

Curves on the Road to An Integrated Earth Observation System

National Academies Disasters Roundtable Workshop
“Hazards Watch: Reducing Disaster Losses
through Improved Observations”

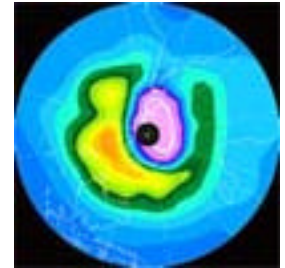
Washington, DC
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Importance of Integrated Earth Observation System

Justified by Growing Needs and Substantial Benefits

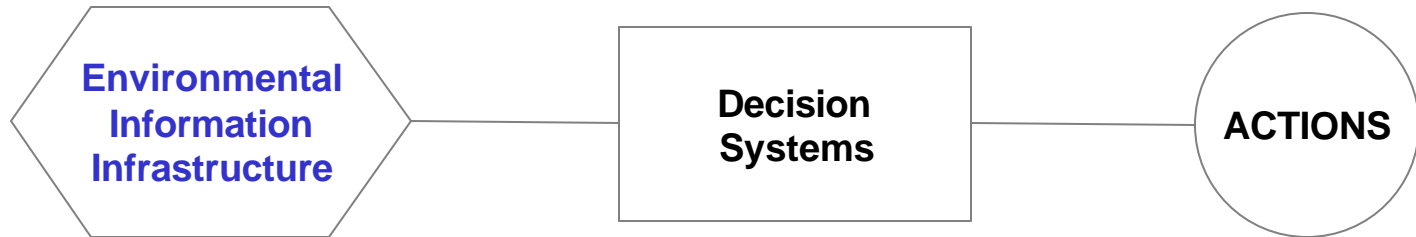
- Proliferation of **Environmental Treaties**
 - The number of agreements and the impact of obligations have grown rapidly over the last several decades with increasingly large economic impacts
 - Earth observations are central to decisions on ratification, maintenance of treaty obligations, and compliance monitoring
- Sensitivity of **Businesses** to Weather and Environment
 - As markets mature, businesses operate closer to the margin
 - Information provides the leverage to operate efficiently and maintain margin
 - Earth observations represent high leverage information
- Vulnerability of Populations to **Natural Hazards**
 - The population is escalating in regions of the world prone to natural disasters, including hurricanes, earthquakes, volcanoes, droughts, and diseases
 - Earth observations are key to both preventative and responsive actions



The “Environmental Information Infrastructure”

Earth Observations are One Element of the “Information Infrastructure”

Environmental decisions are enabled by an extensive
environmental information infrastructure



Includes:

Observation Systems
Prediction Systems
Information Systems

Research Functions
Operations Functions
Applications Functions

**Provider
Examples:**

NWS
FEMA
EPA
State Dept
Private Sector
Individuals
Many Others

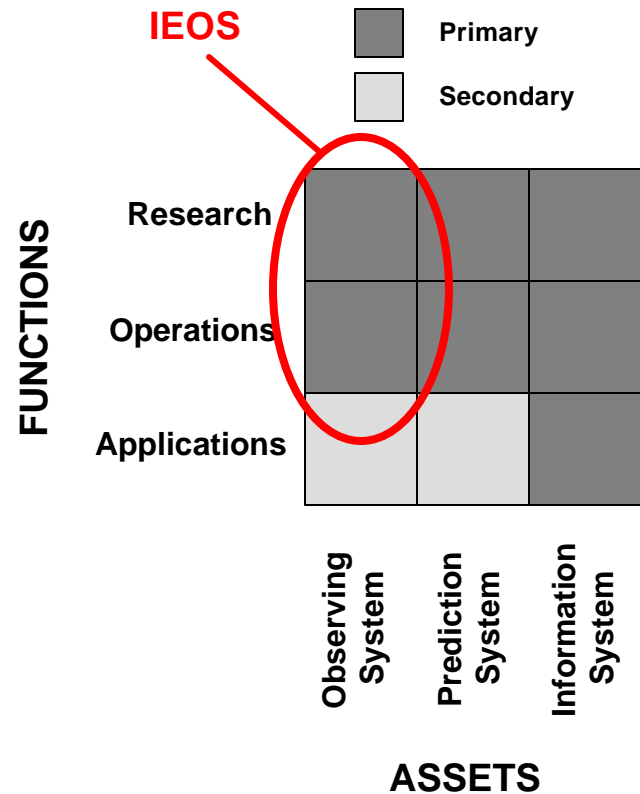
Examples:

Treaty Negotiations
Airline Routing
Hurricane Evacuations
Tornado Warnings
Flood Management
Insurance Rates
Land Use
Pollution Monitoring
Resources Exploration
Fisheries Management
Volcano Eruptions
Personal Decisions

The “Environmental Information Infrastructure”

The Infrastructure Elements are Highly Inter-Dependent

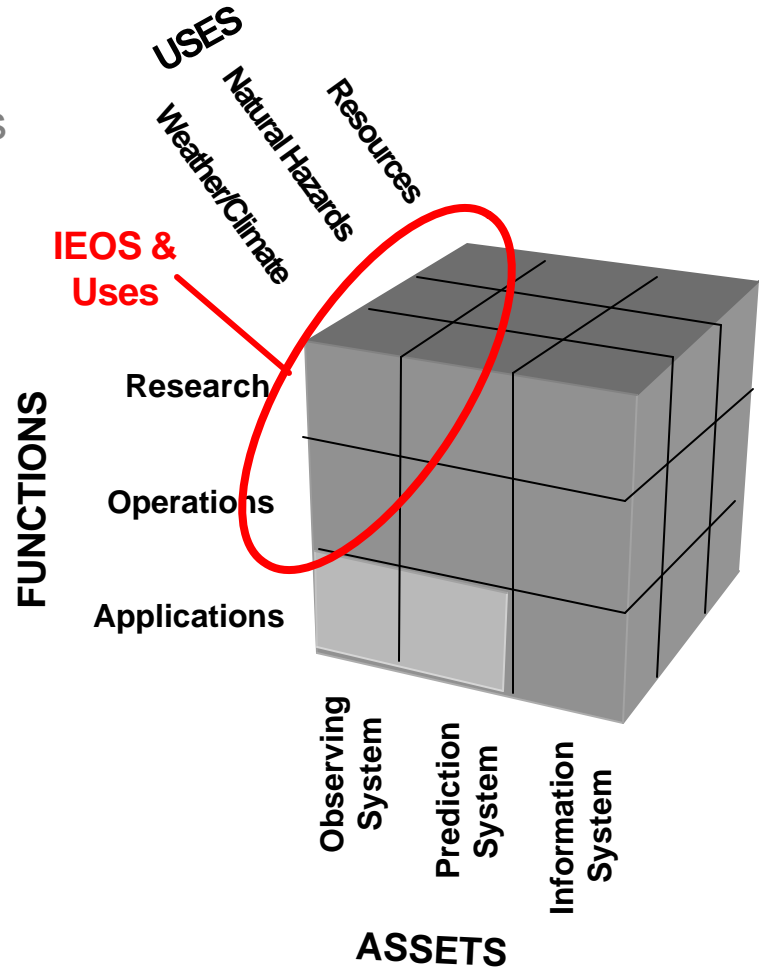
- The infrastructure can be separated into two distinct categories of elements
- “Hard” infrastructure - *physical assets*
 - Observing systems
 - Predictions systems
 - Information systems
- “Soft” infrastructure – *functions (capabilities and knowledge base)*
 - Research function
 - Operations function
 - Applications function



The “Environmental Information Infrastructure”

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- “Soft” infrastructure – *functions (capabilities and knowledge base)*
 - Research function
 - Operations function
 - Applications function
- Inter-dependence increases when the different **uses** are considered



Five Questions for IEOS Planners

Attention to these Questions Will Help “Straighten the Curves”

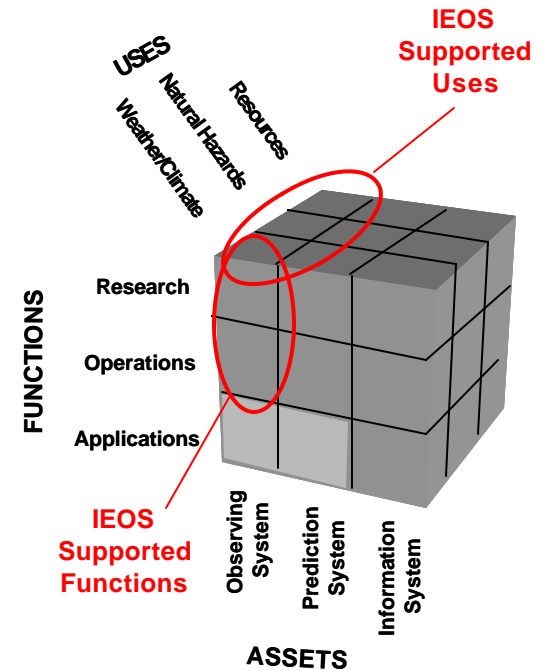
- *Question 1* - Does the IEOS efficiently support all functions and uses?
- *Question 2* - Will other infrastructure improvements keep pace?
- *Question 3* - Is the infrastructure overly segmented?
- *Question 4* - Are public, academic, and private sectors used effectively?
- *Question 5* - Are we planning adequately for unanticipated needs?

Question 1

Does the IEOS efficiently support all functions and uses?

- Underlying Problems and Issues
 - **Overlap of Research and Operations** - Research and operations functions often have overlapping observations needs, but historically separate observation systems
 - **Support to Natural Hazards** - Natural hazards are not properly represented in relationship to their economic and human impacts*

- Toward Solutions
 - **Share Support for Research and Operations**
Increase efficiency by performing some research and operations with common systems
 - **Highlight Natural Hazards Requirements** –
Ensure the IEOS is designed to satisfy the needs of natural hazards users

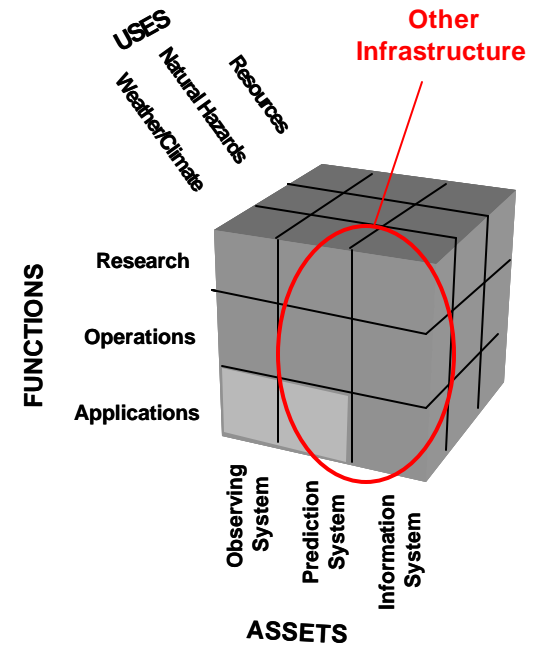


* A recent OSTP/RAND report concludes that losses from weather-related hazards are twice that of earthquakes, but earthquakes receive one tenth the R&D funding (Assessing Federal Research and Development for Hazard Loss Reduction, MR-1734-OSTP, 2003)

Question 2

Will other infrastructure improvements keep pace?

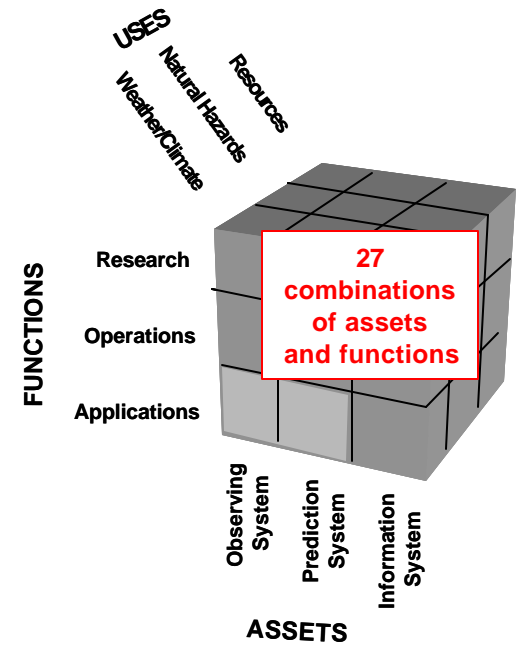
- Underlying Problems and Issues
 - **Balancing Improvements** - Investments in improving the infrastructure need to be properly balanced across “hard” and “soft” elements
 - **Impact of Increasing Data Volumes** – Rapidly increasing data volumes require enhancements to modeling and prediction systems, data archive and distribution, and decision systems
- Toward Solutions
 - **Treat the Infrastructure as a System** - Need enhanced processes and resources for dealing with the information infrastructure as a system
 - **Encourage Capabilities “Push” as Well as Requirements “Pull”** – The dynamic tension between these promotes efficient system improvement



Question 3

Is the infrastructure overly segmented?

- Underlying Problems and Issues
 - **Research to Operations Transition** - Research and operations generally performed by separate agencies with weak transition mechanisms
 - **The Air-Land-Oceans Split** - Land is separated from atmospheres and oceans for operations but highly coupled within the Earth system and in the research community
 - **Multiple National Systems** - Nations are motivated to retain observing systems as national assets
 - **Hazards Diversity** - Natural disasters infrastructure spread across multiple agencies
- Toward Solutions
 - **Improve Research to Operations** – Potential solutions are addressed by the NRC CONNTRO report
 - **Integrate/Coordinate Systems** - The Earth Observation Summit represents substantial international progress



Question 4

Are public, academic, and private sectors used effectively?

- Underlying Problems and Issues
 - **Achieving Benefits of All Sectors** - The sectors have complementary strengths that should be used to advantage in the IEOS
 - **Role of Private Sector** - Environmental information infrastructure has been largely a government activity, though attempts to increase the private sector role have proven only partly successful
- Toward Solutions
 - **Establish Optimal Balance of Roles** - IEOS should explicitly seek broad external input to identify portions of infrastructure where each can be used to advantage
 - **Design IEOS to Evolve Toward the Balance** – Build in incentives to gradually increase roles of academic and private sectors as appropriate

STRENGTHS OF THE SECTORS

Public Sector - *Stewardship*

- Dedicated to public stewardship
- Institutional stability supports long-term planning

Academia - *Creativity*

- Intellectual freedom supports creative breakthroughs
- Challenge institutional “ruts”

Private Sector - *Efficiency*

- Competition motivates innovation
- Profit motive optimizes efficiency

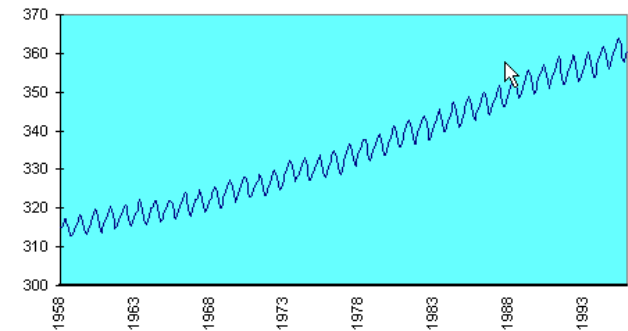
Question 5

Are we planning adequately for unanticipated needs?

- Underlying Problems and Issues
 - **Our Grandchildren's Policy Needs** - Policy decisions 40+ years from now may require 40+ year data sets that need to be initiated today – do we have a process?
 - **Impacts of Climate Change** - Will observing system needs change as a result of climate change?
 - **Knowing What is Needed** - The broadening user base makes it difficult to identify user needs
- Toward Solutions
 - **Include Non-Deterministic Planning** - Utilize contingency-based and scenario-based planning tools in developing the IEOS
 - **Design Flexible and Evolvable Systems** - Design an “evolvable” IEOS architecture based on explicitly upgradeable technologies



Potential for Change
in Severe Weather Patterns



Need for Long-Term Data Sets,
Such as the
40 Year CO2 Data Record

Conclusions

- The Earth observation system is part of a larger **environmental information infrastructure** – it is facing growing demands from its users and thus an increasing need for coordination and enhancement
- The **IEOS** is an important step forward toward achieving better coordination and greater efficiency
- The **natural hazards** field can obtain great benefit through the IEOS process
- This community has an unusual opportunity to **influence the future** through the development of the IEOS plan