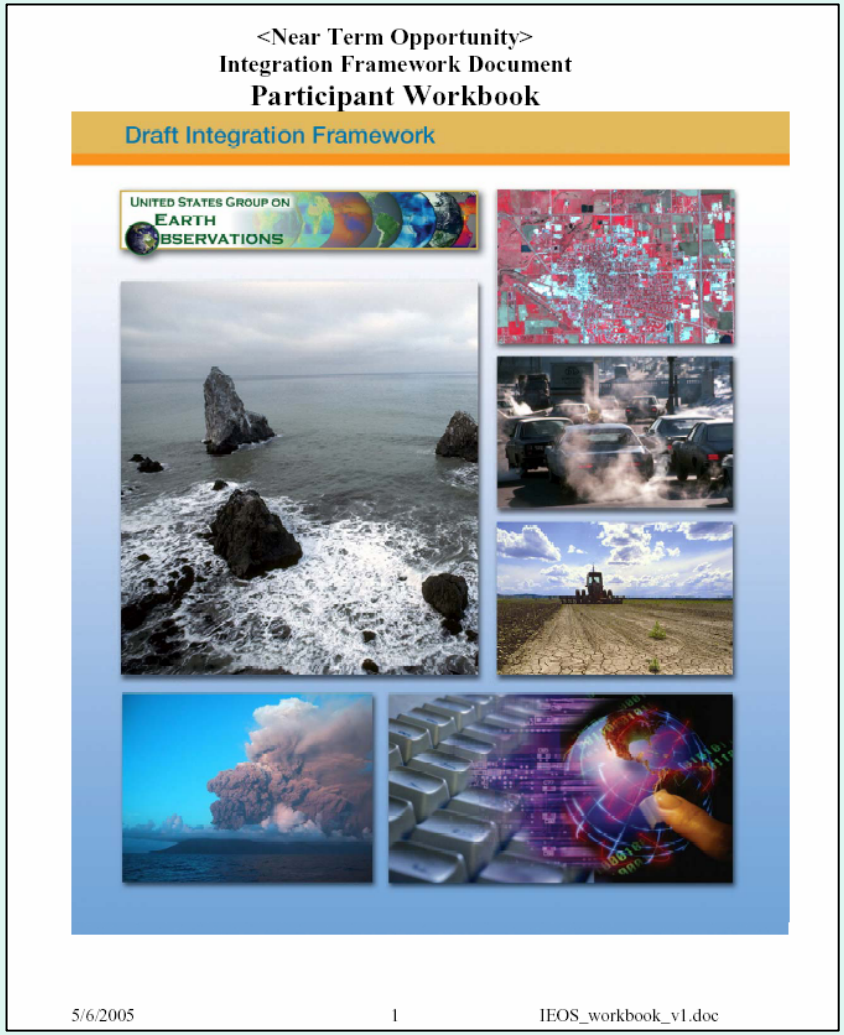
“ …to develop and begin implementation of the U.S. framework and 10 year plan for an integrated, comprehensive Earth observation system to answer environmental and societal needs,

- including a U.S. assessment of current observational capabilities,
- evaluation of requirements to sustain and evolve these capabilities considering both remote and in situ instruments,
- assessment of how to integrate current observational capabilities across scales, and
- evaluation and addressing of data gaps”

…to formulate the U.S. position and input to the intergovernmental Group of Earth Observations (GEO) as formed at the Earth Observation Summit in February, 2005.

Where is US GEO Going? Near -Term Opportunities Integration Frameworks

- Improved Observations for Disaster Warnings
- Global Land Observing System
- Sea Level Observing System
- National Integrated Drought Information System
- Air Quality Assessment and Forecast System
- *Data Management*



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M-05-18

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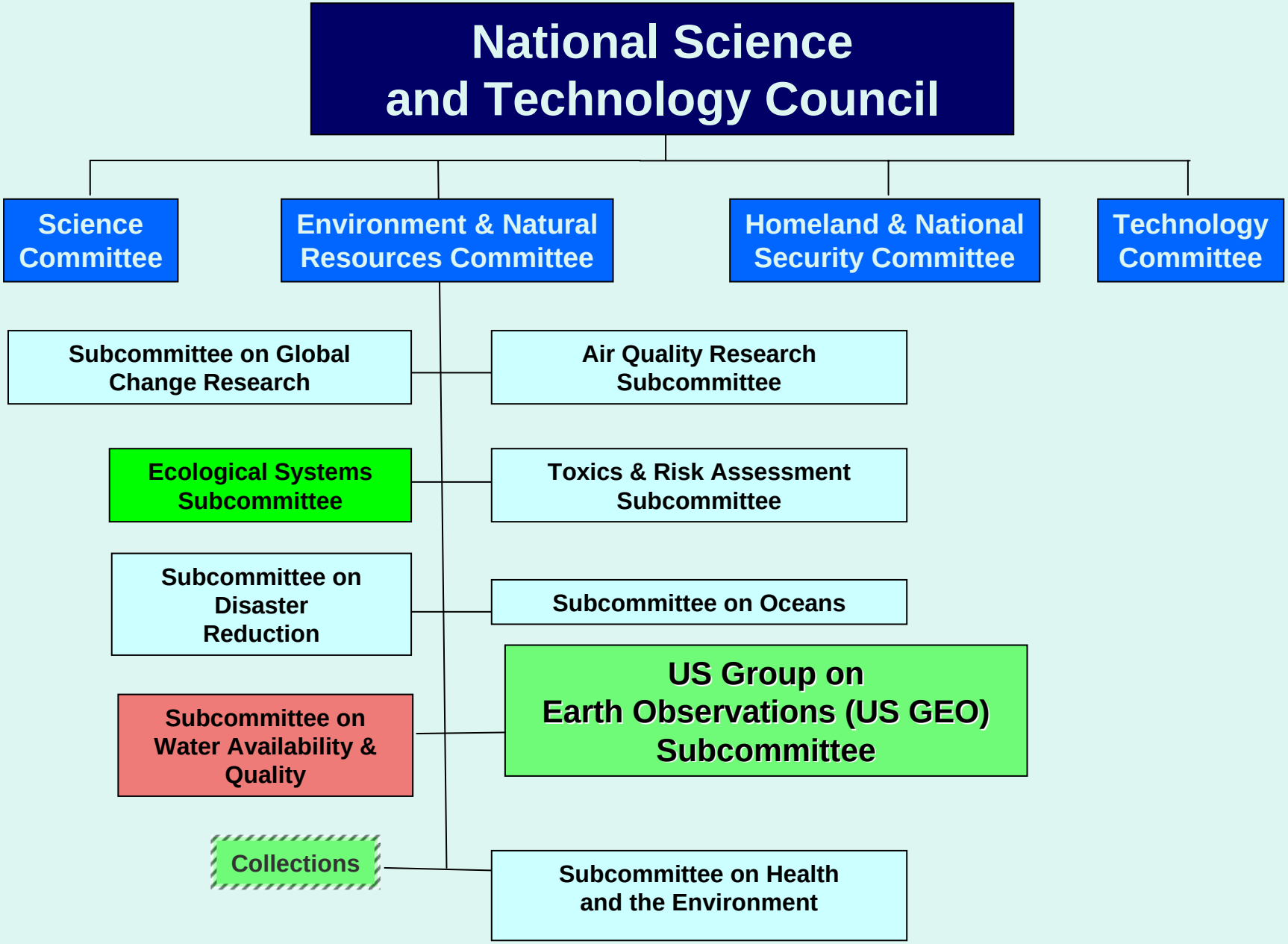
JOSHUA B. BOLTEN
DIRECTOR, OFFICE OF MANAGEMENT AND BUDGET

Global earth observations support research in a wide range of sciences important for society. The *U.S. Strategic Plan for an Integrated Earth Observations System* (IEOS) provides guidance for agencies contributing to these efforts. Agencies should focus on near-term opportunities to pilot integrated observing systems, such as those that contribute to natural hazards assessment and disaster warnings. Agencies also should work through the NSTC U.S. Group on Earth Observations Subcommittee to ensure continued coordination and implementation of the U.S. Strategic Plan and continued strong U.S. leadership in the international community.

For more information…

- Intergovernmental Group on Earth Observations
  - http://earthobservation.org
- US Group on Earth Observations
  - http://iwgeo.ssc.nasa.gov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Subcommittee on Water Availability & Quality
Collections
Subcommittee on Health and the Environment

Climate change
Demographics
Allocation
Irrigation
Economics
Sustainability
Security

Health
Fishing
Swimming
Drinking
Habitat
Recreation
Invasive species
Biological integrity

Are the supplies of water for human and ecological uses sustainable for decades into the future? If not, how might we develop new supplies or better manage for sustainability?

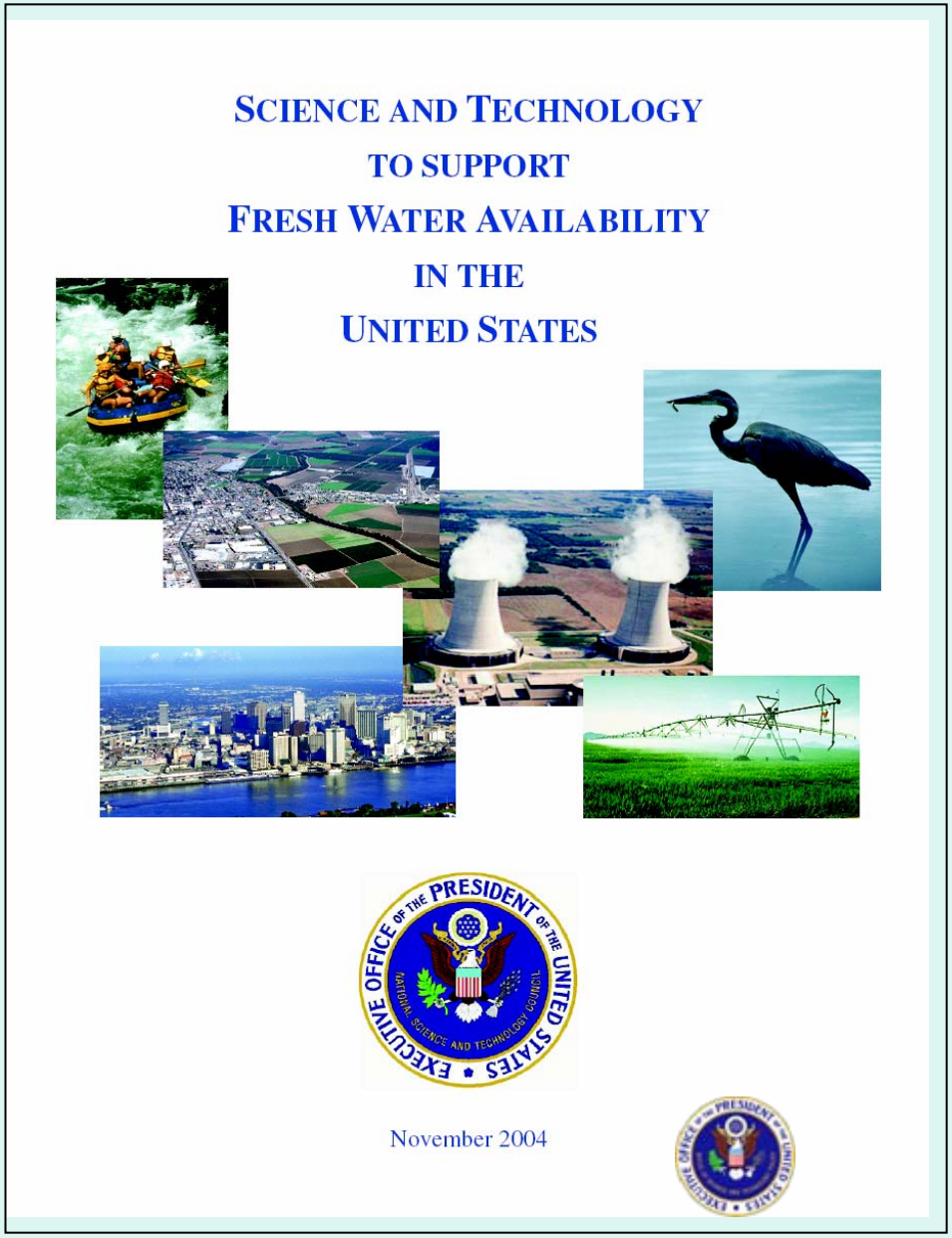
WATER AVAILABILITY AND QUALITY

Subcommittee on Water Availability and Quality (SWAQ)

Co-chairs:
Bob Hirsch, USGS
Rochelle Araujo, EPA

OSTP-OMB Guidance Memo FY06:

"The ability to measure, monitor, and forecast the U.S. and global supplies of fresh water is another high-priority concern. Agencies, through the NSTC, should develop a coordinated, multi-year plan to improve research to ***understand the processes that control water availability and quality***, and to collect and make available the data needed to ensure an adequate water supply for the Nation's future."



“Science and Technology to Support Fresh Water Availability in the United States”

(NSTC/CENR Subcommittee on Water Availability and Quality, 2004)

<u>Key needs and recommendations:</u>

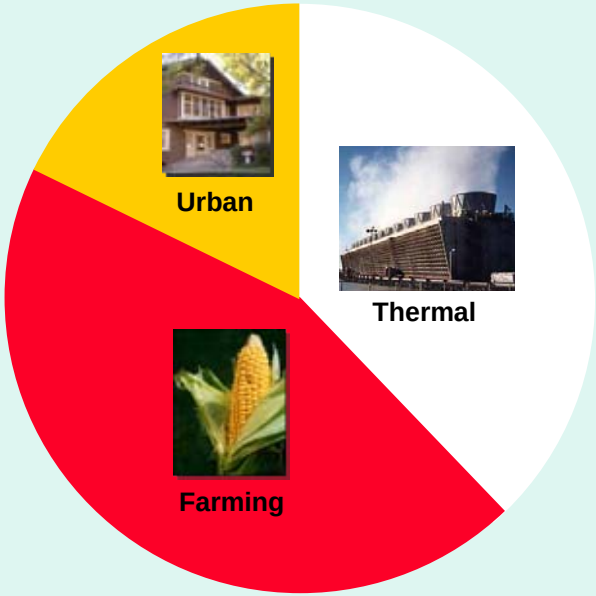
- **Comprehensive assessment of water availability and use, including examination of trends related to both, is overdue**
- **Quantifiable and scientifically defensible estimates of environmental water requirements**
- **Research and development on water reuse, desalination, aquifer storage and recovery**
- **Research on socioeconomic factors that determine water use**
- **Improved river forecasts, including recognition of the role of ground water in those forecasts**

Are we running out of water?

- Water is both renewable and non-renewable
- In general, we are not “running out of water” …but
- Competition is increasing and water is being reallocated

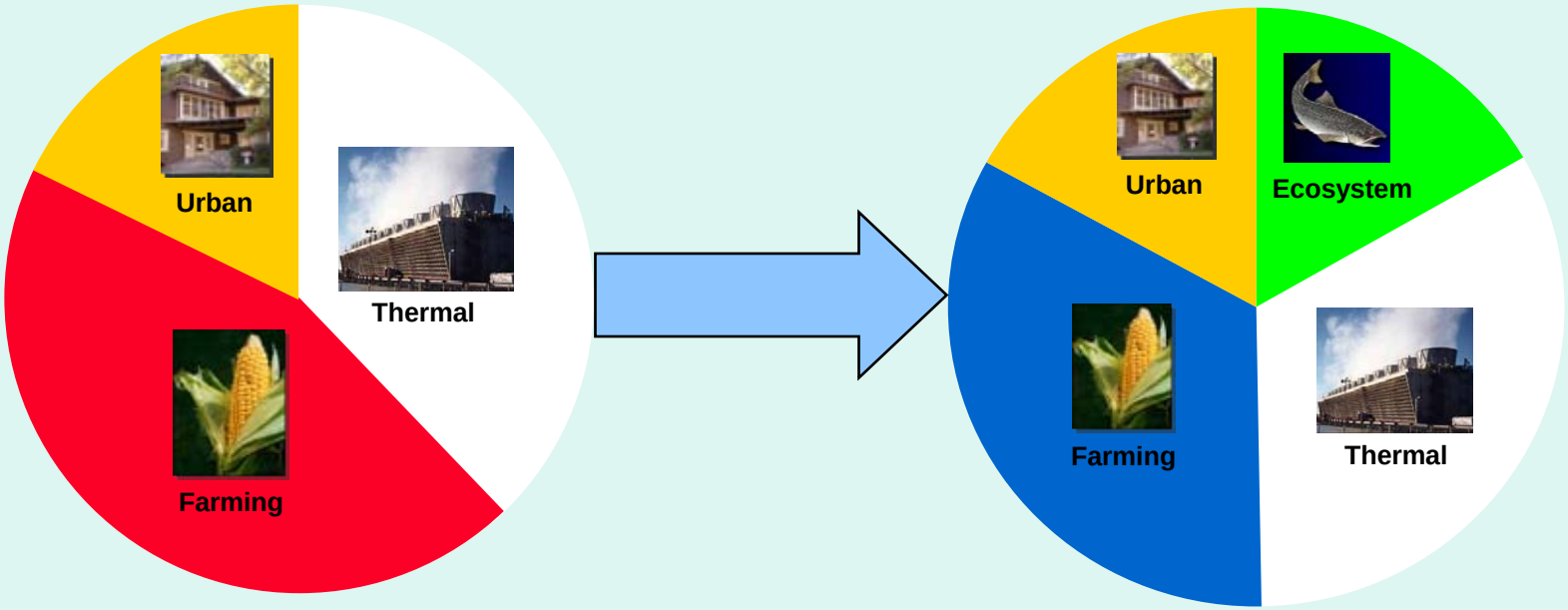
The allocation of water is changing in response to:

- **Market forces – energy costs, agricultural prices**
- **Demographics**
- **Public Values (Ecosystem Services)**
- **State Water Laws (creating markets)**
- **Federal Law (CWA, ESA)**
- **Changing climate**
- **Technology: Water reuse, Conservation, ASR**



USGS

The Demand for Ecosystem Services is a Major Driver of the Changes in Water Allocations



USGS

When the systems were designed the question was: How much water can we reliably withdraw from the river?

Today's question is:

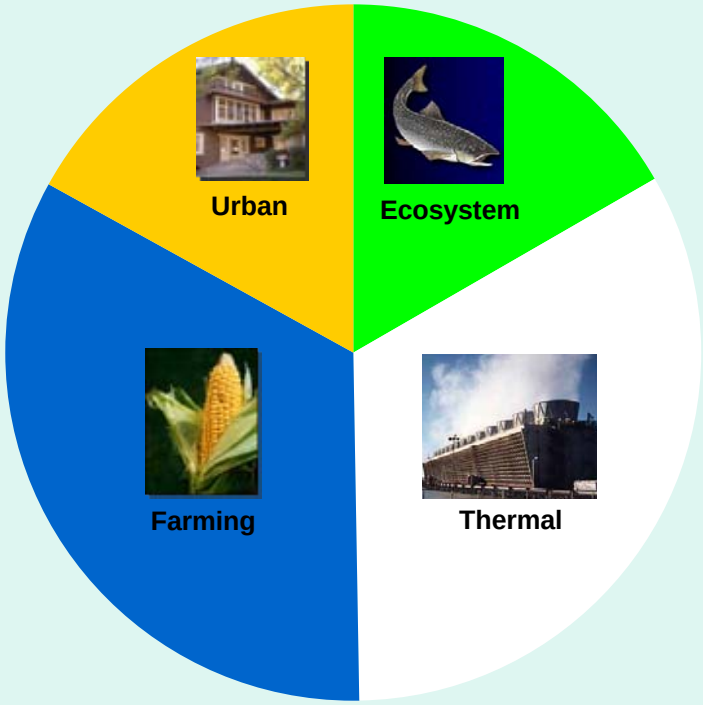
How much water do we need to leave in the river?

Science was needed then and is needed now!!

Back to the overall problem of water reallocation: There are some other complexities

- The size of the “pie” might also be changing
- Science is needed to help identify and predict these changes
- For example. . . .

The pie might be shrinking because ground water in storage is being depleted

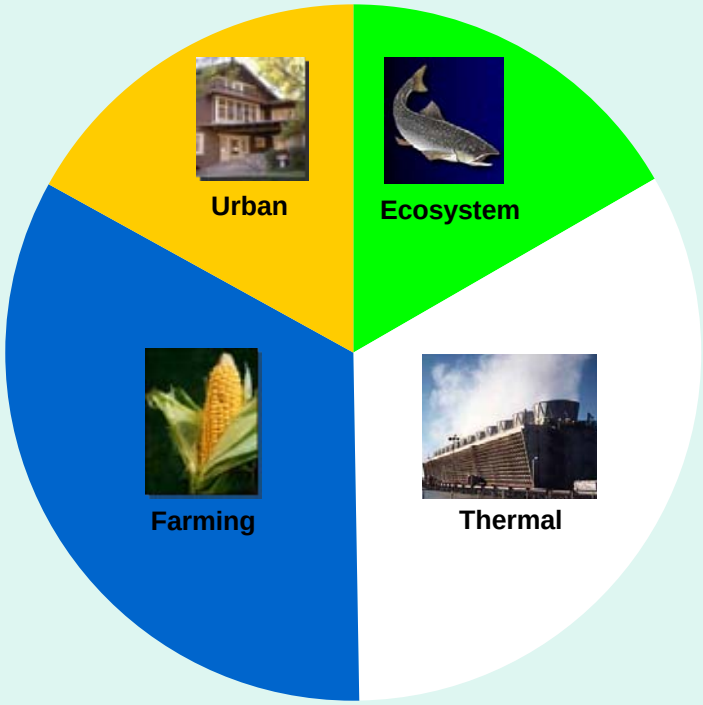


Depletion impacts:

- **Wells**
- **Streamflow**
- **Riparian vegetation**
- **Subsidence**
- **Water quality**
- **Future generations**

USGS

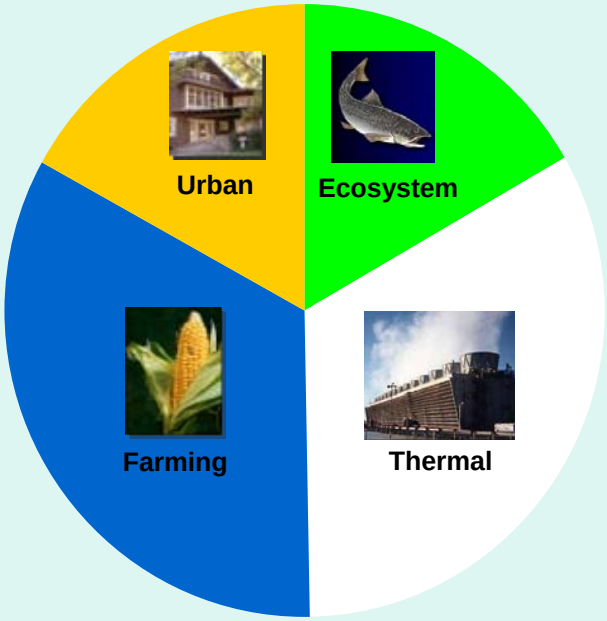
The pie might be shrinking because climate warming leads to less snow-pack storage



Precipitation-runoff models coupled to climate models are needed to simulate the impact on reliable supply

USGS

The pie might be able to grow if technology provides for an enhanced supply



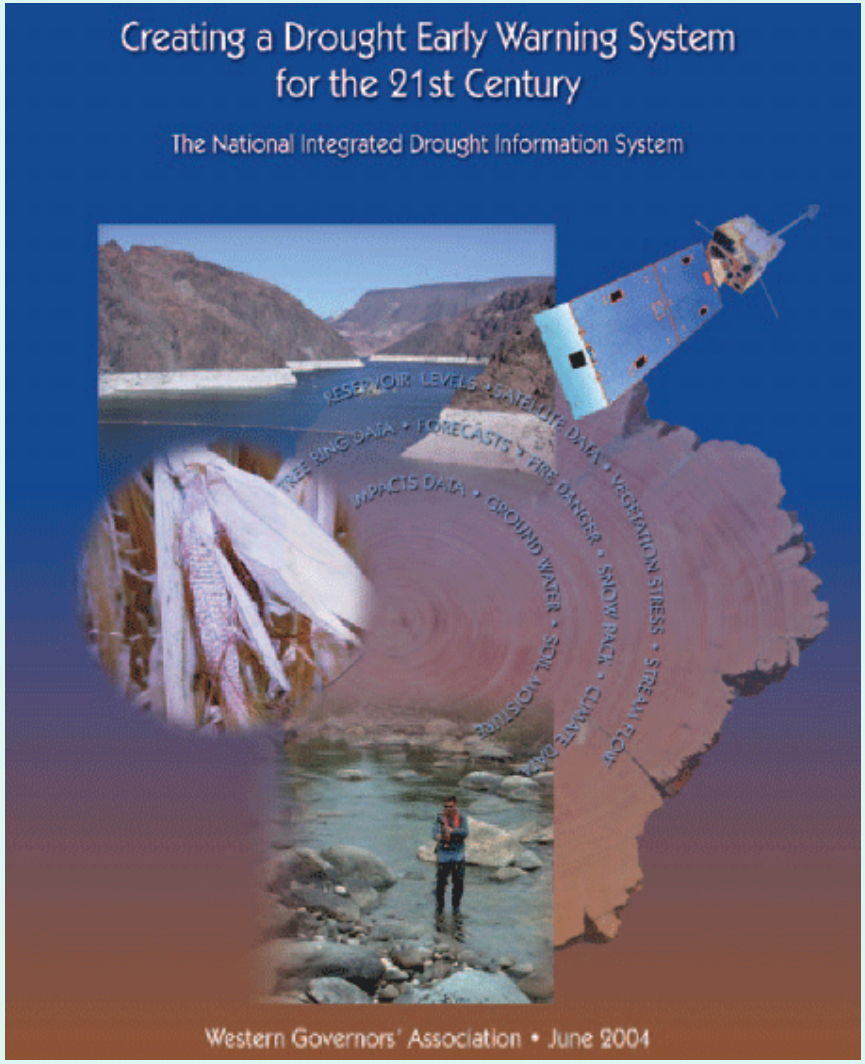
Water reuse, aquifer storage and recovery, phreatophyte control, desalination, all have the potential to enhance supply

Science and Technology provides the basis for effective management in the face of increasing competition

- Science provides the context: status and trends of the resource
- Science can provide the basis for smarter decisions through prediction of outcomes (hours to generations into the future)
- Technology can enhance supplies and efficiency of use

Water Availability and Earth Observations: National Integrated Drought Information System (NIDIS)

- Key Components
  - Integrated National Drought Monitoring & Forecasting System
  - Multi-agency collaboration; NOAA lead
  - Facilitates information exchange between local, state and federal agencies
  - Proactive, Not Passive, Drought Response
  - Improve Drought Indicator Data/Networks (Physical, Hydrological, Socio-Economic, Impacts)
  - Integrate & Interpret that Data with Easily Accessible & Understandable Tools
- Supported by Western Governors



Subcommittee on Water Availability and Quality: Plans

- **Developing** “coordinated, multi-year plan”

- **Goals:**

• To improve research to understand processes that control water availability and quality

• To improve water data collection and availability

- **When:** Preliminary plan summer of 2005

- **Needed:** Input from all water sectors (Feds, states, local, academia, tribes, NGOs, others)

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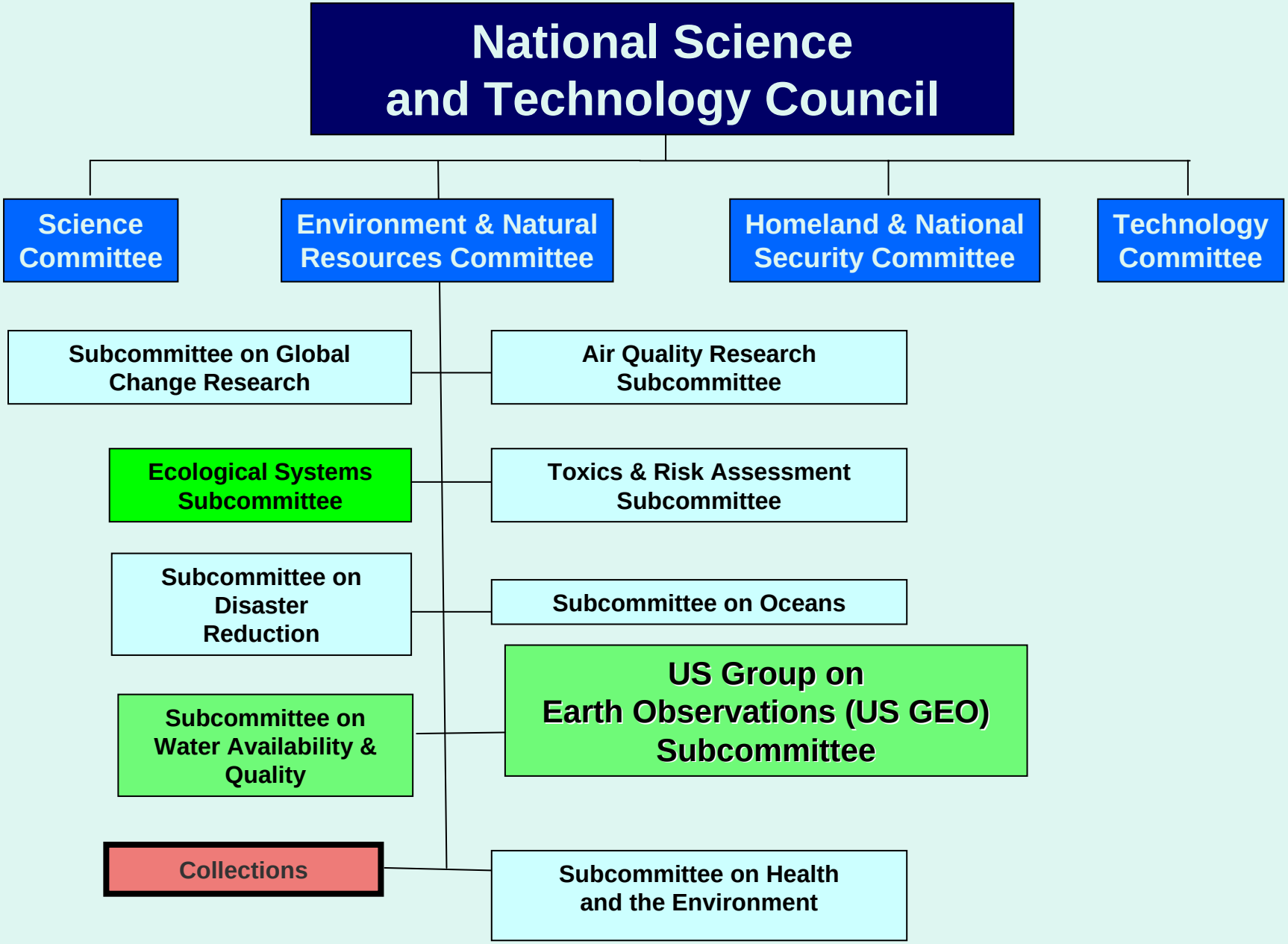
The ability to measure, monitor and forecast U.S. and global supplies of fresh water is important because agencies are developing a coordinated, multi-year plan through the NSTC to improve research to understand the processes that control water availability and quality, and to collect make available the data needed to ensure an adequate water supply for the future. Significant progress on this plan, including stakeholder input, is expected during the next two years.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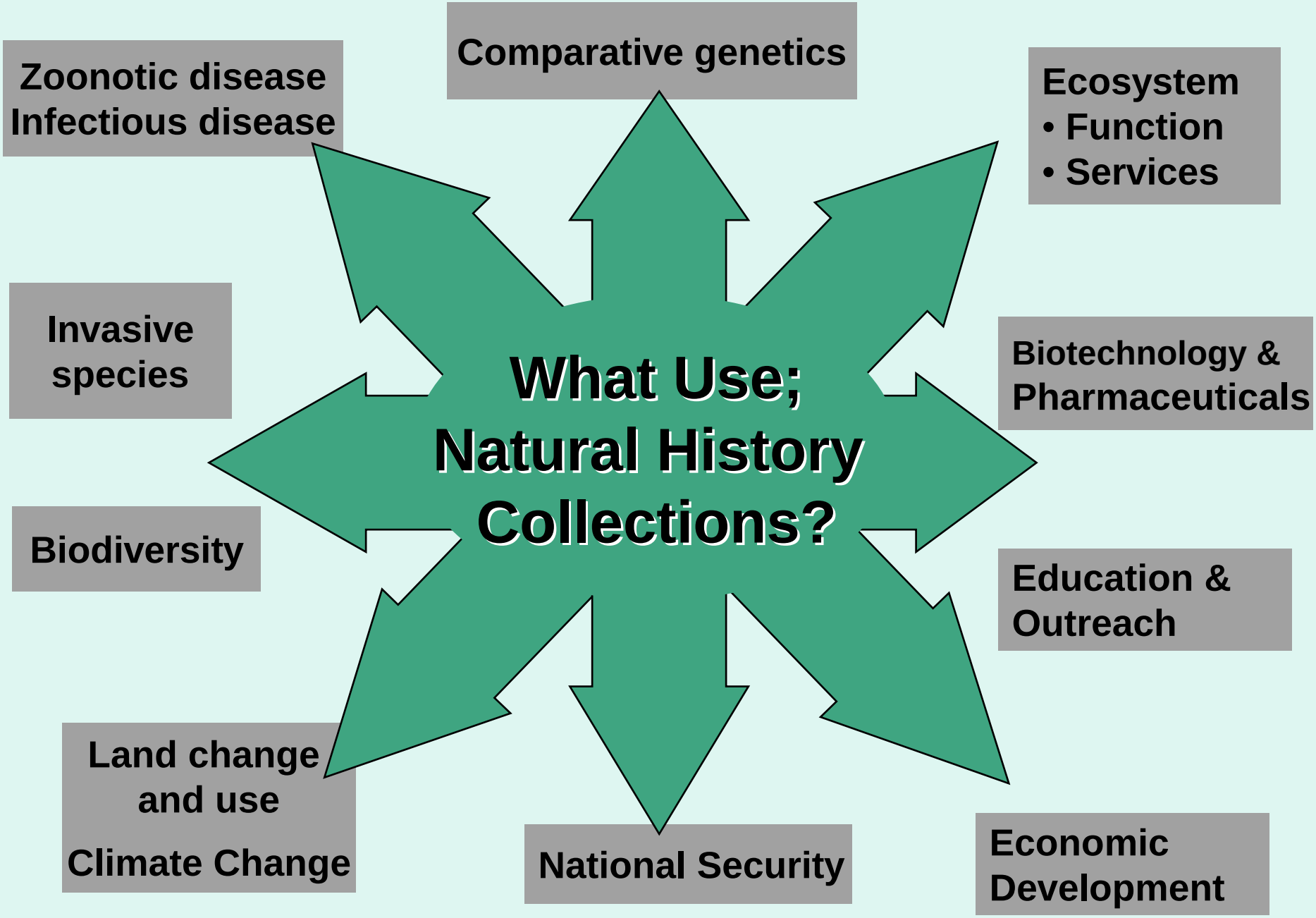
Agencies should maximize the coordination and planning of their R&D programs through the NSTC. Two areas requiring special agency attention and focus through the NSTC are Federal scientific collections and R&D assessment.

- Agencies should assess the priorities for and stewardship of Federal scientific collections, which play an important role in public health and safety, homeland security, trade and economic development, medical research, and environmental monitoring. Agencies should develop a coordinated strategic plan to identify, maintain and use Federal collections and to further collections research.
- Determining the effectiveness of Federal science policy requires an understanding of the complex linkages between R&D investments and economic and other variables that lead to innovation, competitiveness, and societal benefits. An interagency process is needed

Scientific Collections

- Biological, physical, data, artifacts…
- Collections of all kinds need attention
  - importance of is not widely recognized
  - workforce issues--taxonomy, systematics
  - museums, universities, private, global
- Issues
  - how to prioritize
  - digitization
  - preservation
  - space
  - funding


What Use;
Natural History
Collections?
Comparative genetics
Zoonotic disease
Infectious disease
Ecosystem
• Function
• Services
Invasive species
Biotechnology & Pharmaceuticals
Biodiversity
Education & Outreach
Land change and use
Climate Change
National Security
Economic Development

US Collections

- More than 500 million specimens of plants and animals
- 200 years of biological exploration in the U.S.
- Numerous, diverse collections
  - **Museums,** universities, government facilities, private collectors
- Unique natural history—irreplaceable record of national heritage
- Facing numerous challenges
  - Deteriorating facilities—potential for loss
  - Need to network together using modern information technologies
  - Unidentified or misidentified specimens
  - Few taxonomists

For Example
Preserving the Past:
Bio-Collections

How Big is the Job?

- About 10,000 new species discovered each year
  - 1-5 birds, 1-5 mammals
- About 60,000-70,000 species have been studied
- Genomics databank (GenBank) has information on about 100,000 species
- Catalog of Life 2004 – lists 323,000 species
  - Species 2000 (international) in partnership with ITIS (partnership of federal agencies)
- Around 1.75 million species have been discovered and described
- Anywhere from 2-100 million may exist
  - (Michael Rosenzweig, Society for Conservation Biology)
- Extinction rates: 10-100 / day
  - Difficult to estimate

Public-Private Partnerships are ESSENTIAL

Federal Government

- Collections
- Scientists
- Funding
- Infrastructure
- International collaboration

Museums, Societies, Universities, Botanical Gardens, etc.

- Collections
- Scientists
- Funding
- Infrastructure
- International collaboration

Neither the government nor the private sector "owns" this subject, but the preservation and utilization of these collections is of great national importance

The Earth as a Living System

“taking the pulse of the planet..”