Committee on Hydrologic Science

and

Committee on Integrated Observations for Hydrologic and Related Sciences

Eric Wood, Princeton University
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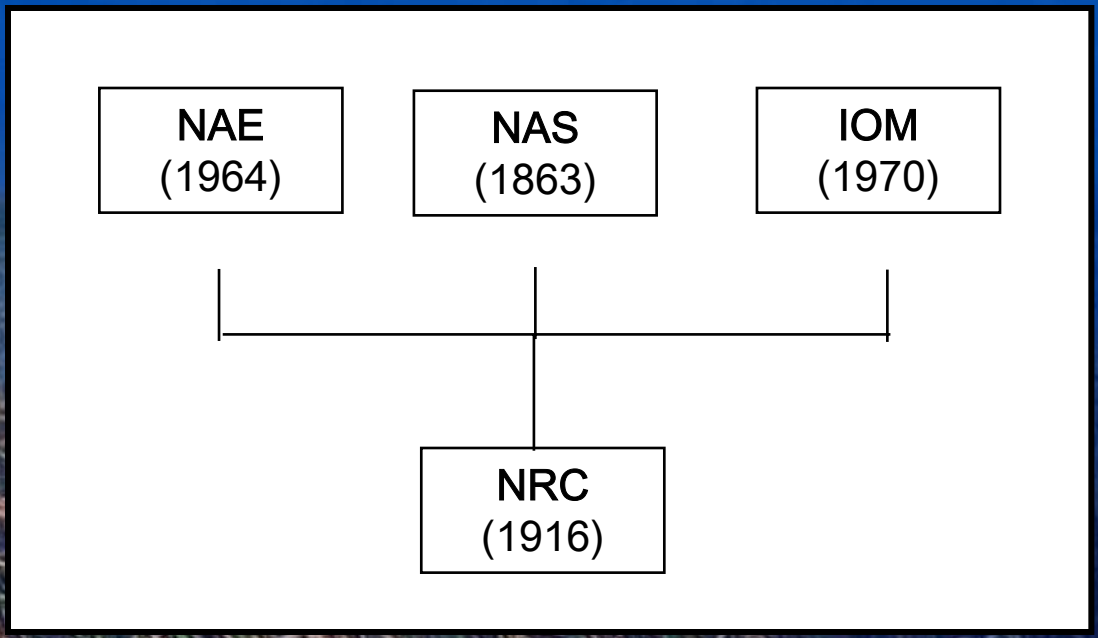
THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

The National Academy of Sciences

"...the Academy shall, whenever called upon by any department of the Government, investigate, examine, experiment and report upon any subject of science or art...."

The National Academies

- To advance science and technology
- To advise government
  - on policy for science institutions
  - on applications of science to policy



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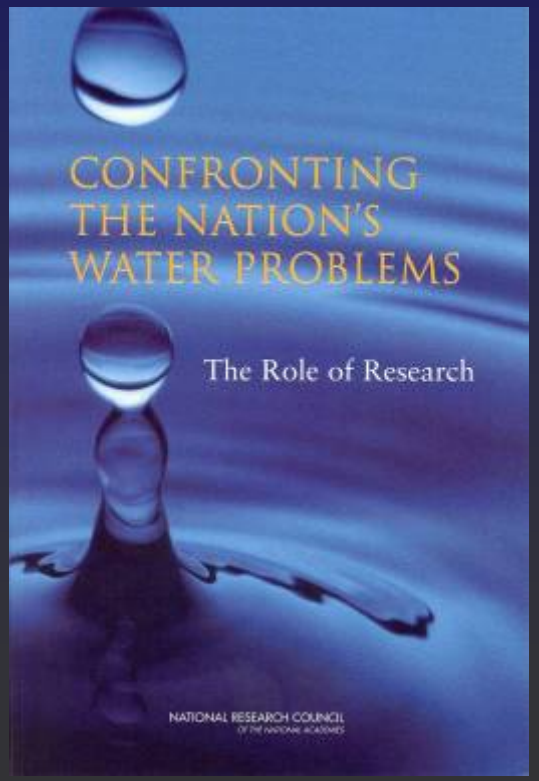
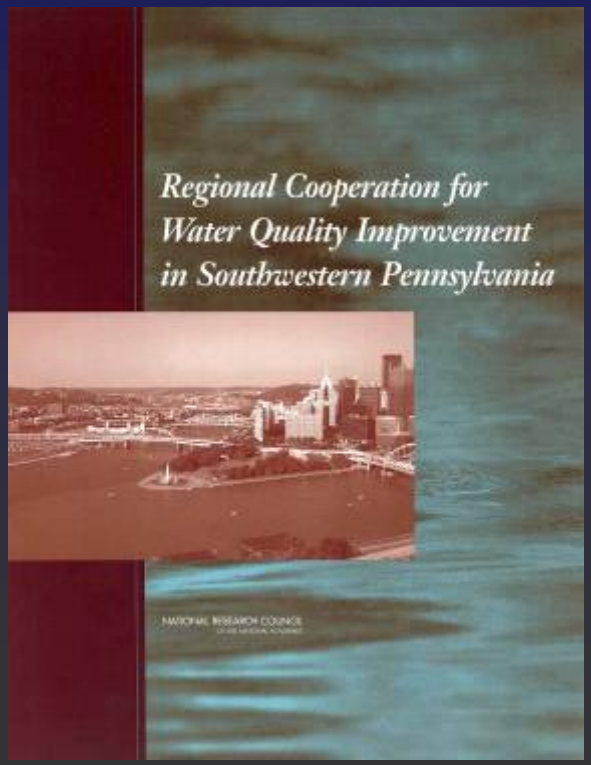
Water Science and Technology Board

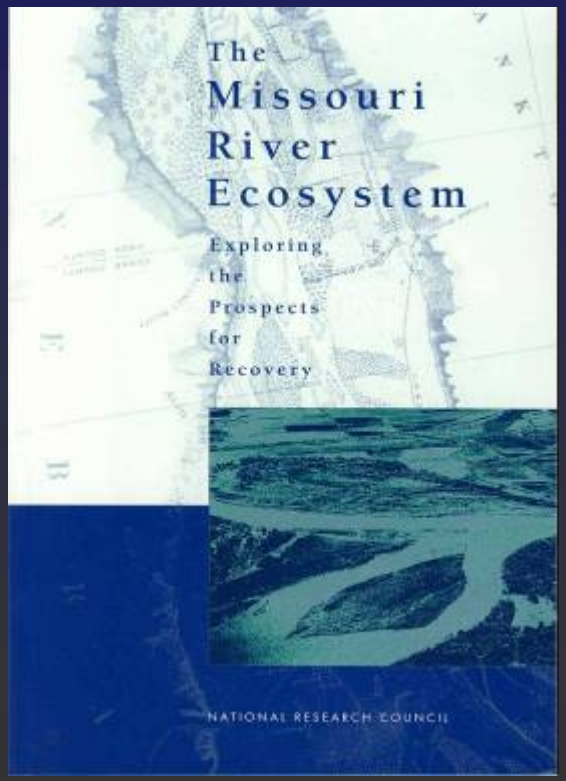
Mission and Scope

Mission

Established in 1982 as focal point for water resources studies, including science, engineering, economics, policy, and social aspects.







Mission

A standing committee within the WSTB designed to address research and educational opportunities in the hydrologic sciences. It is a venue to

•identify concerns and opportunities in hydrologic sciences,

•provide advice within the National Academies, and

•provide oversight of approved projects conducted under its auspices.

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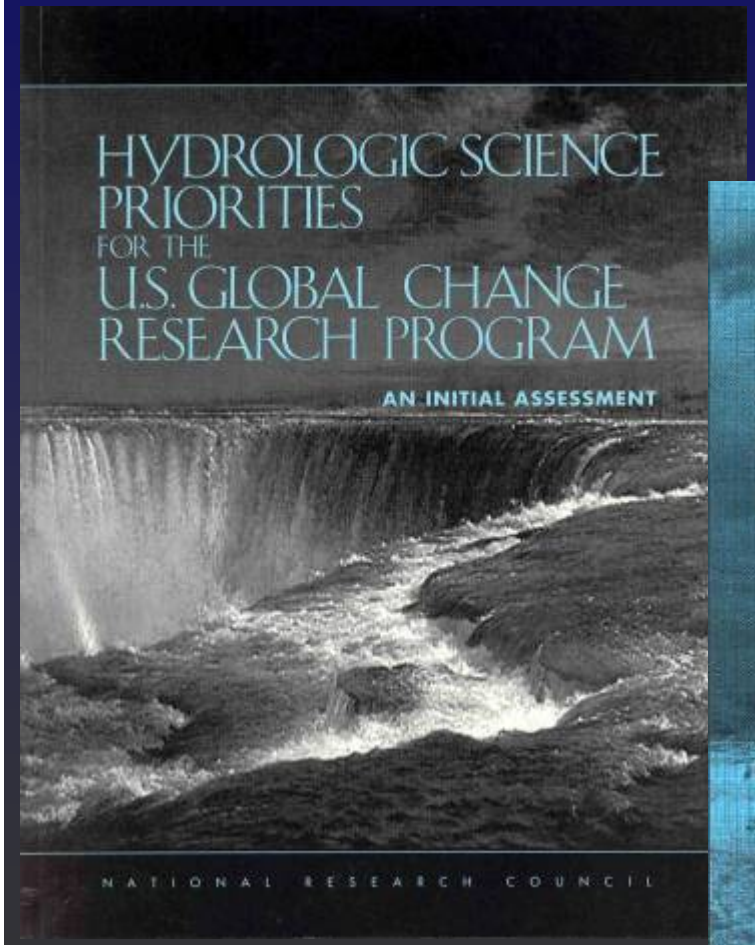
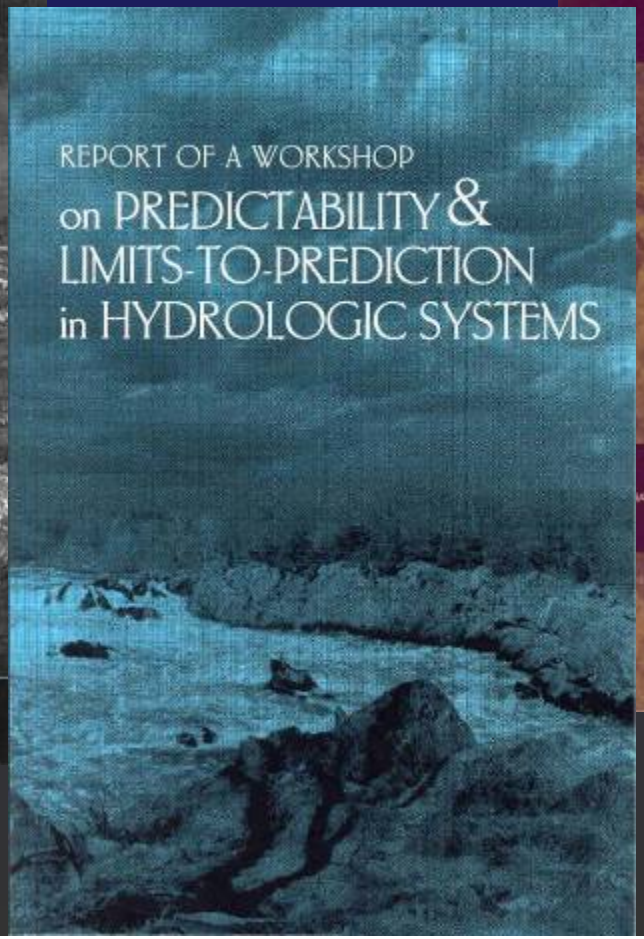
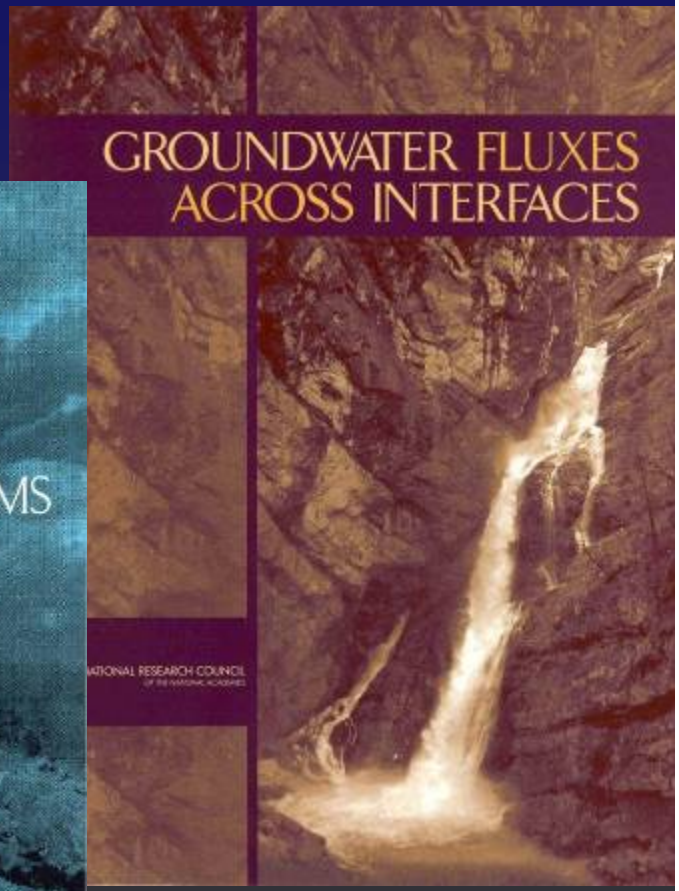
Committee on Hydrologic Science

Results







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Committee on Hydrologic Science

This past year-and-a-half…

- COHS Workshop on Research and Education Needs for Water Management, March 2006
- Hosted Sixth International Implementation Planning Meeting of the GEWEX Coordinated Enhanced Observing Period (CEOP) March 2007
- Hosted Third Integrated Global Water Cycle Observations (IGWCO) Planning Meeting March 2007
- Hosted Third Meeting, U.S. National Committee for UNESCO IHP, April 2007

This fall it is expected to host a meeting on US activities in Global Earth Observation System of Systems (GEOSS)

EARTH OBSERVING SUMMIT I LAUNCHES A HIGH LEVEL APPROACH TO PLANNING OBSERVATION SYSTEMS

J → **2003**

LAUNCH OF THE PREPARATION OF THE GEOSS FRAMEWORK
EOS I

Membership open to all countries

International organizations are Participants

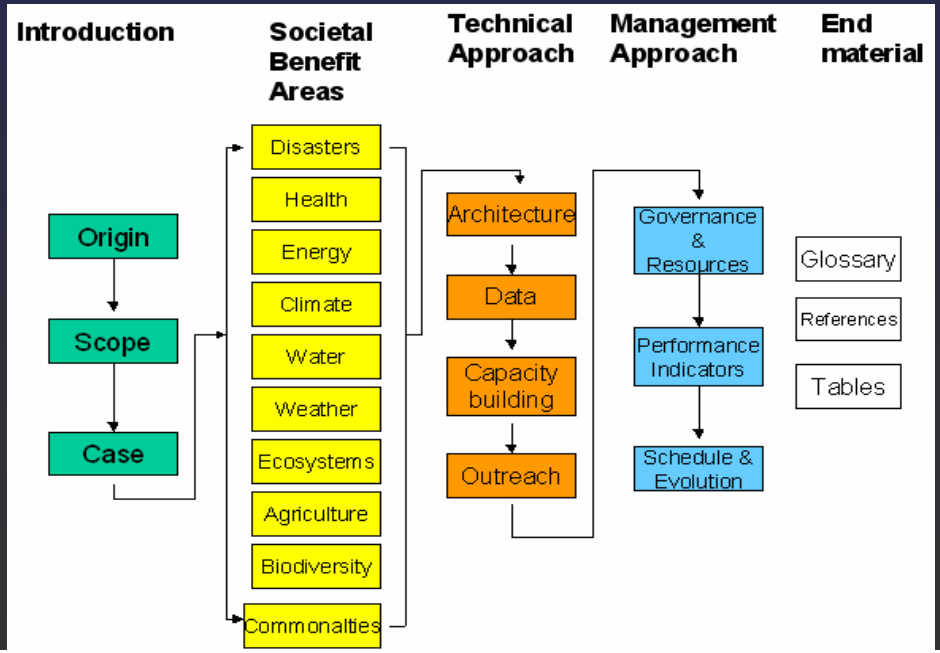
Established 5 subgroups Architecture, User requirements and outreach, Data utilization, Capacity building, International cooperation

Established GEO Secretariat – hosted by U.S. and comprised of GEO Members and Participants

GEOSS PLANS DEVELOPED ON A HIGH PRIORITY BASIS EOS II LAUNCHED THE DEVELOPMENT OF THE TYIP

APRIL → **2004**

LAUNCH OF THE PREPARATION OF THE GEOSS IMPLEMENTATION PLAN WITH SOCIETAL BENEFIT AREAS INCLUDING WATER. WATER THEME TARGETS ARE BUILT UPON THE IGWCO REPORT.



GEO ADOPTS A TEN YEAR PLAN AND LAUNCHES THE DEVELOPMENT OF WORK PLANS

2007

EOS III: February 16, 2005
Brussels, Belgium

JUNE 30: DEADLINE FOR INPUTS TO GEOSS 2005-07 WORK PLANS

AUGUST 30: PROGRESS REPORT ON GEOSS

70 Nations

32 International Organizations

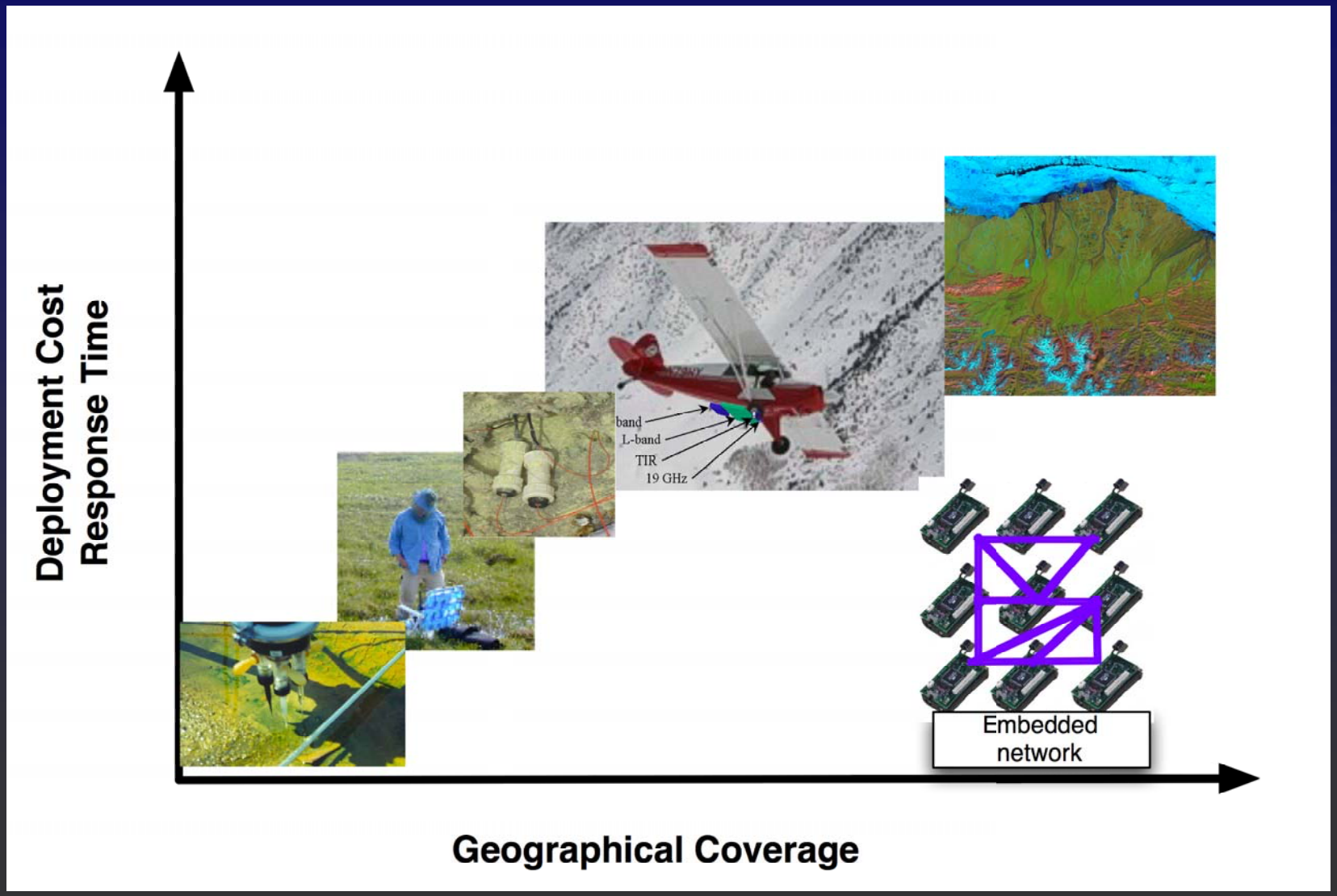
Integrated Observations for Hydrologic and Related Sciences

- A study under the auspices of COHS
- Funded directly or indirectly from NASA, NSF, USACE, NOAA, NRC, EPA – Thank you!
- Still in response to review phase, so discussion will focus on key issues rather than specific recommendations
- Complements Water Chapter of the "Decadal Survey"

Motivation for the Study

- The interrelated challenges of population growth, global climate change and regional changes in land use and land management will increasingly stress water resources around the world.
- Meeting these challenges will require significant improvement in our management of water resources, which in turn requires improvements in our capacity to understand and quantify the hydrologic cycle and its interactions with the natural and built environment.
- Recent and potential future technological innovations in sensors and sensor networks, cyber-infrastructure, and data fusion offer unprecedented opportunities to improve our capacity to observe, understand, and manage hydrologic systems.

Scales from nano to satellite (not necessarily in the same location)



Charge to the committee

To examine the potential for integrating new and existing spaceborne observations with complementary airborne and ground-based observations to gain holistic understanding of hydrologic and related biogeochemical and ecological processes and to help support water and related land-resource management.

1. identify processes in water flow and transport … where better information is needed to understand important mechanisms;
2. identify (where) observations obtained by remote sensing or other existing technology could improve process understanding (and) be used for addressing water management problems;
3. evaluate the readiness of the scientific and technical communities to make effective use of more precise and reliable observations;
4. suggest research opportunities;
5. identify gaps in federal agency plans for integrating across sensors and products obtained from either in situ or space-based observations.

Key components are:

- Sensors that are smaller and less expensive, and thay demand less power, enabling deployment in far greater numbers;
- Sensor networks that enable the sharing of information and hence produce synergistic gains in observational capacity;
- Computer models that assimilate (merge) data from multiple sources to predict system behavior;
- Cyber-infrastructure initiatives that provide efficient and effective ways to share data with scientists, managers, and other potential users.

Case studies to illustrate the needs and opportunities for new measurement capacity:

- Hydrologic monitoring in the Everglades
- Tradeoffs between water quantity and quality in the Southern High Plains
- Multi-disciplinary research on malaria in Sub-Saharan Africa
- Hydro-climatic research in the Arctic
- Hydrologic extremes and water quality in the Neuse River watershed
- Mountain hydrology in the western U.S.

The Vision for Integrated Observations:

- Ability to integrate a wide variety of measurements across all relevant scales;
- Use of models to offer wide-ranging predictive capabilities;
- Make available data and (model) predictions through ‘web portals’—where water managers and educators can easily access the information.

Many elements of this vision currently exist:

- Examples include sensors of physical properties, sensor networks, methods for data assimilation, and web-based methods for communicating data (e.g. planned NIDIS web-portal).
- But the larger picture “needs some work.”

Challenge: Development and Field Deployment of Land-Based Chemical and Biological Sensors

For widespread field use chemical and biological sensors must:

- Be inexpensive
- Tolerate environmental stresses (temperature extremes, biofouling…)
- Have stable calibrations or be capable of remote calibration
- Have low energy requirements.

Challenge: Doing more with Airborne Remote Sensing

- Historically viewed as an intermediate step between initial sensor development and space deployment.
- Should NASA and other federal agencies spend more time thinking about airborne platforms as operational measurement systems?
- Might we develop smaller, less expensive sensors that could be used on these platforms?

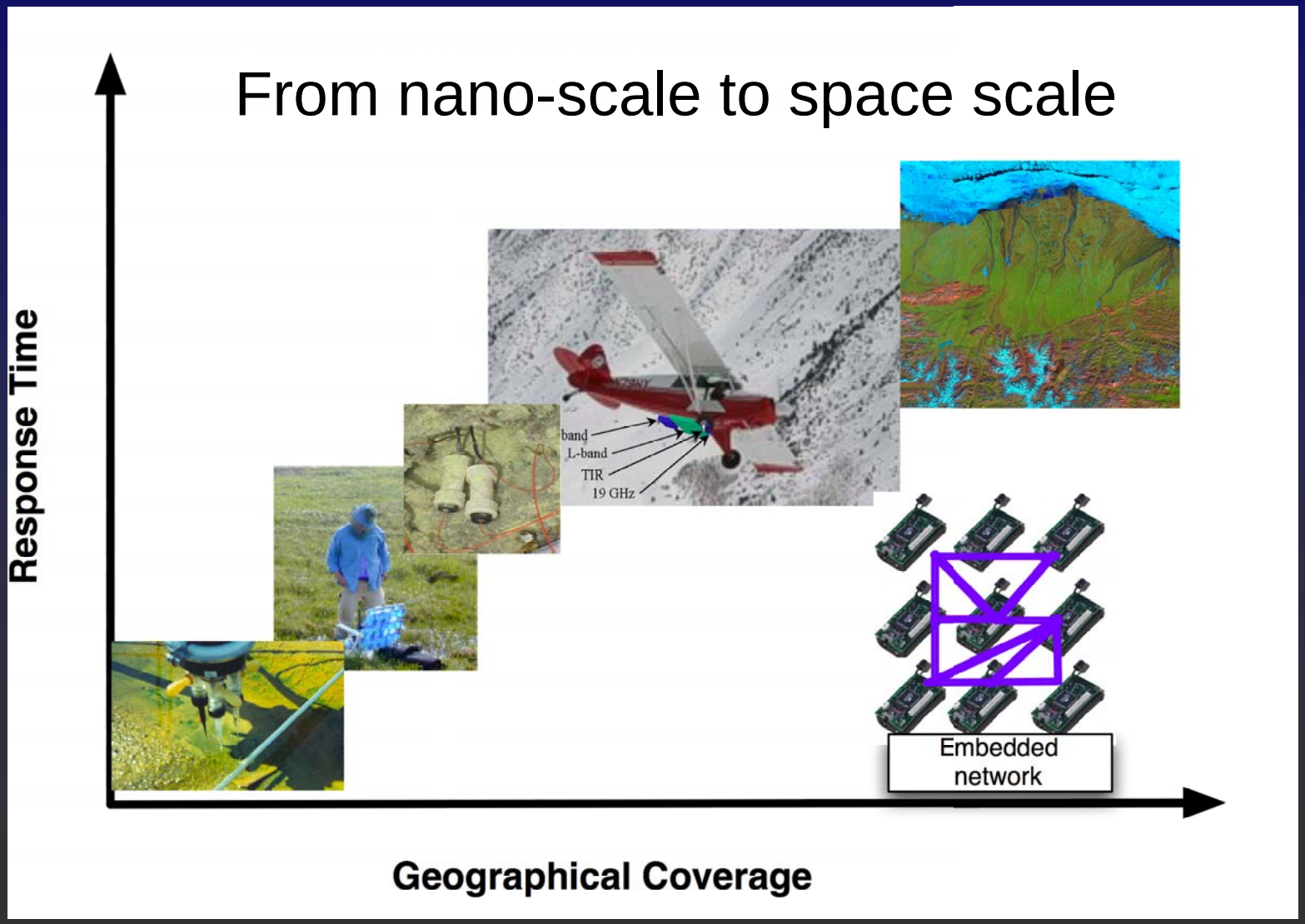
Challenge: Interagency gaps between the steps of sensor development, demonstration, and operational deployment

- How can we close these gaps?
- Would coordinated and jointly funded observatories, demonstration projects, test beds, and field campaigns help?
- What kind of funding would this require and for how long?

Challenge: Fractured Federal Responsibility for Measurement, Monitoring and Modeling

- How might NSF, NASA, NOAA, EPA, USGS, and health and security agencies, work together on multi-disciplinary sensor development? An interagency sensor laboratory?
- How might NASA (and NOAA) work with NSF and others during the early design phase/s of the WATERS/NEON observatories so space-based and airborne observations are incorporated?

Challenge: Getting the new information to those who can use it

- How can we expand support for the application of integrated data products that meet educational, modeling, and decision support needs.
- Are web-based services (e.g., “collaboratories” for the distribution of observations, model predictions and related products to potential users), part of the solution?

Questions? Comments?