



# OneNOAA Science Seminar

## Towards Integrated Earth Observation and Data Management Systems

**Helen Wood**

*GEOSS Integration Manager*

*Chair of NOAA's Environmental Data Management Committee*

June 22, 2010



# The Benefits of Earth Observations

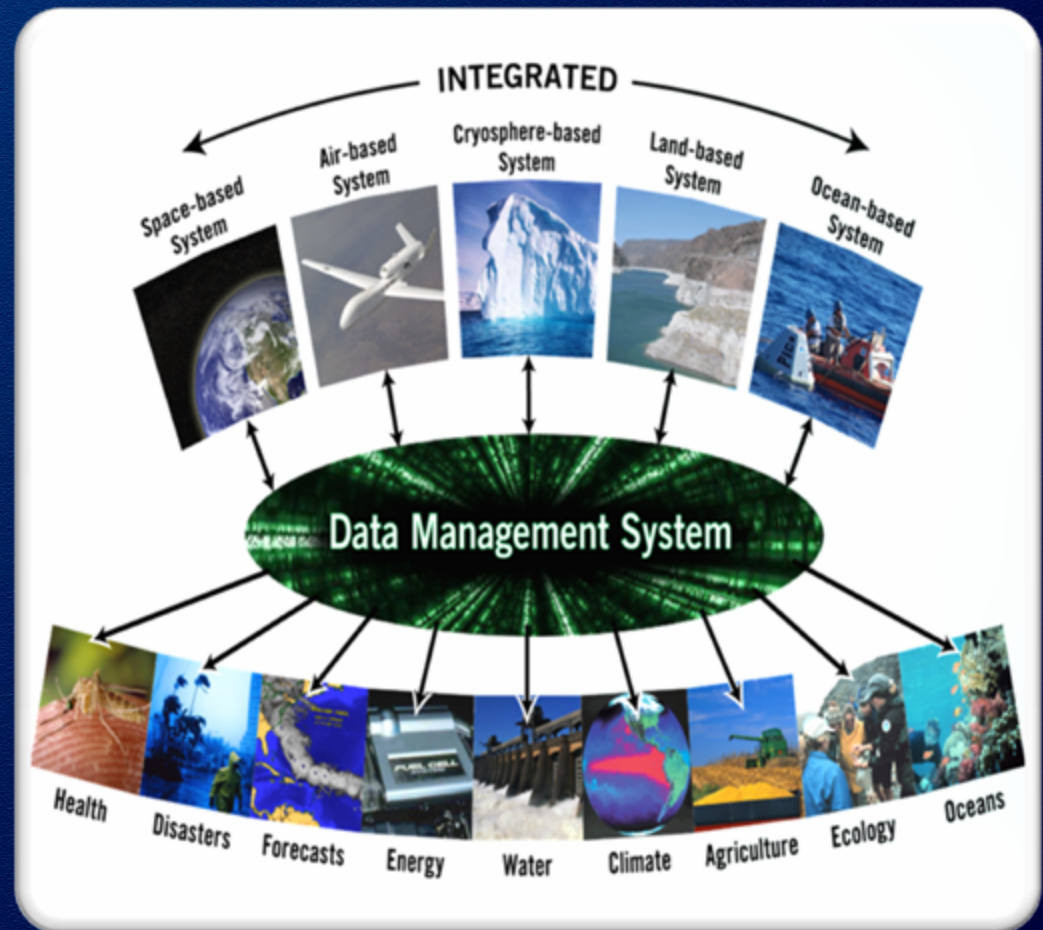
- Provide the right information,  
in the right format,  
at the right time,  
to the right people,  
to make the right decisions.



# The Global Earth Observations System of Systems (GEOSS)

## What is GEOSS?

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



# Group on Earth Observations (GEO)



## What is GEO?

- The intergovernmental Group on Earth Observations (GEO) is a voluntary partnership of 80 Member governments and the European Commission, working with 58 Participating Organizations
- GEO is coordinating efforts to build a Global Earth Observation System of Systems, or GEOSS
- A forum to develop new projects, coordinate strategies and investments



# U.S. Group on Earth Observations



- Established in March 2005 as a standing subcommittee of the National Science and Technology Council Committee on Environment and Natural Resources
- Develops the U.S. Integrated Earth Observation System
- Advances international coordination by formulating U.S. positions and inputs to GEOSS, taking into account the requirements of the widest range of decision-makers, researchers, service-providers, the public and other stakeholders

# USGEO in the Federal Structure



The White House / Executive Office of the President  
- Office of Science and Technology Policy

National Science and  
Technology Council

Committee on Environment  
and Natural Resources



Functional Groups

International

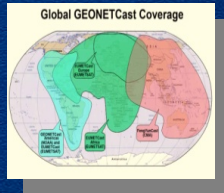
Architecture and  
Data Management

Strategic Assessment

25 Federal agencies and agency components



# U.S. Supports GEO and GEOSS



## U.S. Contributions include:

*Hosting of GEO-VI Plenary Meeting*

*GEOSS in the Americas*

*SERVIR*

*GEONETCast*

*North American Drought Monitor*

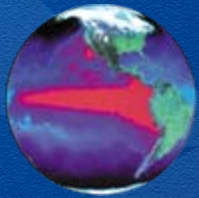
*AIRNow—International*

*Integrated Earth Observation System*

*2015 GEOSS Strategic Targets*

*GEO 2009-11 Work Plan*





# GEOSS in the Americas

- The efforts of governments and others to support the realization of GEOSS in the Western Hemisphere.
- A conceptual, umbrella framework to highlight existing collaborative efforts throughout the region that support the aims of GEOSS.
- A catalyst for new regional initiatives and cooperative opportunities.

## GEO Member Countries





# SERVIR



- SERVIR is a regional visualization and monitoring system for Mesoamerica that integrates satellite and other geospatial data for improved scientific knowledge and decision making.
- SERVIR is the first regional system of its kind in the world, enabling informed decision-making in areas of great significance, including weather forecasts, disaster management, air pollution, fire monitoring and red tides.



**SERVIR**  
Applying Earth Observation  
Science and Technology  
in Central America

SERVIR (Spanish acronym for Regional Visualization & Monitoring System) is bringing the satellite resources of the U.S. and other countries to aid previously inaccessible Earth observation data and other tools that assist in Central America. Serving all seven Central American countries and southern Mexico, SERVIR is the first regional system of its kind in the world, enabling informed decision-making in areas of great significance, including weather forecasts, disaster management, air pollution, fire monitoring and red tides. SERVIR encourages the sharing of data and information across multiple countries and data-sharing across international boundaries.

Each participating country contributes to SERVIR by providing its own geospatial data to a central hub in Panama, housed at the Walter Center for the humid Tropics of Latin America and the Caribbean (CATHALAC). The SERVIR team integrates that data and links it to the many types of satellite imagery that is collected regularly over the region. Our program's data is disseminated to scientists, researchers, educators, students and the public via an internet web portal in both Spanish and English. The portal allows for online map-making and makes available the specialized mobile tools to help users understand the data. To build capacity for use SERVIR tools, the center in Panama provides training to regional environmental scientists and technological services.

The SERVIR system is expanding functionality to provide decision support for climate prediction, coral reef monitoring, biodiversity conservation and agriculture crop forecasting among other areas. SERVIR can be replicated and tailored to the needs of other geographic regions. SERVIR are currently underway in Asia.

SERVIR reflects the collaborative efforts of all the Central American countries, CATHALAC, Central American Commission on Environment and Development, U.S. federal agencies including the National Aeronautics and Space Administration, Agency for International Development, National Oceanic and Atmospheric Administration and the U.S. Geological Survey and a number of key partners, including the World Bank, United Nations Environmental Program, The Nature Conservancy, Institute for the Application of Geospatial Technology, University of Alabama in Huntsville and University of Maryland, among others.

[www.servir.net](http://www.servir.net)

# GEONETCast



- GEONETCast is a low-cost, global environmental information delivery system by which remotely sensed and *in situ* data and services from GEOSS are transmitted to users through communications satellites offering near-global coverage.
- Using a multicast, broadband capability, GEONETCast provides information essential to protecting lives allowing for faster decision-making and policy response.



**GEONETCast Americas:**  
Near-Global Coverage to More Effectively Manage a World of Resources

In recent years, sources of satellite and in situ data and services have been essential to gather environmental information. As a milestone in the emerging Global Earth Observation System of Systems (GEOSS), GEONETCast is helping to make this vital information more widely available. The program transmits information on climate, water quality, air pollution, and more.

The U.S. National Oceanic and Atmospheric Administration (NOAA) has approved a national satellite service to provide near-global coverage of GEOSS data. The American Society of Geographers (ASG) is also providing an alternative means of distributing data and other information about the Earth's changing environment to users, particularly those in developing countries.

As a low-cost, global environmental information delivery system, GEONETCast will transmit data and services from GEOSS to users through communications satellites. GEONETCast offers near-global coverage of GEOSS data and services. GEONETCast provides information essential to protecting lives, allowing for faster decision-making and policy response.

Communication satellite providers broadcast using a standard protocol interface. Different data streams or products may be available on separate streams. The user determines which data are to be received, managed and saved locally. No internet connection is required. The receiving system is simply a standard personal computer, an off-the-shelf satellite receiver dish, and a few computer cables.

The total cost—around \$300 versus \$2,000 dollars. The result is essential, worldwide dissemination of urgently needed environmental data to users located just about anywhere on the planet—automatically—24 hours a day.

The communication satellite for each portion of the globe is provided by one or more GEONETCast partners. Current coverage is based on contributions from the European Organization for the Exploitation of Meteorological Satellites, the U.S. National Oceanic and Atmospheric Administration, and the Chinese Meteorological Administration. Private, for-profit interests in providing coverage in Europe. As a GEONETCast partner, the North American Organization contributes by providing its own geostationary, inter-satellite telecommunications systems for near-real-time information.

**GEONETCast Americas Quick View**  
To visit the GEONETCast Americas website, click on the "Quick View" link in the top right corner of the page.

**GEONETCast Americas**  
The GEONETCast Americas website provides a comprehensive overview of the program, including information on how to get started, a list of participating organizations, and a gallery of satellite imagery and data products.

# The North American Drought Monitor

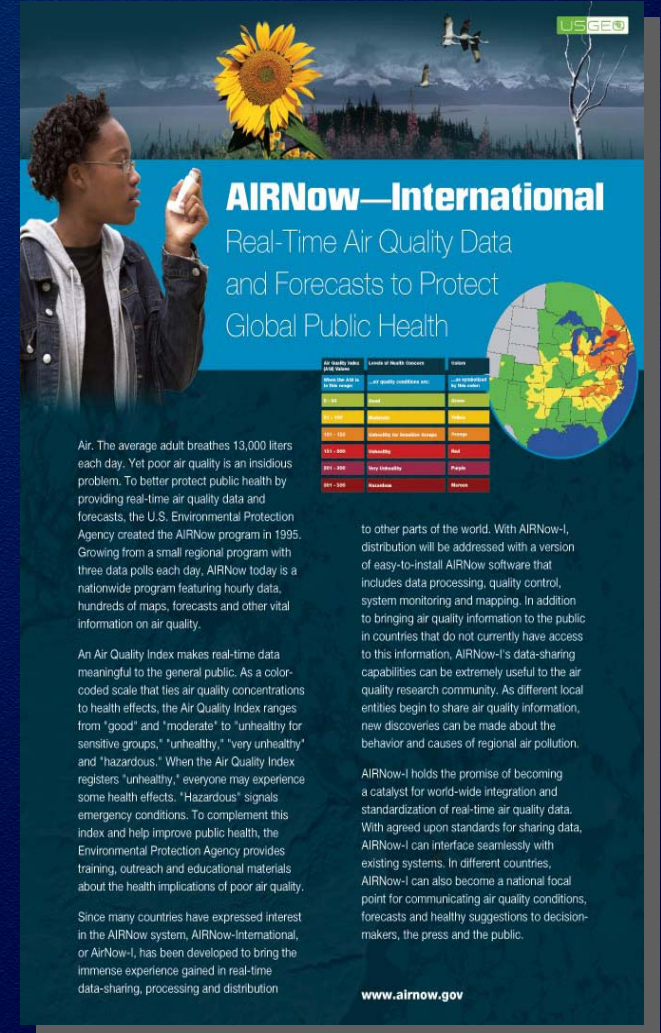


- Recognizing the need to improve drought response, the U.S., Canada and Mexico established the North American Drought Monitor program (NADM) demonstrating the value of open data exchange, shared scientific expertise and data management principles across borders.
- In the U.S., where drought affects more people than any other natural hazard, advances in drought monitoring, planning and responses also are being demonstrated through the U.S. National Integrated Drought Information System (NIDIS).



# AIRNow

- AIRNow is a U.S. nationwide program featuring hourly data, hundreds of maps, forecast and other vital information on air quality.
- AIRNow International holds the promise of becoming a catalyst for world-wide integration and standardization of real-time air quality data.



**AIRNow—International**  
Real-Time Air Quality Data and Forecasts to Protect Global Public Health

Air Quality Index (AQI) Range	Levels of Health Concern	Color
0-50	Good	Blue
51-100	Moderate	Yellow
101-150	Unhealthy for Sensitive Groups	Orange
151-200	Unhealthy	Red
201-300	Very Unhealthy	Dark Red
301-500	Hazardous	Maroon

The average adult breathes 13,000 liters each day. Yet poor air quality is an insidious problem. To better protect public health by providing real-time air quality data and forecasts, the U.S. Environmental Protection Agency created the AIRNow program in 1995. Growing from a small regional program with three data polls each day, AIRNow today is a nationwide program featuring hourly data, hundreds of maps, forecasts and other vital information on air quality.

An Air Quality Index makes real-time data meaningful to the general public. As a color-coded scale that ties air quality concentrations to health effects, the Air Quality Index ranges from "good" and "moderate" to "unhealthy for sensitive groups," "unhealthy," "very unhealthy" and "hazardous." When the Air Quality Index registers "unhealthy," everyone may experience some health effects. "Hazardous" signals emergency conditions. To complement this index and help improve public health, the Environmental Protection Agency provides training, outreach and educational materials about the health implications of poor air quality.

Since many countries have expressed interest in the AIRNow system, AIRNow-International, or AIRNow-I, has been developed to bring the immense experience gained in real-time data-sharing, processing and distribution

to other parts of the world. With AIRNow-I, distribution will be addressed with a version of easy-to-install AIRNow software that includes data processing, quality control, system monitoring and mapping. In addition to bringing air quality information to the public in countries that do not currently have access to this information, AIRNow-I's data-sharing capabilities can be extremely useful to the air quality research community. As different local entities begin to share air quality information, new discoveries can be made about the behavior and causes of regional air pollution.

AIRNow-I holds the promise of becoming a catalyst for world-wide integration and standardization of real-time air quality data. With agreed upon standards for sharing data, AIRNow-I can interface seamlessly with existing systems. In different countries, AIRNow-I can also become a national focal point for communicating air quality conditions, forecasts and healthy suggestions to decision-makers, the press and the public.

[www.airnow.gov](http://www.airnow.gov)



# USGEO Progress and Way Forward

## 2009 Accomplishments

- **Successful Host of GEO-VI Plenary in November 2009**
- Participation of over 300 representatives of 45 governments and 34 international organizations
- Advancement of the GEOSS Common Infrastructure (GCI) and the creation of a GCI Team;
- Acceptance by governments of the Data Sharing Implementation Guidelines;
- Acceptance of the GEOSS Strategic Targets for 2015; and
- Advancement of the Monitoring and Evaluation process for GEOSS
- **Increased Interagency Coordination**
- Completed Strategic Assessment of U.S. Earth Observations
- Completed IEOS Web Services Architecture Technical Resource

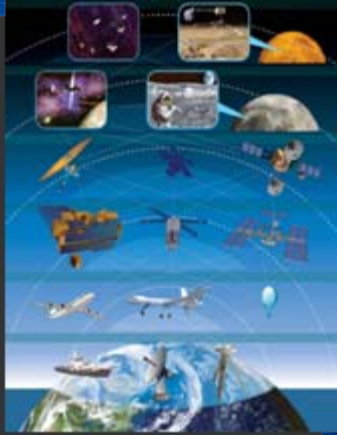


## 2010 Priorities

- **Preparation for the GEO Ministerial Meeting in Beijing, China, on November 5, 2010**
  - Ministerial Task Force identification of 10 showcases
- **Increased U.S. Focus on Emerging GEO Priorities:**
  - Forest monitoring for carbon
  - Global carbon monitoring and analysis
  - Global Biodiversity Observation Network
  - “2010 Baseline” for key Earth observation data sets
- **Development of a National Strategy for Earth Observations**
- **Increased Regional Collaboration**
  - GEOSS in the Americas
- **Clearance and Dissemination of the Strategic Assessment of U.S. Earth Observations**
  - Societal benefit area follow-up reports



# Strategic Assessment



Recently, the U.S. has expanded existing evaluation and assessment methodologies to better understand the costs and benefits of closing identified gaps in Earth observing capabilities and to prioritize future investment opportunities based on this framework.

This strategic assessment will further develop the U.S. Integrated Earth Observation System (IEOS), which harmonizes Federal government investments in Earth observations and comprises the U.S. National contribution to GEOSS.

A follow on document focusing on Earth observations priorities is the next step.



## Assessment Goals

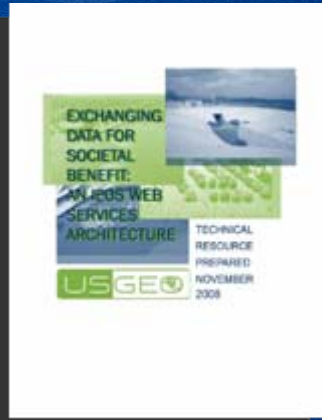
Provide an integrated picture of national Earth observations priorities  
 observations  
 focus near-term decision-making at the highest levels of government  
 Consider measurements from all types of platforms: space-based, airborne, subterranean, land and sea-based

well as the need for new measurements

# Architecture and Data Management

To enhance Earth observations systems and data interoperability, USGEO has authored a technical guidance document laying forth best practices in the development of Internet-based architecture to serve users by providing seamless access from multiple locations to new and legacy data.

This web-services architecture supports a set of powerful tools for the creation, collection, documentation, analysis, preservation, and dissemination of digital data.



# Towards the 2010 Ministerial and Beyond

## GEOSS Themes:

Water

Health

Climate

Energy

Weather

Disasters

Agriculture

Biodiversity

Ecosystems



The 2010 GEO Ministerial Summit, to be held in November in Beijing, represents a significant opportunity to strengthen and accelerate GEOSS on important issues, such as global carbon observing, ecosystems, advancing public health, and water resources quality and quantity.

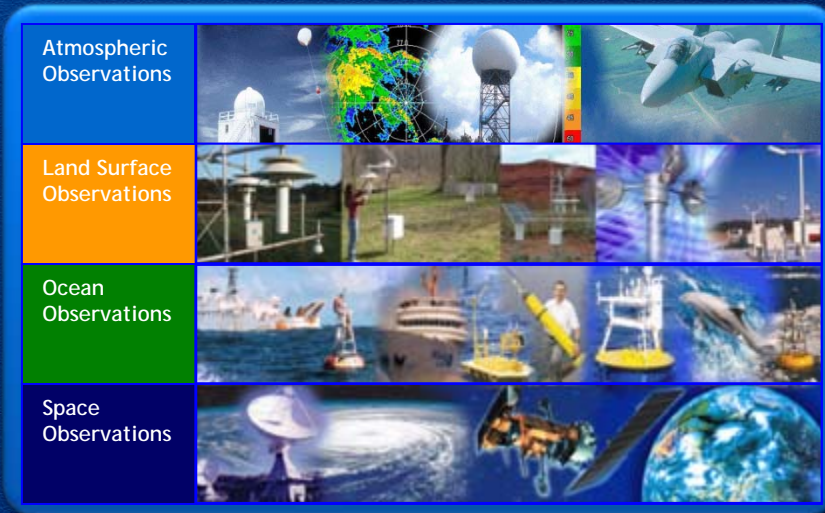




# NOAA: a Leader in Environmental Data Management

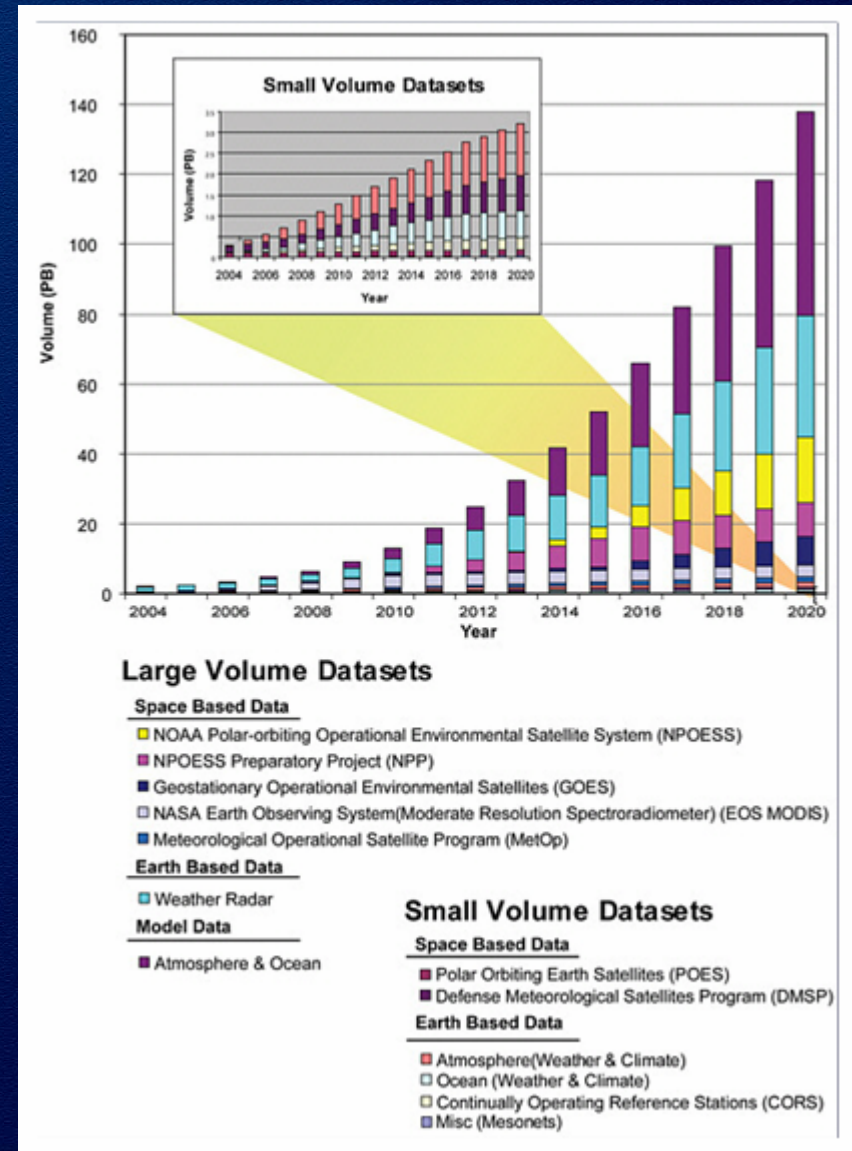
## Broadest Scope of any Agency for Environmental Data Stewardship

- ~150 Research & Operational Observing Systems ([http://www.nosa.noaa.gov/observing\\_systems.html](http://www.nosa.noaa.gov/observing_systems.html))
- ~4-5 Petabytes of data/year (~15 Pb total)



## Data Management Challenges are Changing

- No longer about data volume
- Data discovery and integration
- Data stewardship and information



# Environmental Data Management at NOAA

## Requirements

- Accessibility
- Discoverability
- Usability
- Integration
- Preservation/reuse

## Benefits

- Weather and water
- Climate
- Ecosystems
- Commerce and transportation

## Approaches/Systems

- Comprehensive Large Array-data Stewardship System (CLASS)
- Meteorological Assimilation Data Ingest System
- Global Earth Observations-Integrated Data Environment
- Integrated Ocean Observing System Data Integration Framework
- National Integrated Drought Information System/climate portals

## Strategic Emphasis

- Access to long-term archives
  - Applying CLASS to address large data records
- Addressing increased information volume and diversity
  - Developing high performance computing plan
- Gaps in environmental data records
- Integration of observations and products



# Transforming NOAA Environmental Data Management

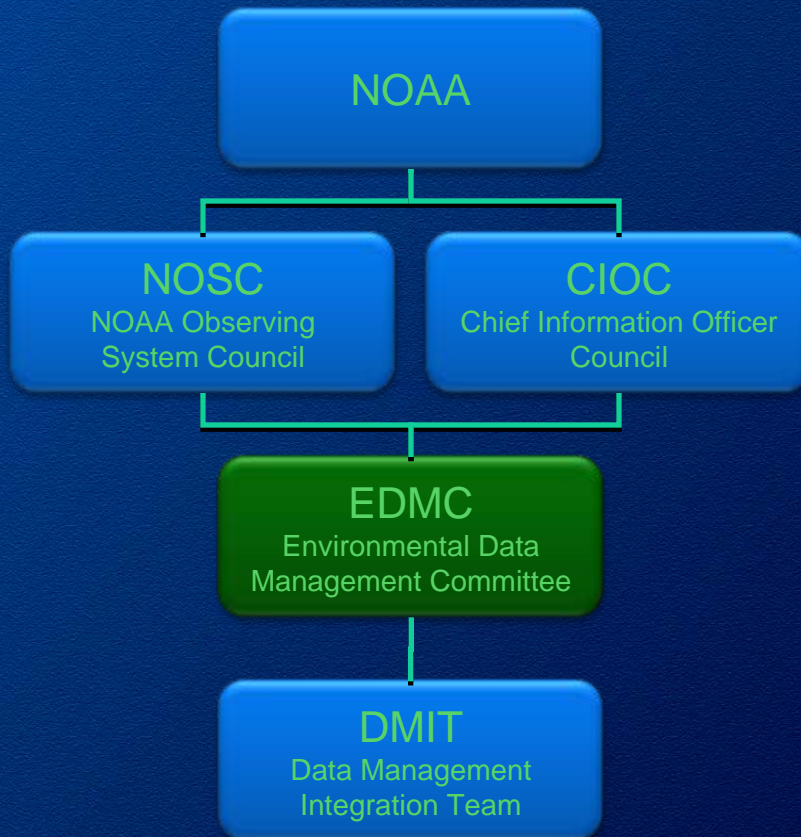
- Strengthening Policies and Directives
- Leveraging Standards
- Expanding Data Discovery and Access



# Strengthening Policies and Directives

## Environmental Data Management Committee (EDMC)

Established in Fall of 2009



- Coordinates the development of NOAA's environmental data management strategy, and policy, and provides guidance to ensure consistent implementation across NOAA, on behalf of the NOSC and CIO Council
- Environmental data management is an end-to-end process that includes acquisition, quality control, validation, reprocessing, storage, retrieval, dissemination, and long-term preservation activities
- The goal of the EDMC is to enable NOAA to maximize the value of its environmental data assets through sound and coordinated data management practices
- Leadership: Chair and Deputy Chair appointed by NOSC and CIO Council
- Membership
  - Line Office Representatives
  - NOAA Chief Enterprise Architect
  - NOAA Data Management Architect
- Ex-officio or Advisory
  - NOAA National Data Center Directors
  - Designated Mission-Goal & Sub-Goal Team Representatives
  - NOAA liaisons to key Federal and International initiatives concerning environmental data management

# Strengthening Policies and Directives

## NOAA Environmental Data Management Framework

### Overarching all Aspects of the Data Management Lifecycle

Governance, Requirements Management, Architecture Management  
Developing and maintaining rich metadata to accompany the data  
Establishing mechanisms that allow for user requirements and feedback

#### Planning of New Observing or Data Management Systems

- Requirements definition
- Analysis of alternatives
- Systems design
- Integration with observing systems (NOAA, interagency, state, international)
- Determining what to archive and associated funding
- Buy/build

Stewardship Overarches Observing Operations, Archive, Access, Use  
All ongoing, iterative processes that improve: 1) data and metadata content (include reprocessing data) and 2) access and user understanding

#### Observing Operations

- Actual observation
- Transmission/processing QA
- Integration with other data to create products (e.g., models)
- Dissemination to real-time subscribers
- Delivery to archive

#### Archive

- Ingest (Receipt)
- Archival storage
- Data management (populating catalogs, registries, metadata)
- Preservation planning (migration to new technologies)

#### Access

- Discovery (catalogs, registries, metadata)
- Dissemination to users (web services, legacy systems, standard formats)

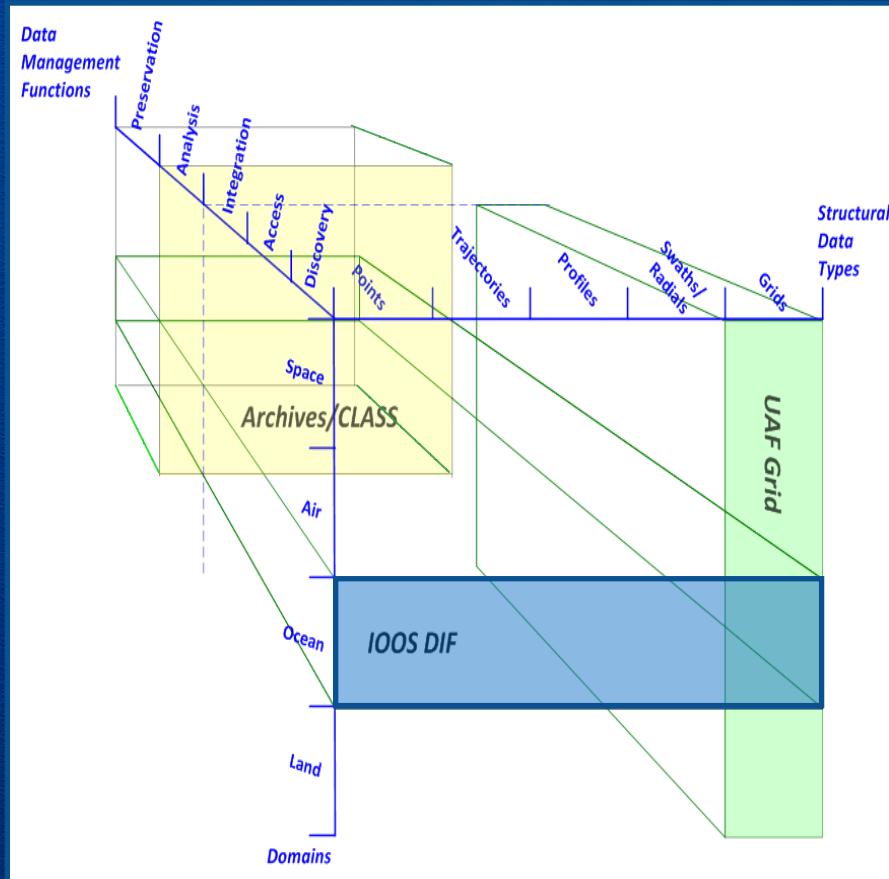
#### Use

- Integration with other information (NOAA, others)
- Assimilation into models
- Product creation
- Make decisions (policy, emergency, others)
- Scientific discovery
- Feedback to NOAA



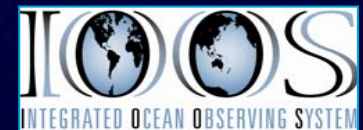
# Leveraging Standards

## Global Earth Observation-Integrated Data Environment (GEO-IDE)



Unified Access Framework for Gridded Data (UAF Grid)  
 Integrated Ocean Observing System Data Integration Framework (IOOS DIF)

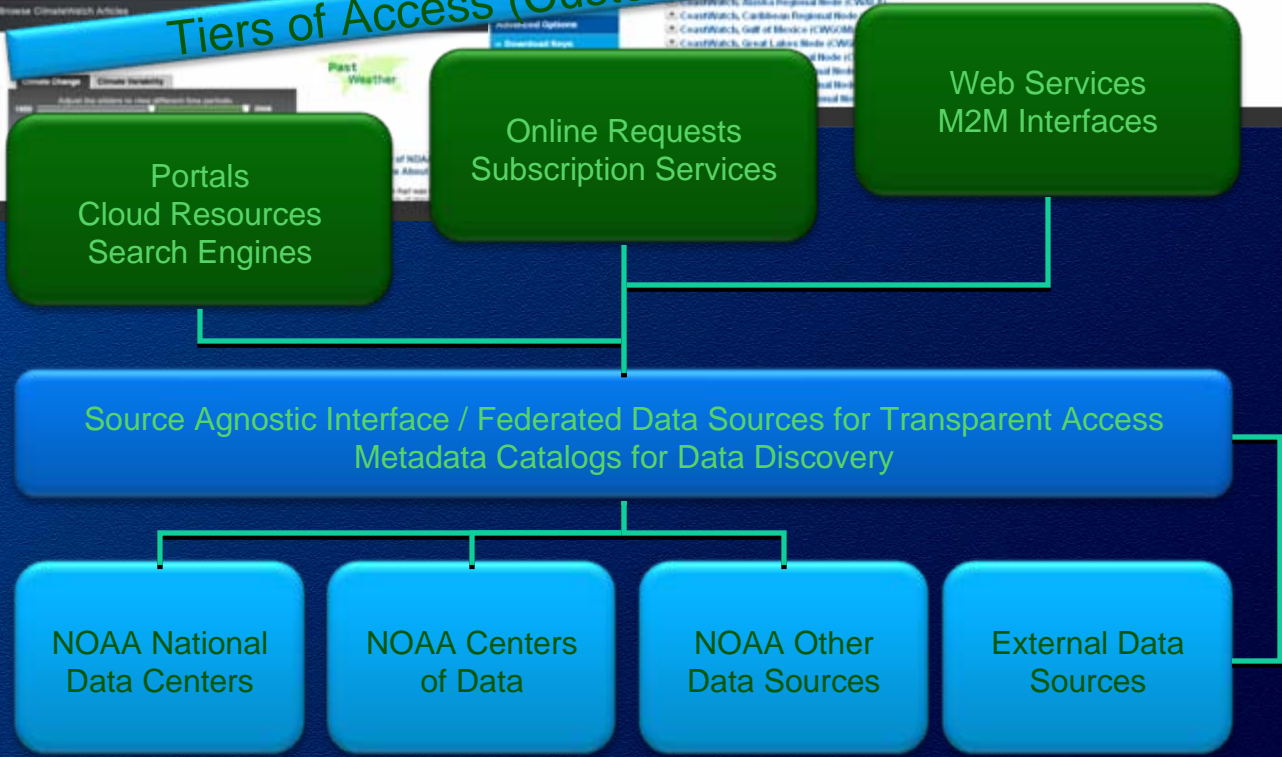
- **Scope** – NOAA-wide architecture development to integrate legacy systems and guide development of future NOAA environmental data management systems
- **Vision** – NOAA’s GEO-IDE is envisioned as a “system of systems” – a framework that provides effective and efficient integration of NOAA’s many quasi-independent systems
- **Foundation** – built upon agreed standards, principles and guidelines
- **Approach** – evolution of existing systems into a service-oriented architecture
- **Result** – a single system of systems (user perspective) to access the data sets needed to address significant societal questions



# Expanding Data Discovery and Access



Tiers of Access (Customer Sophistication) →



# Summary

- NOAA is facing some major challenges in managing its environmental data resources
  - Rapid growth in data types, volume, and complexity
  - High levels of information heterogeneity
  - Increasing demand for data exchange/integration/interoperability
  - Need for cost-effective, secure solutions
- Inside NOAA, we are seeing increasing information exchange and collaboration
  - Projects leveraging common standards and technologies
  - Greater use of Integrated Product Teams
  - Strengthened partnership between environmental data managers and the Office of the CIO
- Also strong interest in participation in community, interagency and international initiatives
  - Includes making NOAA contributions to the initiatives and leveraging expertise of the external partners

