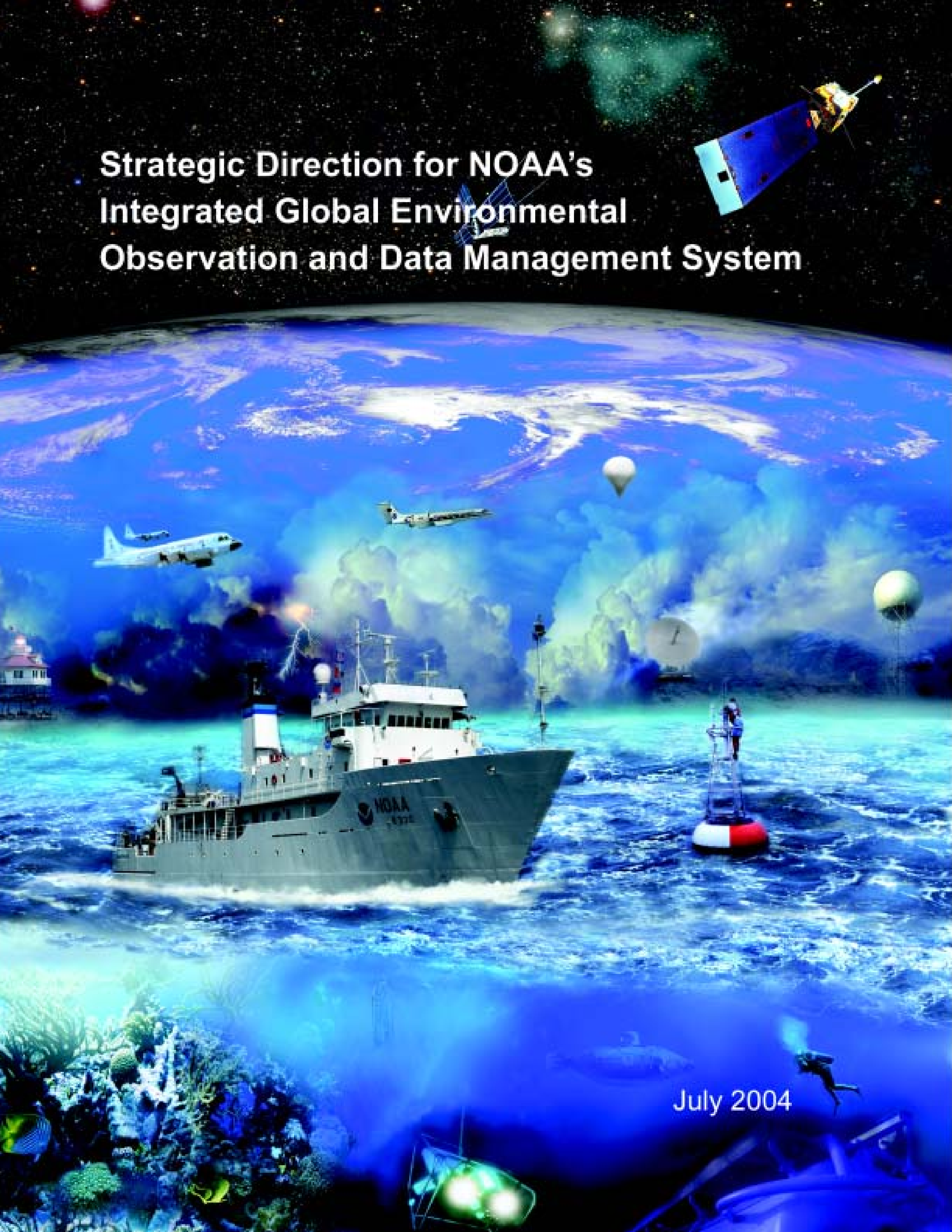
Strategic Direction for NOAA's Integrated Global Environmental Observation and Data Management System



July 2004

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Contents

NOAA's Vision

Move NOAA into the 21st Century scientifically and operationally, in the same interrelated manner as the environment that we observe and forecast, while recognizing the link between our global economy and our planet's environment.

NOAA's Mission:
Understand and predict changes in the Earth's environment and conserve and manage coastal and marine resources to meet our Nation's economic, social, and environmental needs.

NOAA's Mission Goals:

1. Protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management.
2. Understand climate variability and change to enhance society's ability to plan and respond.
3. Serve society's needs for weather and water information.
4. Support the Nation's commerce with information for safe, efficient, and environmentally sound transportation.

Foreword

Earth observations have been at the heart of NOAA's mission throughout its existence. In fact, environmental information is our lifeblood. NOAA depends on observing systems for virtually every activity the agency does, from fundamental research to long range operational forecasting and day-to-day regulatory decisions. Our present observing system architecture is composed of many different systems covering a wide range of critical environmental information needs. Many of these observing systems were built for a single purpose and consist of limited numbers of sensors connected to different networks using a variety of data formats and dissemination methods. In order to meet today's ever-growing needs, we must conduct our business using more efficient methods. As the population of the world potentially doubles from the present six billion people over the next 50 years, it is critical that we improve our current limited understanding of the complex and interconnected systems of our planet. Understanding our environment and being able to forecast accurately conditions and outcomes both in the near- and far-term form the basis of sustainable economic development and the wise use of our limited natural resources.

The benefits of a single integrated system or system of systems will be enormous. Not only national, but global coverage of all of the Earth's many subsystems will become, for the first time, a reality. Resources can be applied in a more efficient and effective manner to reduce duplication in today's observing systems, improve coverage, and provide networks to disseminate information and knowledge where and when it is needed around the world. The economic benefits to our nation alone will be both significant and vital in maintaining our global leadership and supporting an ever-growing population. For the first time, the vital role of the environment as a major contributing factor in our global economy will be more clearly understood. Public policy makers around the world will have a common basis for making wise governance decisions in a shared framework. Valuable environmental "nowcasts" and forecasts will provide industry worldwide with the wherewithal to make efficient investment decisions.

This document describes the beginning of NOAA's journey on the road to developing our integrated global environmental observation and data management system. I'm enthusiastic about, and committed to, NOAA's priority on Earth observations. I encourage you to contribute to, keep aware of, and take advantage of our agency's progress in environmental observations and data management.

Vice Admiral Conrad C. Lautenbacher, Jr., U.S. Navy (Ret.)
Under Secretary of Commerce for Oceans and Atmosphere and
NOAA Administrator

Preface


In our roles as Co-Chairs of the NOAA Observing Systems Council, it is our pleasure to transmit the following document, which describes the early shape of NOAA's observing systems and future plans. NOAA is in the midst of exploring ways of achieving more value through its observing program. This evaluation includes examining various end-to-end architecture options that will integrate more effectively user needs, through the identification of requirements, with observations, data collection, products, and archival and access systems.

We have started down this path with the creation of this document which provides an overview of the process being used to examine requirements and prioritize observations, describes how NOAA is addressing several challenges associated with this effort, and presents an initial observing system inventory. This document fulfills the NOAA Observing Systems Council requirement to develop an Integrated Global Environmental Observation and Data Management System Strategic Plan as specified by the NOAA Strategic Plan.

It is our hope that we in NOAA can set the example for the U.S. Government through the shaping of our observation program and can leverage our work with the White House Committee on Environment and Natural Resources' Interagency Working Group on Earth Observations. This is the next step in the process of working with local, state, regional, national, and international partners to develop global to local environmental and ecological observation and data management systems for comprehensive, continuous monitoring of Earth's environment.

Gregory W. Withee
Co-Chair, NOAA Observing Systems Council
Assistant Administrator for Satellite and Information Services

David L. Johnson
Co-Chair, NOAA Observing Systems Council
Assistant Administrator for Weather Services

Executive Summary

For more than 30 years, the National Oceanic and Atmospheric Administration (NOAA) has been the U.S. leader in operational environmental observations. Over that time, we have addressed the need for change as we explored new science and introduced new products, and fielded new systems. **Today, we continue to posture ourselves to maintain our role as leaders and innovators.**

The nations of the world are aware of the increasing social and economic need for an effective global Earth observation system that depends on science to realize environmental and scientific benefits. NOAA has been working with national and international partners to strengthen cooperation in Earth observations.

We believe we are in a new era where human ingenuity must be more rigorously applied to develop a deeper understanding of the complex systems of planet Earth. We are focused on building **"an integrated global environmental observation and data management system"—**an operational Earth observation system that is comprehensive, coordinated, and sustained, with a robust research underpinning.

NOAA will continue to play an active role in the intergovernmental Group on Earth Observations (GEO) and the Interagency Working Group on Earth Observations (IWGEO) development activities begun in summer 2003. NOAA is also working with our partners to develop a prioritization process that will be critical to the success of the operations of our future systems within the GEO and IWGEO.

To develop the pathway to an integrated global environmental observation and data management system, we will establish the NOAA Information Service Enterprise (ISE) as an end-to-end, NOAA-wide system that recognizes the value of operational environmental observations and addresses the essential functionality necessary to satisfy the future needs of users. **The initial set of strategic goals for the ISE** has been identified (see page 10). The ISE will recognize the "lifeblood" of NOAA—the environmental information provided by the enterprise to our users. The ISE will also recognize the importance of research (in advancing and evolving our ISE) to meet future users' needs and to anticipate and investigate environmental issues before they become significant.

NOAA is concentrating its efforts in 2004 on defining and establishing the ISE. The Ecosystem-based Management Enterprise (EME) definition and establishment will become the focus of 2005. We also anticipate that the Final Report of the U.S. Commission on Ocean Policy (USCOP) and the implementation of the report's recommendations by the Executive and Legislative branches will have an impact on this enterprise.

In August 2002, NOAA initiated its first-ever comprehensive review of all of its observing systems and their interrelationships. This activity was termed the baseline NOAA Observing Systems Architecture (NOSA) and addressed "only NOAA-owned, -operated, or -funded systems." Building on the foundation of the baseline NOSA, NOAA developed an implementation plan for its Observing Systems Architecture. Much more work is ahead for us as we continue to expand the baseline architecture to include linkage to our external partners (local, regional, national, and international) and their data, information, and/or systems, and to develop our target Integrated Global Environmental Observation and Data Management System architecture.

Data management within NOAA will support the enterprise functions with **common and NOAA-approved hardware and software, policies, practices, and standards,** as we migrate into an integrated information enterprise from stovepipe-specific solutions (including stovepipe collector systems) with literally hundreds of data management systems.

NOAA is, and will continue to be, in the operational and environmental observations and information "business." NOAA has made substantial initial progress in its journey to develop an Integrated Global Environmental Observation and Data Management System—but a tremendous amount of work lies ahead.

NOAA will continue the work, begun over the past year and a half, to organize, better equip, and develop an Integrated Global Environmental Observation and Data Management System. Working effectively with our national international partners and by working to improve corporate business processes, **NOAA is poised for success.**

NOAA and Earth Observations

The 21st Century presents complex challenges for the National Oceanic and Atmospheric Administration (NOAA). Every aspect of NOAA's mission—ranging from managing coastal and marine resources to predicting changes in the Earth's environment—faces a new urgency, given intensifying national needs related to the economy, the environment, and public safety. As the new century unfolds, new priorities for NOAA action are emerging in the areas of climate change, freshwater supply, ecosystem management, and homeland security.

Observations of the environment are intrinsic to NOAA's mission. NOAA envisions an **Integrated Global Environmental Observation and Data Management System** that will bring together all aspects of environmental monitoring on common platforms, ensuring data quality, managing data efficiently for the long-term, and making these data easily and readily accessible. NOAA will continue to work with our partners (local, regional, national, and international) to develop these global-to-local environmental observations, continually monitoring the complex, coupled ocean/atmosphere/land systems. This activity will maximize the mutual benefits of data exchange with all partners.

For decades, NOAA has been working with national and international partners to strengthen cooperation in Earth observations. Although not comprehensive, the following are important examples of international Earth observation initiatives in which NOAA has actively participated.

- World Meteorological Organization (WMO) World Weather Watch
- International Strategy for Disaster Reduction (ISDR)
- Global Climate Observing System (GCOS)
- Global Ocean Observing System (GOOS)
- Integrated Global Observing Strategy Partnership (IGOS-P)
- Committee on Earth Observation Satellites (CEOS)

Recent political initiatives, building on decades of technical work and successes, demonstrate the unique opportunity and political will now available to build this Integrated Global Environmental Observation and Data Management System. These political initiatives, with an Earth observation system focus, include:

- World Summit on Sustainable Development (August 2002)
- G-8 agreement on Cooperative Action on Science and Technology for Sustainable Development (June 2003)

- Earth Observation (EO) Summit (the first ever held), where the U.S. joined 33 other nations and the European Union in adopting a declaration (**Appendix 1**) for the development of a "comprehensive, coordinated, and sustained Earth observation system or systems" (July 2003)
- In association with the EO Summit, an *ad hoc*, intergovernmental Group on Earth Observations (GEO) was formed to develop a 10-Year Implementation Plan for this comprehensive Earth observation system of systems (August 2003)
- National Science and Technology Council, Committee on Environment and Natural Resources established an Interagency Working Group on Earth Observations (IWGEO) to develop a U.S. 10-year plan and to coordinate U.S. input into the intergovernmental process (August 2003)
- The Earth Observation Summit II held in Tokyo, Japan (April 2004). At this Summit, ministers from 43 countries and the European Union adopted a Communiqué of the Second Earth Observation Summit (**Appendix 2**) and the Framework for a 10-Year Implementation Plan (**Appendix 3**). The Communiqué commissions GEO to take necessary steps to have in place a draft 10-Year Implementation Plan before the Earth Observation Summit III, to be hosted by the European Union in early 2005. The Framework Document (a starting point for the 10-Year Implementation Plan) gives guidance for establishing a Global Earth Observation System of Systems (GEOSS).

NOAA will play an active role in these GEO and IWGEO development activities while building its Information Service Enterprise (described on page 16), in itself a formidable task. We will benefit from the parallel efforts of developing our corporate processes while becoming knowledgeable and contributing knowledge to these national and international processes. NOAA is working with GEO (international) subgroups and IWGEO (national) teams in the following areas:

- User Requirements and Outreach
- Architecture
- Data Utilization
- Capacity Building
- International Cooperation

NOAA is also working with our partners to develop a prioritization process that will be critical to the success of the operations of our future systems within the GEO and IWGEO architectures.

Two recent national initiatives, related to observing systems, will impact NOAA in its development of an Integrated Global Environmental Observation and Data Management System. First, the U.S. Climate Change Strategic Plan (issued in April 2003) presented a national strategy for continuing and accelerating climate observations and research. Second, the U.S. Commission on Ocean Policy issued its Preliminary Report in April 2004, recommending that NOAA be the lead Federal agency for implementing and operating an Integrated Ocean Observing System (IOOS), with extensive interagency coordination. The Commission recommended that Ocean.US be responsible for planning the IOOS. Ocean.US is an interagency office, established by the National Ocean Research Leadership Council (NORLC).

These international and national Earth Observation initiatives emphasize the importance of an integrated environmental observation and data management system to NOAA's mission. NOAA's Strategic Plan calls for this crosscutting system to be based on user requirements and to promote partnerships at all levels (local, national, regional, and international). NOAA's goal in this pursuit is to have an integrated, comprehensive, and sustained observation and data management system serving NOAA's four mission goals by improving our ability to understand, describe, and predict changes to the environment through the efficient, economical, and effective acquisition and dissemination of environmental observation data and information. In the following document, we:

- present the strategic goals for such an integrated system,
- provide an architecture overview for developing the system, and
- describe NOAA's initial implementation steps on the road map to developing such an integrated system.

Strategic Goals for the Integrated Global Environmental Observation and Data Management System

NOAA has taken the first of several important steps to develop a Strategic Plan that will establish the goals for the Integrated Global Environmental Observation and Data Management System. NOAA has identified the Information Service Enterprise (ISE) and the Ecosystem-based Management Enterprise (EME) to comprise the NOAA Services Enterprise. These enterprise initiatives identify the envisioned functions NOAA will perform and provide the construct in which to build an Integrated Global Environmental Observation and Data Management System.

The Federal CIO Council defines an enterprise as ***"an organization supporting a defined business scope and mission and comprised of interdependent resources (people, organizations, and technology) who must coordinate their functions and share information in support of a common mission (or set of missions)."*** The business scope and mission of NOAA is to provide operational environmental observations and services to the American public and to our other stakeholder partners. The Information Service Enterprise (ISE) will be that part of the NOAA organization comprised of the interdependent resources of systems, programs, processes, and people who will operate and support the Integrated Global Environmental Observation and Data Management System.

NOAA is concentrating its efforts in 2004 on defining and establishing the ISE. The EME definition and establishment will become the focus of 2005. The EME has significant dependence on the ISE in that EME's data and information needs will be satisfied by the ISE and the two service enterprises will also share common support services and leadership. (See **Figure 1**, next page.) The ISE will be presented more fully in this document in the section entitled Architecture Overview and the Transition to an Information Service Enterprise. Strategic goals for the ISE will be to:

- **Determine Federal agency environmental observation requirements.** We will collect Federal agency requirements for operational environmental observations to include space, air, ocean, and land sensing requirements. NOAA will become the Federal agencies' focal point to collect these requirements and to determine the best combination of three courses to satisfy these requirements: first, allocate to NOAA-owned, -operated, or -funded systems or programs; second, work with other Federal agencies, regional providers, and international partners to determine if these other providers can satisfy the communities' requirements; and third, determine and work with commercial industry to determine how industry could develop systems to meet these needs. We will commence this effort by first determining the NOAA-wide environmental observation requirements, a task for which a significant amount of work has already been accomplished. Two important elements of this goal are to:

1. Work with our growing and increasingly diverse set of users to determine future environmental requirements and new applications and to improve our interface with users.

2. Understand that we have unrealized potential for the use of our data and information in new applications. We will establish a robust and diverse customer interface and will work with users to understand mission, observable requirements, and attribute values. We will also provide NOAA enterprise resources to interface with constituents and develop applications to realize more fully the use and value of NOAA assets.

- **Establish NOAA-wide policies for observations and data management.** NOAA will develop enterprise-wide common processes, tools, interfaces, terminology, and standards (including achieving commonality with other Federal users where appropriate). We will manage our processes on a corporate-wide basis to include standardizing processes and

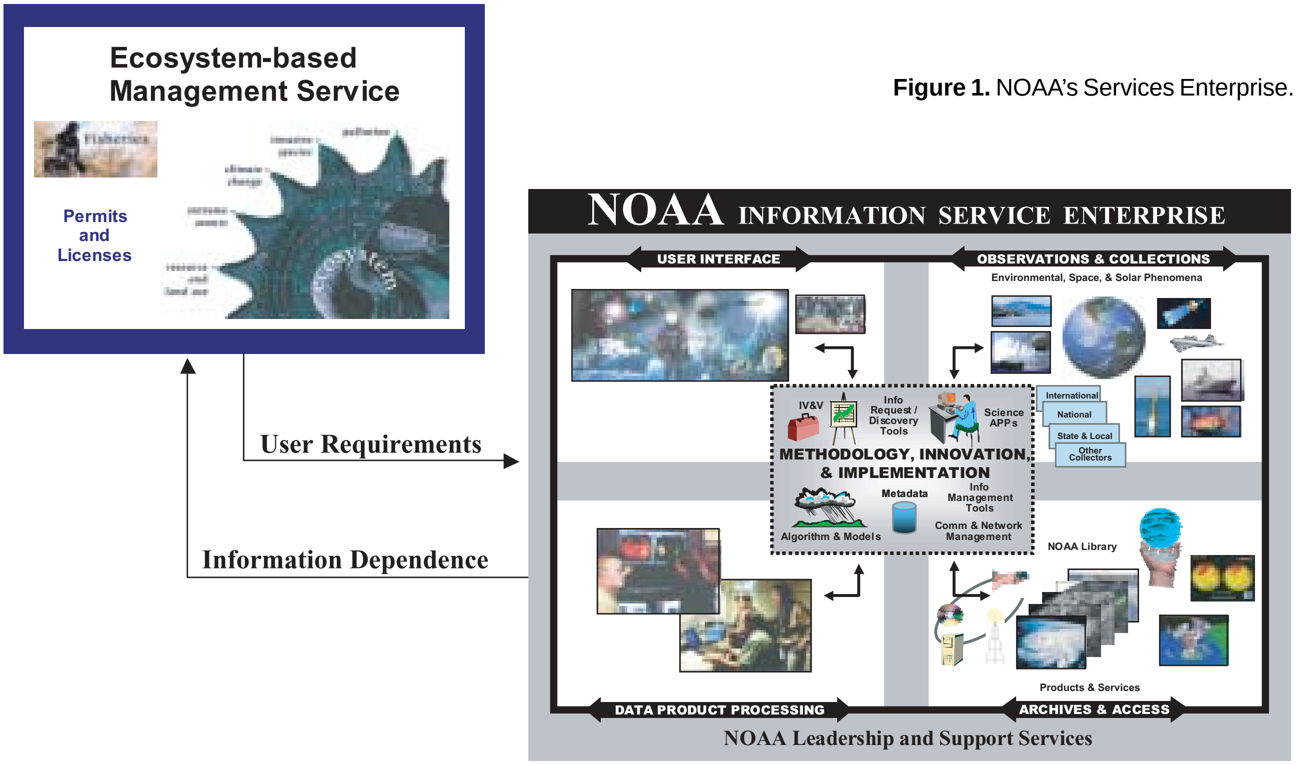


Figure 1. NOAA's Services Enterprise.

practices at the enterprise level, moving away from current practice of managing at the system level (currently our upper tier). We will design and plan, engineer and develop, and control and manage at the enterprise level as we move away from stovepipe systems and programs. Two important elements of this goal are to:

1. Focus on environmental information as the lifeblood of the enterprise. We will reduce the number of stovepipe systems and programs, and systems interfaces without sacrificing the collection of critical observations or the rigor we must continue to employ in the processing, archiving, and distribution of our products and services. We will obtain data, information, and services from all available sources that meet the criteria for inclusion in the NOAA Services Enterprise.

2. Move toward an all-digital environment for information collection, data management, product distribution, etc. We will bring new systems into the enterprise that are fully digital and we will examine which systems and processes need to be transitioned. We will also give priority to the digitization goal in the determination of decommissioning systems. Increasingly, we will move toward providing digitized services and products with a phase-out of non-digitized services and products by 2008.

- **Prioritize observables (e.g., environmental parameters) and provide a clear focus for high priority missions.** We will establish a prioritization schema for use among the mission goals and supporting tasks and will revalidate these priorities annually in guidance to the enterprise through the NOAA Administrator's Annual Guidance Memorandum (AGM). We will then capture these changes in the NOAA Strategic Plan and the NOAA Planning, Programming, Budgeting and Execution System (PPBES). We will also improve our processes matching enterprise resources to better address mission priorities within a 10-year plan.

- **Establish efficient and streamlined operations.** Mission refinement and redefinition, and products and services divestiture opportunities provide us with the opportunity to re-engineer our processes as we construct and transition to the ISE. As we identify the functionality and processes that we will need to incorporate into the ISE, we must be mindful of opportunities to increase our efficiency and to streamline our operations. We will also take maximum advantage of electronic means to interface processes and operations and will more actively reduce our reliance on physical co-location of similar processes or sequences of processes. Finally, we will adapt the proven processes of other organizations where an advantage exists rather than to create every process within NOAA that we need. We may also look to establishing Federal partnerships to share or contract for support to our operations where those arrangements would make sense. Three important elements of this goal are to:

1. Refine and redefine the modified or new observations and collections, and modified or new products based on mission changes and evolving user needs. Recent examples of mission refinement and redefinition have resulted from increased concerns for homeland security, ecosystems-based management, response to climate change impacts and sustained development. NOAA will also extend our support for the operational land mission where we already collect snowmelt, snow cover, runoff, soil moisture, drought indicators, and land cover for reflectance.

2. Divest NOAA from providing products and services that are more appropriate to the charters of other Federal agencies and to other sectors of our society. We will prepare our first divesture plan by late summer and will develop annual divestiture plans. NOAA's goal in divestiture planning will be to move to other organizations those functions that are mature or those functions that better fit with the resources and infrastructure of other agencies. Some mature functions that result in products and services are appropriate for transfer to the private sector and our partnering initiatives will manage this transition.

3. Redirect resources toward the development of new science. As we migrate mature products and services out of NOAA, we will have the opportunity to redirect resources to developing new science and new applications. When we identify new areas of development we must also develop plans to mature the science and transition it into new operational systems and into other sectors outside NOAA where appropriate. We will develop a balanced research to operations road map to increase the application of our resources and improve the quality of our future programs and systems.

- **Expand our traditional partnerships and develop a long-term partnership with U.S. industry.** We will move mature product production into the commercial sector. We will develop partnering opportunities that will contribute toward the creation of jobs in the private sector. We will communicate the future needs of our users to industry and we will work with Congress to obtain legislative authority and funding to award contracts that would allow the development of commercial systems for which we would have future guaranteed use. Such partnerships will assist us in shaping the marketplace so that we are assured of having U.S. commercial providers who can satisfy the future environmental data, information, and service needs of the Federal user. We also intend to use our experience in building partnership with the States, academia, and the international community in developing these partnerships with industry. Finally we look to build further on the success that we have achieved with our traditional partners.

Throughout the rest of calendar year 2004, NOAA will take the steps necessary to build the Information Service Enterprise guided by these strategic goals as we build the Integrated Global Environmental Observation and Data Management System.

Strategic Goals for the NOAA Information Service Enterprise:

- Determine Federal agency environmental observation requirements.
- Establish NOAA-wide policies for observations and data management
- Prioritize observations and provide a clear focus for high priority missions.
- Establish efficient and streamlined operations.
- Expand our traditional partnerships and develop a long-term partnership with U.S. industry.

Architecture Overview and the Transition to an Information Service Enterprise

Benefits-driven Architecture

NOAA is focused on building "an Integrated Global Environmental Observation and Data Management System"—an operational Earth observation system that is comprehensive, coordinated, and sustained, with a robust research underpinning. We believe we are in a new era where human ingenuity must be more rigorously applied to develop a deeper understanding of the complex systems of planet Earth.

Three imperatives frame our concept for this Earth observation system: social, economic, and scientific. The ***social imperative*** recognizes population growth and redistribution trends that are and will continue to impact crucial Earth resources like air, water, and food. Sustainable development captures the range of ***economic imperative*** issues that arise from these demographic population changes and the impact on economic well being of Earth's stewards. The ***scientific imperative*** is critical in helping us understand and manage these precious resources of planet Earth. We look to the scientific imperative to help us understand complex interactions, to examine, assess, and to preserve options to act before downstream negative effects overwhelm us and limit our options. We will approach the development of this Integrated Global Environmental Observation and Data Management System and the enterprise system architecture from a societal benefit and desired effects perspective.

Today, NOAA operates a complex network of observing systems. These systems include satellites, ships, and aircraft, and an extensive network of buoys, balloons, radar towers, and human observers. We have both operational and research assets in the network. Yet today, that complex network with many technically sophisticated supporting systems is insufficient to meet all dimensions of these social, economic, and scientific imperatives. The increased complexities of tomorrow will require all of us to do more.

NOAA has begun to address the challenge of determining the configuration of tomorrow's more complex and robust network of observing systems and the associated information processes necessary to translate those environmental observations into actionable information. NOAA's architecture development uses a structured architecture process with four main components:

- ***Our Existing Structure***—as foundational and documented in NOAA's Baseline Observing System Architecture (first phase complete) and baseline Data Management Architecture (yet to be completed).
- ***The Builder***—the NOAA Observing Systems Architect leads the architecture development process.

- ***The Toolset***—the set of software collaboration and visualization tools used by the NOAA architect, the architecture development team, and NOAA personnel to build the architecture.
- ***The Plan***—the structured process that translates user requirements into concepts for future systems. The plan will also include a reassessment of current systems against future requirements and may result in decommissioning some systems and developing new systems.

Since the summer of 2002, NOAA has aggressively pursued building the enterprise architecture.

NOAA is becoming our nation's enterprise system for operational environmental observations and ecosystem-based management. We are moving toward operating as an enterprise, and this construct is in keeping with our ongoing efforts to evolve into a more corporate NOAA. Our business scope, in the broadest sense, will be serving our Nation's needs for operational environmental information for space, air, ocean, and land in addition to ecosystem management. The four NOAA mission goals—Ecosystems, Climate, Weather and Water, Commerce and Transportation—will fall within the domain of these Federal responsibilities.

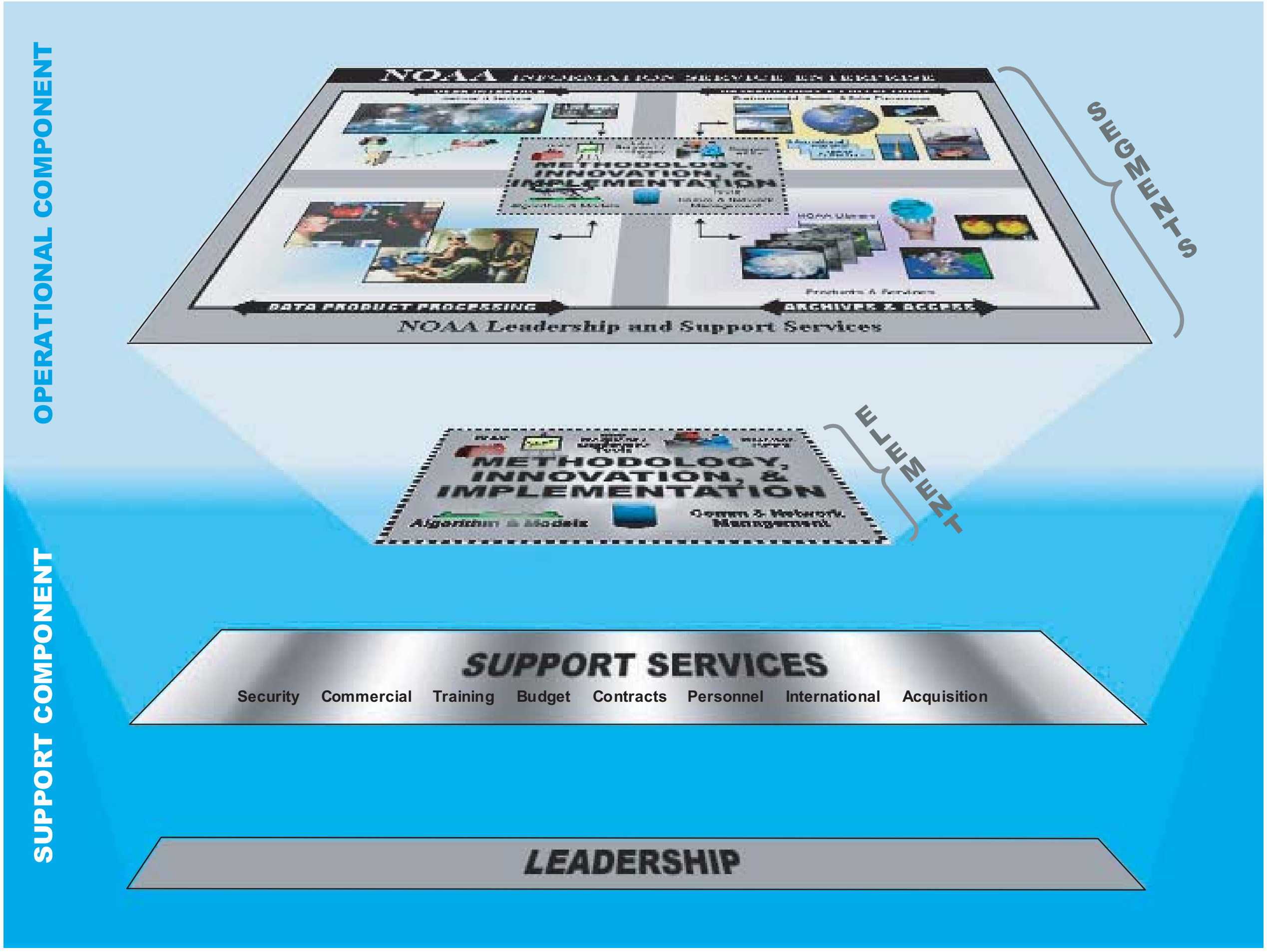
Functionality of the Information Service Enterprise

We will establish the NOAA Information Service Enterprise (ISE) as an end-to-end, NOAA-wide system that recognizes the value of operational environmental observations and addresses the essential functionality necessary to satisfy the future needs of users. The NOAA Information Service Enterprise will recognize the "lifeblood" of NOAA as the environmental information provided by the enterprise to our users. The ISE will also recognize the importance of research in advancing and evolving our ISE to meet future users' needs and to anticipate and investigate environmental issues before they become significant.

The Information Enterprise is depicted in **Figure 2.** The ISE contains an operational component and a support component. Within the operational component and its 24/7/365 operations lie four segments: User Interface; Observations and Collections; Data Product Processing; and Archives and Access. The segments represent top-level, essential functions for the NOAA-wide enterprise. Orchestrating the actions of those four segments and providing evolution and innovation is the Methodology Innovation and Implementation (MII) Element. The Support Component provides the services necessary to sustain the operational component into the future by developing and procuring new systems, providing experienced personnel, security services, budget support, etc. The Leadership Component is critical to the enterprise as it provides vision and guidance, obtains resources, and interfaces with external stakeholders and users at the senior levels.

Figure 3 (next page) highlights the four ISE segments and the central role of the MII. **Table 1** (page 19) presents the expected functionality of the segments and **Table 2** (page 20) presents the expected MII functionality.

Figure 2. Components of NOAA's Information Service Enterprise.



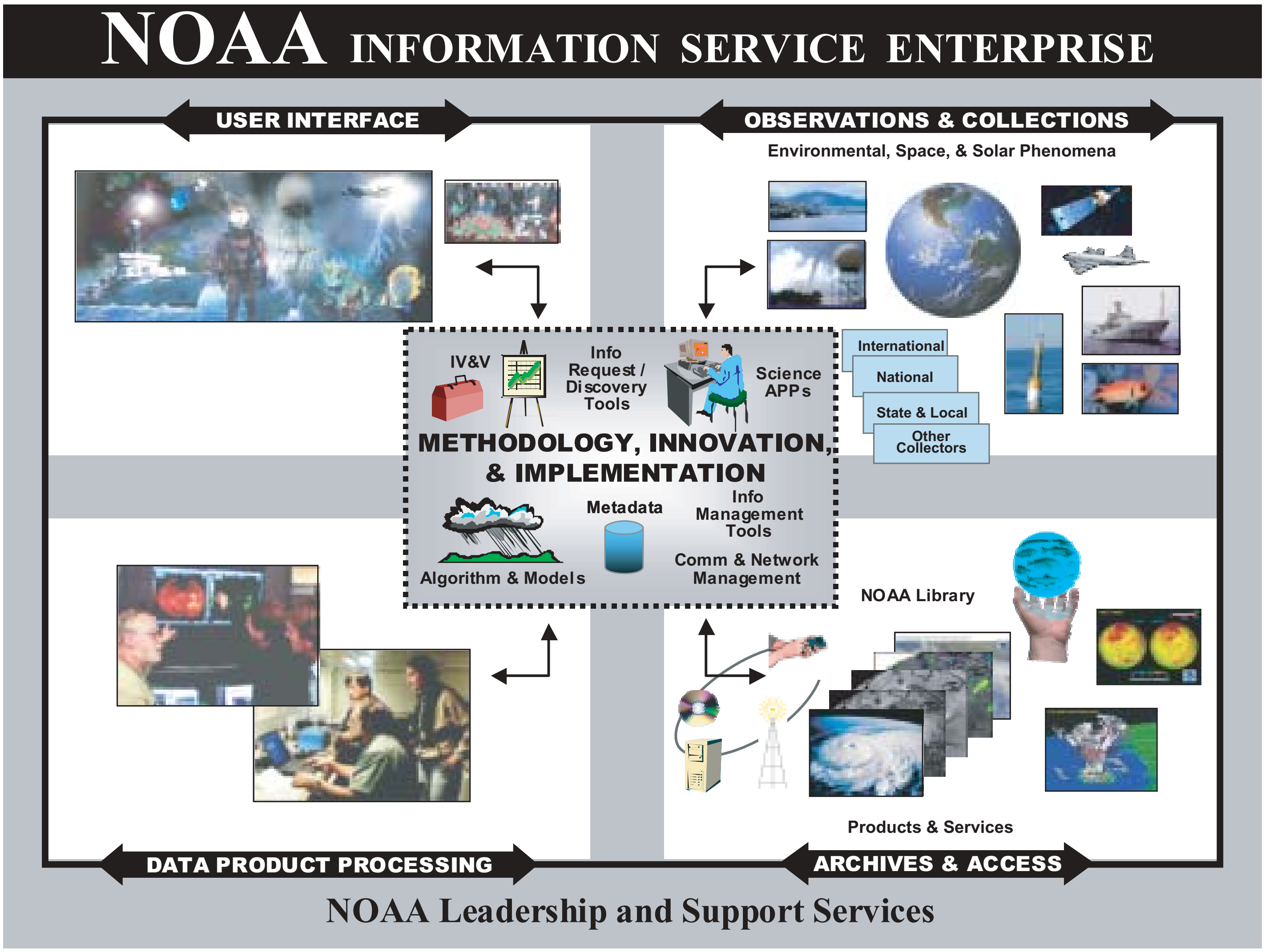


Figure 3. The four segments of the ISE and the central role of the MII.

Table 1. Functional Description of the ISE Segments.

The **User Interface (UI) Segment** would be responsible, among other functions to:

- Define and manage all processes internal to the UI Segment necessary to satisfy enterprise performance goals
- Develop and manage Dynamic Database of all enterprise user requirements
- Develop and manage user access validation process
- Develop and manage requirements process
- Develop and manage customer profiles
- Provide system status to user
- Develop and manage user prioritization schema and implementation procedures
- Develop and manage expert rules and routing mechanism to handle customer needs
- Develop and manage dynamic interface with schedule and scheduler (residing in Observations and Collections Segment)
- Provide access to toolsets, algorithms, models, reports, etc.
- Provide access to public domain information (including notices and warnings, and reports)
- Provide access to certification, licensing, and permits processes
- Provide access to submit time-critical data or reporting

The **Observations and Collections (O&C) Segment** would be responsible, among other functions to:

- Define and manage all processes internal to the O&C Segment necessary to satisfy enterprise performance goals
- Respond to composite user needs in accordance with the Prioritization Schema with an optimal schedule for use of O&C assets
- Monitor, assess, and maintain the operational status of all O&C assets
- Collect all observations
- Monitor, assess, and maintain the operational status of all other systems within the segment (such as communications links and ground system assets)
- Report system status to other Segments, and MII
- Task, operate, and maintain O&C assets, including research assets
- Respond to acts of nature through reconfiguration of the O&C assets

The **Data Product Processing (DPP) Segment** would be responsible, among other actions, to:

- Identify and manage all processes internal to the DPP Segment necessary to satisfy enterprise performance goals
- Identify all DPP processes that interface with another segment or with MII
- Identify and execute the strategy to move to digital product development and delivery
- Establish and execute the processes for users to participate in the development of new products
- Define and manage the strategy and methods to leverage product development in other agencies and with partner organizations
- Identify to MII all DPP requirements for hardware, software, and infrastructure
- Provide status and reporting on DPP performance

The **Archives and Access (A&A) Segment** would be responsible, among other functions, to:

- Manage all processes (including performance goals) internal to the A&A Segment necessary to satisfy enterprise performance goals
- Define and manage processes for long-term access and holdings preservation, and processes for short-term access and holdings
- Identify and manage archive categories and data storage needs for categories
- Develop and maintain the data model
- Determine and manage A&A internal data flows and processes
- Identify data flows and processes between A&A and all other segments and the MII
- Establish and manage processes to preserve data for long-term retention
- Assist in determining and comply with enterprise data policies
- Determine and manage processes for license compliance and data reuse
- Identify A&A requirements for hardware, software, and infrastructure to MII
- Provide status and reporting on A&A performance
- Identify and manage processes to satisfy NARA requirements

Table 2. Functional Description of the ISE MII Element.

The **Methodology Innovation and Implementation (MII) Element** would be responsible, among other functions, to:

- Define and manage all processes internal to the MII Element necessary to satisfy enterprise performance goals
- Define and manage all processes within the MII Element and among all the segments, ensuring overall performance of the enterprise
- Establish and monitor performance goals for the segments to achieve enterprise performance goals
- Establish common terminology and processes for the enterprise
- Determine and manage all processes necessary for the enterprise to address all conditions of operation, including responses to crises and conditions that may degrade enterprise operations
- Determine and manage data flows and processes between MII and all other segments
- Develop and manage statistical data (outcome reporting, maintenance, etc.)
- Define and manage the processes necessary to conduct independent validation and verification (IV&V) for all proposed system changes before introducing them into the NOAA operational environment
- Define and manage the processes to advance our understanding of the science necessary to meet user needs
- Define and manage processes necessary to transition research to operations
- Define and manage the processes necessary for the information network.

A major challenge will be to anticipate and position the ISE to respond to our users' future operations and the downstream changes in support they will require—as we develop processes to procure and share data and information and to field systems that may be ready for operational use in 6 to 14 years, or in the 2010 to 2020 time frame. We will begin to address this challenge in NOAA's internal Concepts of Operation (CONOPS) where we commence an ongoing dialogue to consider the issues that make up the social imperatives (cited earlier) that demand our attention, the concepts that are changing our society and affecting our users and their future operations, the trends of technology, and the impact to NOAA operations.

Once we have made significant progress in establishing the framework for the ISE, we will commence a similar effort for the EME beginning with a CONOPS, in 2005. We also anticipate that the USCOP Final Report and the implementation of its recommendations by the Executive and Legislative branches will have an impact on this enterprise.

Environmental observations cover all domains that affect planet Earth. **Figure 4** (next page) presents a construct for an observations data model within the NOAA Information Service Enterprise and would include observations collected from space, atmosphere, oceans, land, and for undersea. Within the model we must also incorporate the spectral component of observations collection (e.g., visible, radiometric, etc.). To maximize our efficient use of the data in our enterprise, we must have an overall construct to organize the data. A data model is a method to assist us in that organization.

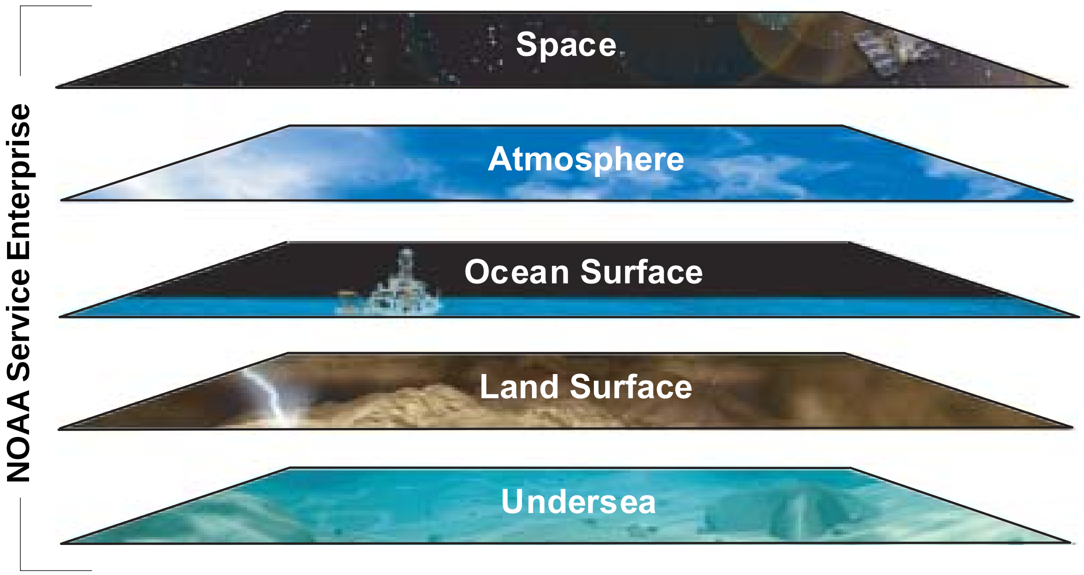


Figure 4. The NOAA Service Enterprise data model allows data collection and organization from all observational domains.

We also have a need to harmonize our terminology across the agency. We have many similar functions that have different names across NOAA, contributing to confusion and some level of inefficiency. Developing a common taxonomy and a common data model for our enterprise will be essential.

Other milestones (and progress) in the development of the NOAA enterprise architecture include:

- Concepts of Operation (Draft)
- Requirements process, including our new responsibility to collect requirements of the other Federal agencies and NOAA external partners (Refined)
- Baseline NOAA Observing System Architecture (First phase completed)
- Integrated Planning Process for the Target (Future) Observing Systems Architecture (Established)
- NOAA Observing Systems Council (Established)
- NOAA Observing System Architect Office (Established, along with the architecture development team and toolsets)

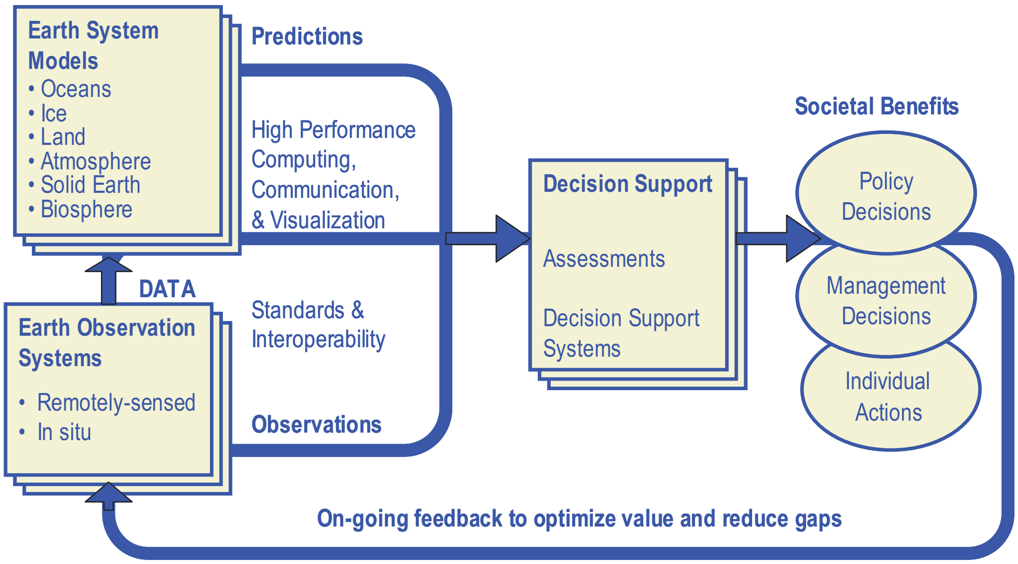


Figure 5. Societal benefits-based Earth Observation System.

Figure 5 illustrates the interrelationships between Earth observations and decisions benefiting society and provides a broader view of the important role of environmental observations within a more complex and complete systems architecture construct that describes the value-added analysis provided by science models and decision support tools as they support policy and management decisions. Our environmental observations have no intrinsic value—but accrue value through their use in scientific models and decision support tools. They also result in value to society by achieving the social imperatives through incisive and timely policy and management decisions.

Translating Requirements into Observations

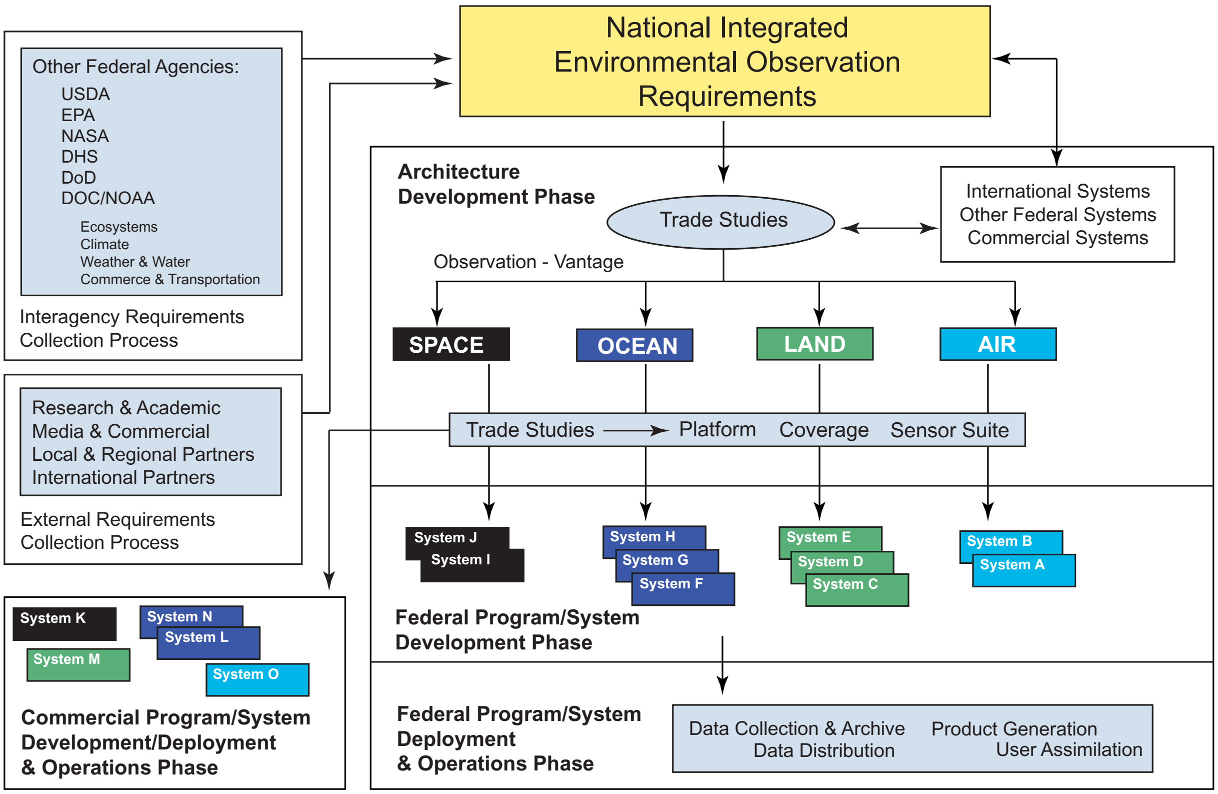
Fundamental to the success of any architecture in operation is the degree to which it satisfies the users' needs or requirements. NOAA has improved its requirements definition and collection processes and has increased substantially its dialogue with users to better understand future requirements. **Figure 6** (next page) depicts the NOAA Requirements Collection, Assessment, and Allocation Process.

Improvements to the requirement process also include making the requirements process more generic. Past efforts to canvas users occurred when NOAA was developing a specific system solution. Now, NOAA is developing a National Integrated Environmental Observation Requirements

Repository. This allows users to define their needs more specifically for environmental observations by environmental parameters, independent of potential future system solutions. Additionally, NOAA is working closely with the other Federal agencies to capture their future environmental observation requirements. We are also beginning to do a better job in assisting our future users to decompose their mission needs/requirements and map them to those environmental parameters.

NOAA will then use analytical tools and conduct trade studies at several levels and engage in a full array of concept and design analysis activities to determine how and where to best collect observations, also giving consideration to the users' attributes needs (such as accuracy, frequency of data/information, timeliness, etc.). Requirements for environmental observations will be allocated to programs and then to systems. Included within the solutions space will be NOAA internal programs, other Federal government programs, international programs, and commercial programs. We will

Figure 6. Requirements collection, assessment, and allocation process.



optimize the mix of observing systems (including remote and *in situ*) and optimize the collection mix against the total set of user requirements and the prioritization schema.

Another important linkage for the National Integrated Environmental Observation Requirements Repository is with our research programs and their objectives. This important linkage will focus more clearly our research initiatives toward those high-priority user requirements. Technology initiatives will be linked similarly to our users' high-priority user requirements. These linkages will not only assist us in developing our research and technology investment plans, but also improve our focus and timing our transitioning of our research and our partner agencies' research activities into our operations.

NOAA Observation Systems Data Management

The NOAA Observation Systems Data Management is that set of hardware and software, policies, and standards that will collectively be used to perform the following functions: record, query, format or reformat, schedule or task, monitor and status, collect, tag, compare, test, correlate or assimilate (includes data fusion), process, compress and decompress, archive, catalog, retrieve, report, assess (including for quality), and distribute all NOAA information and information products.

Data management within NOAA will support the enterprise functions with common and NOAA-approved hardware and software, policies, practices, and standards, as we will migrate from stovepipe-specific solutions (including stovepipe collector systems) with literally hundreds of data management systems into an integrated information enterprise.

The NOAA Observation Systems Data Management (NOSDM) will support the Operational Component in its 24/7/365 operations and will manage every data and information flow in the ISE and the EME. NOSDM will have the functionalities stated above, and others necessary to support and sustain ongoing enterprise-wide operations. It will exist within each ISE segment and will connect the segments through the flow of information. It will also exist in the MII where the overall enterprise performance will be monitored, managed, and optimized.

NOSDM must be dynamic and able to respond to varied loading throughout the enterprise—driven by factors such as improved, high-resolution collectors, communications downlink and pass times, by national or international environmental disasters, and the need to provide rapid enterprise support. NOSDM must be scalable over time and must be able to respond to planned and unplanned outages with minimal affect on the enterprise's performance.

Optimally, we must consider where, for the enterprise, every data or information function is to occur, using our current practices as a baseline option but not as foregone solution for the enterprise era. We will consider, for example, the applicability of algorithms developed for one purpose for more extensive use in the enterprise, as appropriate. Similarly, some algorithms or applications may be determined to have insufficient applicability for enterprise operations.

We will consider the introduction of new applications not just in the context of impact to a single system but more widely synchronizing introduction within the enterprise to other systems, products, and applications already online or being brought online within the same time frame.

We will evaluate the use of sources of data and information from providers outside NOAA and may need to incorporate special handling procedures (and licensing restrictions) as we process this information and make it available.

We will emphasize processes such as data fusion, metadata tagging, and instrument performance data capture in order to increase the value and context of our information to users. We will be attentive to the evolving needs of users for new methods to receive immediate and updated notifications and warnings and will make the necessary improvements in timeliness of high-priority notifications.

Our NOSDM total operational needs will be examined in the enterprise, from end-to-end, and we will also include data refreshing as we move our current and vast holdings into those holdings that will serve future generations of users several decades from today. We will also be prepared to include holdings that may be transferred to use, and we will work with other organizations to access electronically information wherever it exists among Federal, private, and international partners.

The NOSDM will also be used within the Support Component. We will have linkage among the acquisition or “build to” requirements collection processes and their attribute values into the “Active Requirements Database” resident in the ISE operational component. Our prioritization schema developed by the support component will transfer to the operational component, and we must consider early in the development process a wide variety of application parameters necessary for all intended operational users and uses.

Our reports will become more accurate because increasingly they will be based on actual costs and performance metrics of the operational ISE. The need to gather specific data elements will be determined as part of a system development and the data collected routinely, instead of our current practice of conducting data calls and analyzing the data in response to metrics that were not tasked or collected routinely or the basis for our current operations. We will be better able to estimate man-hours required to accomplish tasks and to better anticipate the manpower needs within the segments or element. We will have better data and tools to make better decisions on how to reallocate manpower and other resources to meet changing product and processing needs.

NOAA’s evolution from stovepipe systems to the NOSDM will be guided by strategic goals found on page 10.

Implementing the NOAA Integrated Global Environmental Observation and Data Management System

For more than 40 years, NOAA has been the U.S. leader in operational environmental observing. Over that time, we have addressed the need for change as we explored new science and introduced new products and fielded new systems. Today, we continue to posture ourselves to maintain our role as leaders and innovators.

Prior to 2002, NOAA was not operating with corporate-wide focus and it did not have a comprehensive architectural description of all of its observing systems (remote and *in situ*). Now, we have taken major steps forward to become more corporate, focus and organize our efforts, and increase our efficiency. Now, as mentioned in the Architecture Overview, NOAA has, and is executing, a four-step observing systems architecture development process: a foundation, a builder, a toolset, and a plan. We intend to focus and improve our leadership on the national and the international levels.

Baseline NOAA Observing Systems Architecture

NOAA's observing systems architecture foundation can be traced to its internal program review, conducted from February through May 2002. As a result of that internal review, NOAA pursued recommended actions that led to a new Strategic Plan, the current PPBES process, the new Program Planning and Integration (PPI) line office, and the development of a baseline and target observing systems architecture. These efforts posture NOAA to become more corporate, more focused, and more efficient.

In August 2002, NOAA initiated its first-ever comprehensive review of all of its observing systems and their interrelationships. This activity was termed the baseline NOAA Observing Systems Architecture (NOSA). The first phase was completed in January 2003 and formed the basis of the NOAA observing systems architecture development process. NOAA constructed the baseline NOSA with the assistance of all observing system managers within NOAA. Using a series of Web-based survey forms based on **Figure 7**, NOAA identified 99 separate observing systems measuring over 500 different environmental parameters.[1] Of the 99 observing systems, 40 were termed "operational" by their program managers—see **Appendix 4** for a description of each of those baseline systems. However, the focus of the baseline NOSA effort was restricted to NOAA-owned, -operated, or -funded observing systems and captured a minimum of information on NOAA data management systems. The next phase of the baseline architecture needs to include capturing NOAA's current data management capabilities, as well as linking to existing partners' observing and data management capabilities.

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[1] After applying international standards from the Global Change Master Directory (GCMD), the number of different environmental parameters measured is now approximately 225.

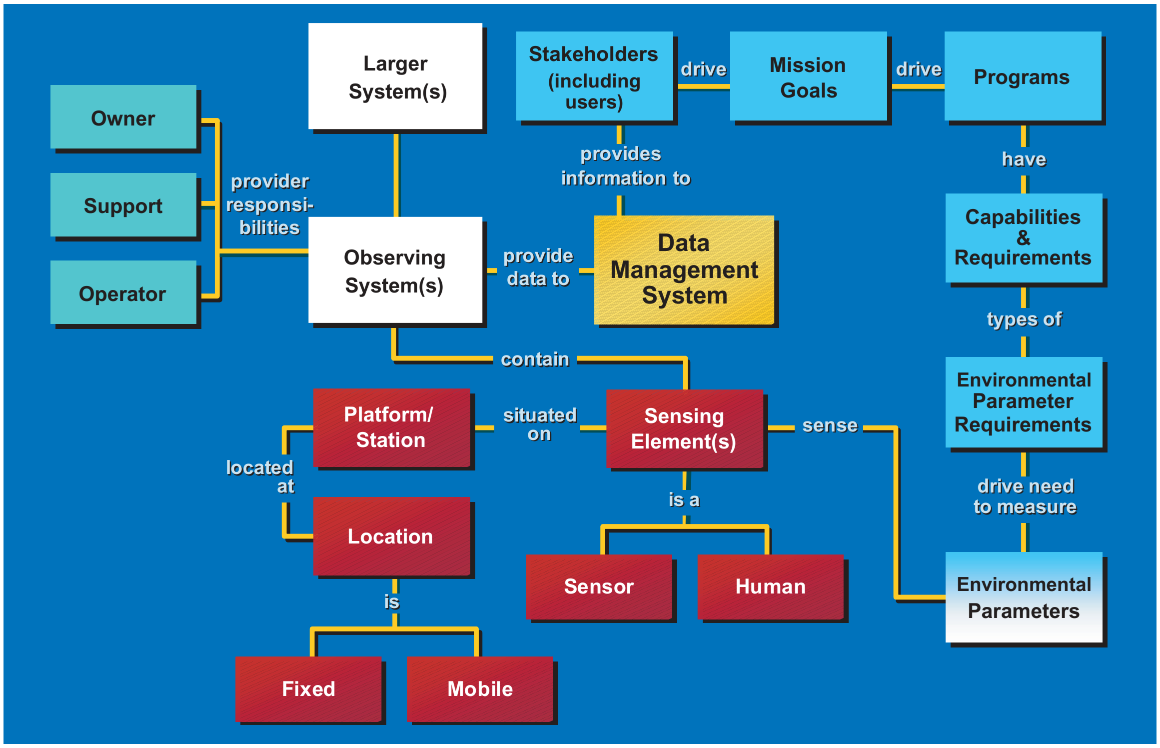


Figure 7. NOAA Observing Systems Architecture Relationship Diagram. The diagram entities are color coded by functions. Blue refers to the user requirements functional components. White refers to the observation functional component and its linkage to partner functions. Red refers to the observation system subcomponents. Yellow refers to the data management functional component, which includes the flow of information among all entities. Green refers to the observing system provider functions.

The initial purpose of the baseline NOSA was to allow NOAA leaders to respond accurately to queries for a variety of information, including (but not limited to):

- Descriptions of NOAA's observing systems, including purpose, intended use (operational or research), life cycle phase, schedule, and system quantities (currently deployed, programmed, or needed)
- Costs for each observing system, including initial acquisition cost (or replacement cost), subsequent upgrade costs, and operations and maintenance costs
- Environmental parameters measured by the observing system
- Applications of NOAA observing systems to NOAA's mission goals
- Location maps of observing platforms or stations that can be overlaid and compared

Some of these queries are business-related and can be depicted using tables, charts, spreadsheets, or by other enterprise architecture visualization tools. However, other queries are geospatial by nature and require GIS tools to properly visualize NOAA observing capabilities. **Figure 8** is one example of the geospatial views available through decision support tools supporting the baseline NOSA.

Establishment of the NOAA Observing Systems Architect and Council

Building on the foundation of the baseline NOSA, NOAA developed an implementation plan for its Observing Systems Architecture, recognizing the need for a process (i.e., plan) and an overseer of that plan (i.e., a builder). In addition to maintaining the baseline NOSA and the architecture toolset, the implementation plan included:

- Establishing a NOAA Observing Systems Architect office
- Establishing a NOAA Observing Systems Council (NOSC)
- Developing a target NOSA

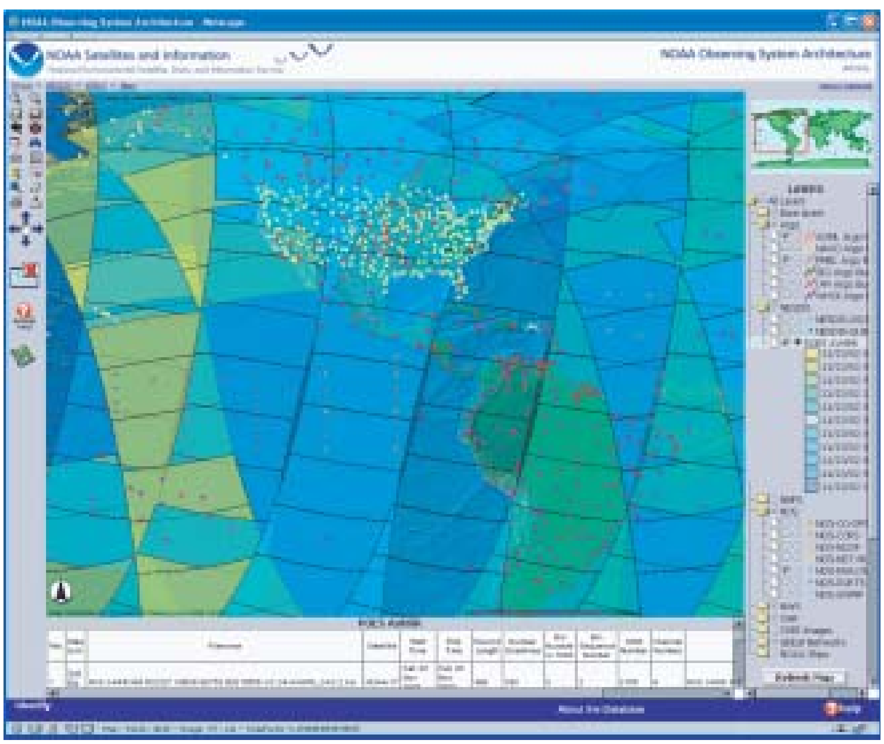


Figure 8. Geospatial view of selected NOAA observing systems locations.

In May 2003, the NOAA Executive Council (NEC) established the NOAA Observing Systems Architect position and the NOAA Observing Systems Council (NOSC). By direction of the NEC, the Architect reports to both the Assistant Administrator for Satellite and Information Services, and the Assistant Administrator for Program Planning and Integration due to the crosscutting focus of observing systems. The Architect has the principal responsibility for maintaining the baseline NOSA, developing the target NOSA, developing and maintaining the NOSA decision support toolset, and developing the road map for the Integrated Global Environmental Observation and Data Management System.

The NOSC is the principal advisory body to the NEC for Earth observations and data management (end-to-end) activities. The NOSC provides corporate oversight of the NOAA Observing Systems Architect office. The NOSC is composed of a team of senior representatives from all NOAA Line Offices, with participation from selected offices, other Councils, and Goal Team representatives. The Assistant Administrator for Satellite and Information Services chairs the NOSC. In its advisory role, the NOSC performs the following functions:

- Reviews observing system requirements
- Identifies gaps in NOAA observations
- Reviews architecture alternatives
- Reviews observing system acquisition alternatives
- Maintains cognizance over all NOAA observing system activities while coordinating NOAA participation in national and international Earth observation efforts
- Identifies activities and specific coordination to be proposed for existing NOAA councils, Line Offices, and program managers

Table 3 (next page) illustrates the role the NOSC plays in the PPBES process, while working with Line Offices, Goal Teams, and program managers on integrated observing and data management system issues.

The NOSC will focus largely on two fundamental issues associated with observations and observing systems: integration and architecture. More specifically, the NOSC intends to address the issues of standardization in data (including data dictionary and data model), metadata, communications protocols, etc., that are critical to ensuring the ability to integrate the full spectrum of observing systems (i.e., terrestrial, atmospheric, ocean). Additionally, the NOSC will focus on concepts and policies associated with developing the procedures and frameworks common to NOAA's observing systems.

Table 3. NOAA Observing Systems Council Roles and Responsibilities in NOAA PPBES.

PLANNING	PROGRAMMING	OTHER
• Develop thematic, multi-year plans as appropriate (e.g., Strategic Direction for NOAA's Integrated Global Environmental Observation and Data Management System) • Assist with the update of the NOAA Strategic Plan and development of the Annual Guidance Memorandum by: - Providing vision and strategy for theme area - Coordinating theme plans and status with constituents and employees in conjunction with PPI and Line Offices - Providing input for the Goal Assessment on issues under the jurisdiction of the NOAA Observing Systems Council	• Provide input to PAE on Program Baseline Assessments and Program Plans regarding consistency with NOAA policy • Offer programmatic and non-programmatic alternatives to PAE for use in the budget process so as to better achieve NOAA's strategic vision while considering constrained resources	• Provide leadership and coordination across the theme continuously • Establish policies and procedures to ensure internal consistency in theme area • Represent NOAA policy/plans for theme area to outside constituents • Provide policy assessments and proposals for NOAA-wide needs for the theme area • Establish performance measures and standards of compliance as applicable • Perform special projects of interest to NOAA management with area of responsibility

In July 2003, the NOAA Observing Systems Architect office initiated the first phase of the target NOAA observing systems architecture development. **Figure 9** (next page) depicts the proposed planning process for that development. The purpose of this process is to provide a "living" target architecture, linked to NOAA's PPBES. The planned output of this process is a NOAA Observing Systems Architecture Master Plan, which will allow NOAA leaders to determine which future observing and data management systems NOAA needs to meet our users' current and evolving environmental information requirements. The Master Plan will be updated routinely during NOAA Program Planning and Integration-directed program review cycles to respond to new policy guidance, new user requirements, and new technological capabilities.

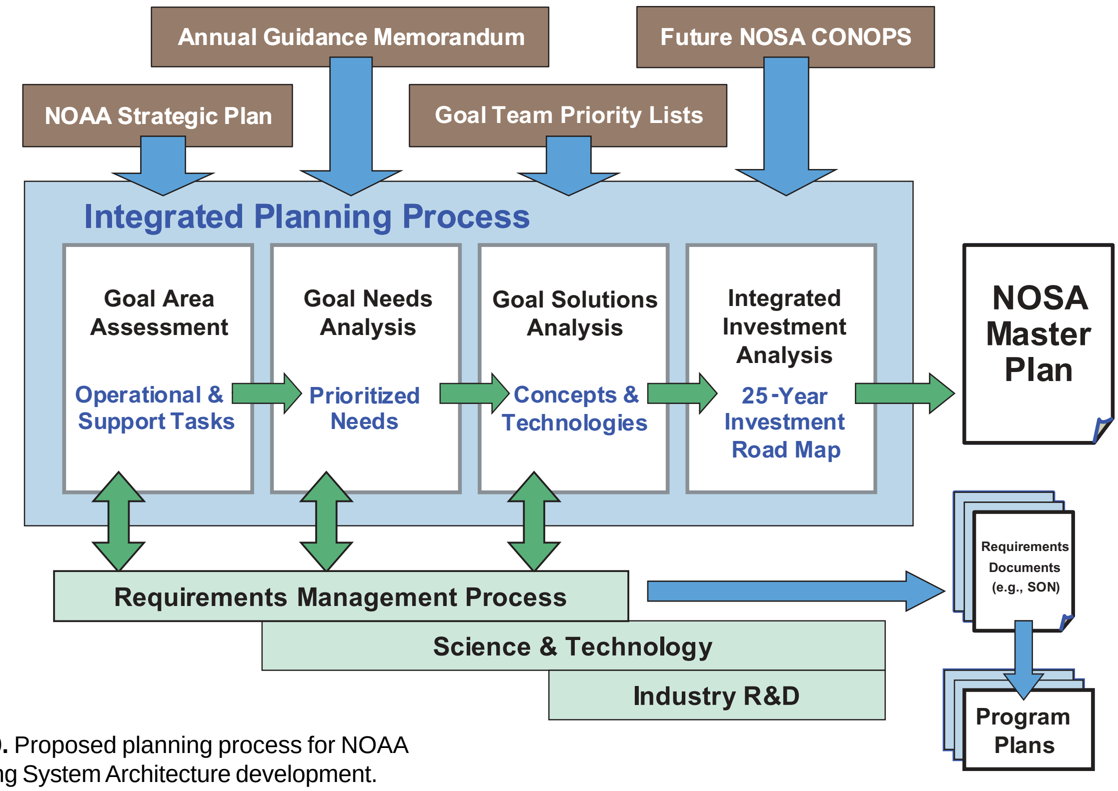


Figure 9. Proposed planning process for NOAA Observing System Architecture development.

NOSC Coordination with Other NOAA Councils, Committees, and Boards

A strong working relationship among the NOSC and other NOAA Councils, committees, and boards is essential to successfully implement NOAA's Integrated Global Environmental Observation and Data Management System to meet NOAA mission goals. Specifically, the NOSC is developing a close working relationship with the NOAA Ocean Council, NOAA Research Council, and NOAA CIO Council. Additionally, NOAA is starting to address NOAA-wide data management functions within the NOSC.

The **NOAA Ocean Council (NOC)** is working toward an effective role in defining NOAA's investments and strategies associated with ocean observing and observation systems. The relationship between the NOC and the NOSC must be understood and be consistent with other NOAA Councils' objectives and terms of reference. In fact, the NOC and NOSC have formed a Joint Ad Hoc Working

Group on Ocean Observations, and Operating Principles for the Working Group. The focus of this joint working group is to act as a coordinating and advisory body to the Councils and Goal Teams to support the goals of both Councils with regard to NOAA's contributions to the interagency effort to develop and implement IOOS. IOOS is an integral component of the NOAA Integrated Global Environmental Observation and Data Management System, addressing the ocean and coastal zone domains.

The **NOAA Research Council** provides corporate oversight to ensure that NOAA's research activities are of high quality, meet long-range societal needs, take advantage of emerging scientific and technological opportunities, and shape a forward-looking research agenda. The NOSC is working with the NOAA Research Council to ensure that the Integrated Global Environmental Observation and Data Management System has effective technology road maps—allowing for technology "push" as well as requirements "pull."

The **NOAA CIO Council** establishes enterprise-wide information technology (IT) policies, procedures, standards, and practices and oversees NOAA-wide IT projects and operations. One of those policies (and another outcome of the internal NOAA review) is the draft NOAA policy on Management of Environmental and Geospatial Data and Information. The NOAA CIO is a principal member of the NOSC. The NOAA Observing System Architect routinely interacts with the NOAA Enterprise IT Architecture (EITA) Committee, which operates under the guidance of the NOAA CIO. In fact, the NOAA-wide team that developed the baseline NOSA worked with the EITA Committee as the pathfinder group using the NOAA-selected enterprise architecture model. The baseline NOSA team also developed a draft enterprise architecture framework that has become the basis of both the NOAA and the Department of Commerce enterprise architecture frameworks.

The **NOAA Data Stewardship Committee** was established originally as the NOAA Environmental Satellite, Data, and Information Service (NESDIS) Data Archive Board to coordinate the development and implementation of data archiving policy within NESDIS. Recognizing the need to expand participation in data management issues across NOAA, the NOAA Data Stewardship Committee was formed under the NOSC to provide clear guidance for managing NOAA data stewardship and to provide the NOSC with the information it needs to integrate data stewardship with the NOAA Observing Systems Architecture and into the NOAA data management enterprise. The NOSC is also considering additional committees to address other data management component needs (e.g., assimilation, standards, data model, data dictionary, metadata).

Recent Observation and Data Management Program Initiatives

Over the past two years, NOAA has established other offices, systems, and programs (beyond those previously described in this document) that address certain NOAA observation and data management needs. Examples of those initiatives are: the Office of Climate Observations, the Comprehensive Large Array-data Stewardship System (CLASS), and the Environmental Modeling program. Additionally, NOAA is considering additional new observing and data management-related programs in FY07.

NOAA formed the **Office of Climate Observations** (OCO) in 2003. OCO is a division of NOAA Research's Office of Global Programs. The mission of OCO is to build and sustain a global climate observing system that will respond to the long-term observational requirements of the operational forecast centers, international research programs, and major scientific assessments. The office has established a Management Plan to meet required capabilities and has produced initial recommended observation systems improvements. Additionally, the Director of OCO is a NOSC member.

CLASS is a new NOAA computer system that serves as a critical "first step" in giving users faster and easier access to environmental data. NOAA began using CLASS in March 2004. CLASS provides researchers and policy-makers access to NOAA environmental data and products, obtained either from spacecraft or ground-based observations. CLASS is designed to minimize environmental risk and maximize environmental opportunities through effective planning and operations.

Working with Ocean.US, NOAA is reviewing the IOOS **Data Management and Communication** (DMAC) subsystem for applicability to NOAA Earth observations data management. DMAC is designed to connect IOOS to ocean data management systems at all levels (local, state, regional, national, and international) and to significant data management systems in other disciplines, such as atmospheric and terrestrial sciences.

During the FY06 planning cycle, NOAA established **Environmental Modeling** as a new program under the Weather and Water Goal area. The mission of NOAA's Environmental Modeling program is to plan, program, and deliver a seamlessly integrated system of models across NOAA, using the best scientific and numerical techniques and the most comprehensive, up-to-date data sets. These models will accurately assess past and present states and predict future states of the atmosphere, ocean, estuaries, watersheds, and land, including relevant physical biogeochemical, and ecosystem processes.

As an exemplar to highlight a continued implementation of a NOAA coporate view and in preparation for FY07 budget submissions, NOAA is considering **Data Stewardship Services** as a goal-wide program to provide data management capabilities in support of all NOAA Mission Goals and associated NOAA programs. The primary purpose of this program is to facilitate the integration of data archive, access, and assessments capabilities and capacities across NOAA and address the NOAA crosscutting priority, an Integrated Global Environmental Observation and Data Management System. Additionally for FY07, the Ecosystem Goal area is considering an Ecosystem Observation System as part of its program structure. While neither the Data Stewardship Services or Ecosystem Observing System are approved programs, NOAA continues to examine programmatic adjustments and resource commitments that facilitate a movement toward enterprise operations.

These recent initiatives point to a variety of views of how to address NOAA's top crosscutting goal. However, despite the progress made in these initiatives, NOAA must produce a road map that directs NOAA from these current initiatives to the envisioned end state of an Information Service Enterprise. The NOAA Observing Systems Architect, with input and oversight from the NOAA Observing Systems Council, should develop this road map.

Summary

In the preceding sections, there are six key points to emphasize regarding NOAA's Strategic Direction for an Integrated Global Environmental Observation and Data Management System:

- NOAA and its partners recognize the social and economic imperatives that demand a fresh focus on Earth observations and the impact of those observations on societal benefits.
- The opportunity to affect those benefits led NOAA to establish an Integrated Global Environmental Observation and Data Management System as its top crosscutting priority and to direct the development of a Strategic Plan for such an integrated system.
- NOAA has established Strategic Goals for such an integrated system, and will develop performance measures linked to those Strategic Goals.
- NOAA envisions an Information Service Enterprise (ISE) as the necessary end state or target for establishing an efficient and effective integrated system.
- NOAA has developed an architecture process that will allow transitioning to the ISE.
- NOAA has made laudable initial progress in evolving to such an integrated system but needs a coherent road map to ensure arrival at the envisioned Information Service Enterprise.

In the following section, we complete our initial look at a Strategic Direction for NOAA's Integrated Global Environmental Observation and Data Management System by suggesting the "Next Steps" in NOAA's environmental information journey.

Next Steps

NOAA is, and will continue to be, in the environmental information "business." The nations of the world are increasingly aware of the need for an effective global environmental observation system that depends on science to realize environmental and scientific benefits, but also to realize crucial social and economic needs as well.

NOAA has made substantial progress in its journey to develop an Integrated Global Environmental Observation and Data Management System—but a tremendous amount of work lies ahead. Our main challenges fall into five areas:

1. Documenting requirements for operational environmental observations;
2. Decomposing the functionality now resident in our 99 legacy observing systems and hundreds more data management systems and determining gaps and overlaps (with allowances for future growth);
3. Determining enterprise practices, policies, standards and protocols, and incorporating them into the ISE;
4. Developing architecture alternatives that satisfy enterprise functional and performance requirements; and,
5. Allocating functionality to new programs and systems that, along with designated legacy systems, will make up the enterprise.

In the baseline NOAA Observing Systems Architecture (NOSA) development, NOAA focused primarily on "NOAA-owned, -operated, and -funded" observing systems, with a secondary emphasis on data management systems tied to those observing systems. We still have much work ahead to migrate from these 99 observing systems, many with their associated stovepipe data handling and processing systems, to an efficient NOAA-wide Information Service Enterprise. For the Target Architecture, we will not restrict ourselves to NOAA-owned, -operated, and -funded observing systems but will seek to include all operational environmental data and information from all sources that can be made available to us.

NOAA will continue to be active in the national (IWGEO) and international (GEO) development efforts to develop a 10-Year Implementation Plan for a "comprehensive, coordinated, and sustained Earth observation system or systems" by February 2005. The schedule is aggressive and the issues are complex, but the potential benefits are immense.

NOAA will continue the work, begun over the past two years, to organize better and equip and to develop an Integrated Global Environmental Observation and Data Management System. By working effectively with our national and international partners and working to improve corporate business processes, NOAA is poised for success.

Appendix 1:
Declaration of the Earth Observation Summit

We, the participants in this Earth Observation Summit held in Washington, DC, on July 31, 2003:

Recalling the World Summit on Sustainable Development held in Johannesburg that called for strengthened cooperation and coordination among global observing systems and research programmes for integrated global observations;

Recalling also the outcome of the G-8 Summit held in Evian that called for strengthened international cooperation on global observation of the environment;

Noting the vital importance of the mission of organizations engaged in Earth observation activities and their contribution to national, regional, and global needs;

Affirm the need for timely, quality, long-term, global information as a basis for sound decision making. In order to monitor continuously the state of the Earth, to increase understanding of dynamic Earth processes, to enhance prediction of the Earth system, and to further implement our environmental treaty obligations, we recognize the need to support:

1. Improved coordination of strategies and systems for observations of the Earth and identification of measures to minimize data gaps, with a view to moving toward a comprehensive, coordinated, and sustained Earth observation system or systems;

2. A coordinated effort to involve and assist developing countries in improving and sustaining their

Representatives of 34 nations attended the first Earth Observation Summit. (Photo: Bill Ingalls.)

contributions to observing systems, as well as their access to and effective utilization of observations, data and products, and the related technologies by addressing capacity-building needs related to Earth observations;

3. The exchange of observations recorded from *in situ*, aircraft, and satellite networks, dedicated to the purposes of this Declaration, in a full and open manner with minimum time delay and minimum cost, recognizing relevant international instruments and national policies and legislation; and

4. Preparation of a 10-year Implementation Plan, building on existing systems and initiatives, with the Framework being available by the Tokyo ministerial conference on Earth observations to be held during the second quarter of 2004, and the Plan being available by the ministerial conference to be hosted by the European Union during the fourth quarter of 2004.

To effect these objectives, we establish an *ad hoc* Group on Earth Observations and commission the group to proceed, taking into account the existing activities aimed at developing a global observing strategy in addressing the above. We invite other governments to join us in this initiative. We also invite the governing bodies of international and regional organizations sponsoring existing Earth observation systems to endorse and support our action, and to facilitate participation of their experts in implementing this Declaration.

President Bush's Statement on the First Earth Observation Summit

"The United States is pleased to host more than 30 nations at the Earth Observation Summit. The Summit participants will discuss plans for achieving the goal of building a better integrated earth observation system in the next 10 years, an objective established by the G-8 Heads of State in Evian, France, in June 2003. An integrated earth observation system will benefit people around the world, particularly those in the Southern Hemisphere. Working together, our nations will develop and link observation technologies for tracking weather and climate changes in every corner of the world, which will allow us to make more informed decisions affecting our environment and economies. Our cooperation will enable us to develop the capability to predict droughts, prepare for weather emergencies, plan and protect crops, manage coastal areas and fisheries, and monitor air quality."

Appendix 2: Communiqué of the Second Earth Observation Summit

We, the participants in the Second Earth Observation Summit held in Tokyo, Japan, on 25 April 2004:

Recalling the Declaration of the first Earth Observation Summit, held in Washington, D.C., on July 31, 2003,

Building on the commitment made at that Summit to move toward a comprehensive, coordinated, and sustained Earth observation system or systems, and:

Remaining cognizant of the fact that what we are designing will change and improve how we perceive and understand the Earth system—its weather, climate, oceans, land, geology, natural resources, ecosystems, and natural and human-induced hazards—and that such understanding is crucial to enhancing human health, safety and welfare, alleviating human suffering including poverty, protecting the global environment, and achieving sustainable development;

We affirm our support to the process underway, recognizing the increased attention to our initiative with more countries and organizations participating since the first Summit;

We acknowledge with appreciation the work of the *ad hoc* Group on Earth Observations thus far to begin to develop a 10-Year Implementation Plan, based on user requirements and building on existing systems, for a comprehensive, coordinated, and sustained Earth observation system of systems.

We adopt with satisfaction the Framework Document, describing principal benefits of Earth observations to a broad range of user communities and the fundamental elements to be included in the 10-Year Implementation Plan for what will henceforth be called a Global Earth Observation System of Systems (GEOSS);

We approve the way forward for the development of the 10-Year Implementation Plan as described in the Framework Document;

We note with appreciation the "GEO Subgroup Reports to the Second Earth Observation Summit," and

We commission the *ad hoc* Group on Earth Observations to take those steps necessary to have in place for our review a draft Implementation Plan before the third Earth Observation Summit to be hosted by the European Union in early 2005.

We renew our invitation to other governments to join us in this initiative. We also invite the governing bodies of international and regional organizations sponsoring existing Earth observing systems to support our action.

Appendix 3:
Framework for a 10-Year Implementation Plan

From Observation to Action—Achieving Comprehensive, Coordinated, and Sustained Earth Observations for the Benefit of Humankind; Framework for a 10-Year Implementation Plan (25 April 2004)

1. Introduction

Understanding the Earth system—its weather, climate, oceans, land, geology, natural resources, ecosystems, and natural and human-induced hazards—is crucial to enhancing human health, safety and welfare, alleviating human suffering including poverty, protecting the global environment, and achieving sustainable development. Data collected and information created from Earth observations constitute critical input for advancing this understanding. In 2003, a consensus emerged among governments and international organizations that, while supporting and developing existing Earth observation systems, more can and must be done to strengthen global cooperation and Earth observations. This Framework Document, while not legally binding, marks a crucial step in developing the 10-Year Implementation Plan for the creation of a comprehensive, coordinated, and sustained Earth observation system or systems as envisioned by the Washington Declaration adopted at the Earth Observation Summit of 2003.

2. Benefits of Comprehensive, Coordinated and Sustained Earth Observations

2.1 Observing and understanding the Earth system more completely and comprehensively will expand worldwide capacity and means to achieve sustainable development and will yield advances in many specific areas of socio-economic benefit, including:

- Reducing loss of life and property from natural and human-induced disasters;
- Understanding environmental factors affecting human health and well being;
- Improving management of energy resources;
- Understanding, assessing, predicting, mitigating, and adapting to climate variability and change;
- Improving water resource management through better understanding of the water cycle;
- Improving weather information, forecasting, and warning;
- Improving the management and protection of terrestrial, coastal, and marine ecosystems;
- Supporting sustainable agriculture and combating desertification;
- Understanding, monitoring, and conserving biodiversity.

2.2 Globally, these benefits will be realized by a broad range of user communities, including (1) national, regional, and local decision-makers, (2) relevant international organizations responsible for the implementation of international conventions, (3) business, industry, and service sectors, (4) scientists and educators, and (5) the general public. Realizing the benefits of coordinated, comprehensive, and sustained Earth observations (i.e. the improvement of decision-making and prediction abilities) represents a fundamental step toward addressing the challenges articulated in the declarations of the 2002 World summit on Sustainable Development and fulfilling the Millennium Development Goals agreed at the Millennium Summit in 2000.

2.3 Full participation of developing country members will maximize their opportunities to derive real benefits in the above socio-economic areas. Such participation is supported as it enhances the capacity of the entire Earth observation community to address global sustainable development challenges.

3. Key Earth Observation Areas

3.1 Coordinated and sustained global cooperation on Earth observations is well established in the crucial area of weather. The World Meteorological Organization's World Weather Watch demonstrates the value of international collaboration in this arena. Improvements in observation networks are still needed and will yield further success through improved accuracy in weather information and long-term prediction.

3.2 Cooperation is less advanced in the areas of land, water, climate, ice, and ocean observation. Nevertheless, some important work and guidance for future action has been developed in a number of areas, for example:

a. Natural hazard understanding through a range of international observing and early warning systems consistent with the International Strategy for Disaster Reduction (ISDR);

b. Climate understanding and research through the World Climate Research Program (WCRP), and climate monitoring consistent with the Global Climate Observing System (GCOS) in support of the Conference of Parties (COP) of the United Nations Framework Convention on Climate Change (UNFCCC):

c. Ocean monitoring, modeling and forecasting through the Global Ocean Observing System (GOOS):

d. A range of observation themes addressed by the Integrated Global Observing Strategy Partnership (IGOS-P) including oceans; carbon; water cycle; solid earth processes, coastal zone (including coral reef); atmospheric chemistry; and land/biosphere.

3.3 In each of these areas, observation efforts to understand dynamic Earth processes have been identified and should be expanded to support action-oriented solutions in the areas of key socio-economic benefit.

4. Shortcoming of Current Observation Systems

4.1 Human knowledge of the Earth system, although advanced in certain areas, is far from complete. Current efforts to observe and understand the Earth system must progress from the separate observation systems and programs of today to coordinated, timely, quality, sustained, global information—developed in accordance with compatible standards—as a basis for future sound decisions and actions.

4.2 Many international organizations and programs are working to sustain and improve the coordination of Earth observations. However, current efforts to capture Earth observation data are limited by (1) a lack of access to data and associated benefits especially in the developing world, (2) eroding technical infrastructure, (3) large spatial and temporal gaps in specific data sets, (4) inadequate data integration and interoperability, (5) uncertainty over continuity of observations, (6) inadequate user involvement, (7) a lack of relevant processing systems to transform data into useful information, and (8) insufficient long term data archiving.

5. What is Needed - The 10-Year Implementation Plan for Earth Observations (2005-2014)

5.1 To achieve the many benefits of coordinated Earth observations and to move from principles to action, governments adopting this Framework Document set forth the primary components of a 10-Year Implementation Plan for establishing the Global Earth Observation System of Systems (GEOSS). GEOSS will be:

- *comprehensive,* by including observations and products gathered from all components required to serve the needs of participating members;
- *coordinated,* in terms of leveraging resources of individual contributing members to accomplish this system, whose total capacity is greater than the sum of its parts;
- *sustained,* by the collective and individual will and capacity of participating members.

5.2 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. Participating members will determine ways and means of their participation in GEOSS. The 10-Year Implementation Plan for GEOSS will be based on the following considerations:

a. With the socio-economic benefits identified in Section 2 as the road map, the 10-Year Implementation Plan will identify, document, and prioritize actions to address user requirements for current and future Earth observations. This process will be based on appropriate dialogue and procedures, taking advantage of and building upon the experience of existing initiatives and infrastructures.

b. The architecture model will build incrementally on existing systems to create a distributed system of systems, incorporating an observation component, a data processing and archiving component, and a data exchange and dissemination component.

c. The 10-Year Implementation Plan will elucidate practical methods for filling critical gaps in, *inter alia,* observation parameters, geographical areas, observation specifications, and accessibility.

5.3 The GEOSS will address key challenges of data utilization, including the need for:

- Full and open exchange of observations with minimum time delay and minimum costs, recognizing relevant international instruments and national policies and legislation;
- Assured data utility and usability (including thresholds for validation, calibration, and spatial and temporal resolution);
- Assured continuity and availability of the many observations and products in place or planned;
- A robust regulatory framework for Earth observations (e.g. through protection of radio frequency bands that are uniquely essential for Earth observations).

5.4 The plan will facilitate both current and new capacity building efforts, particularly in developing countries, across the entire continuum of GEOSS activities, which will include education, training, institutional networks, communication, and outreach as fundamental to those efforts. Building on existing local, national, regional, and global capacity building initiatives, GEOSS will:

a. Focus on training and education for the development and/or utilization of existing human, institutional, and technical capacities for data utilization;
b. Develop the infrastructure resources necessary to meet research and operational requirements;
c. Build on globally accepted sustainable development principles—most notably those outlined in the World Summit on Sustainable Development Plan of Implementation.

5.5 The development of GEOSS should take maximum advantage of developments in research and technologies. Conversely it will enable the global scientific community to address key scientific questions concerning the functioning of the Earth system.

6. Outcomes

The success of the 10-Year Implementation Plan will be measured by the operational achievement of GEOSS. Specific outcomes for GEOSS, both short and long-term, will be elaborated in the 10-Year Implementation Plan, including but not limited to the following:

a. Enabling global, multi-system information capabilities for each of the following:
   - disaster reduction, including response and recovery;
   - integrated water resource management;
   - ocean monitoring and marine resources management;
   - air quality monitoring and forecasting;
   - biodiversity conservation;
   - sustainable land use and management.
b. Global tracking of invasive species;
c. Comprehensive monitoring of global and regional climate on annual, decadal, and longer time scales, and enabling information products related to climate variability and change;
d. Improving the coverage, quality, and availability of essential information from the *in situ* networks and improving the integration of *in situ* and satellite data;
e. Involvement of users from developed and developing countries, monitoring their needs and fulfillment over time;
f. An outreach mechanism to actively demonstrate the usefulness of Earth observation to decision makers in key user communities.

7. The Way Forward

7.1 The adoption of this Framework Document indicates a decision to proceed with the elaboration of the GEOSS 10-Year Implementation Plan along the lines set forth in this Document and a willingness to cooperate on, and participate in, the implementation of the plan. At present the *ad hoc* Group of Earth Observations (GEO) is a "best efforts" activity with voluntary input from States and advice and support from international organizations.

7.2 For 2005 and beyond, the implementation of the “10-Year Implementation Plan” will require a ministerial-guided successor mechanism with maximum flexibility—a single intergovernmental group for Earth observations drawing on the experience of the *ad hoc* GEO, with membership open to all interested governments and the European Commission, and with representatives of relevant international organizations taking part.

7.3 The GEOSS 10-Year Implementation Plan will elaborate details for this Group which will provide generally for:

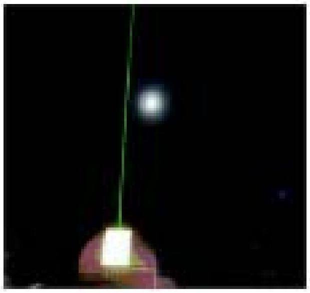
a. Coordination and planning of GEOSS implementation (*in situ* and remotely sensed);
b. Opportunities for engagement of all members and relevant international and regional organizations;
c. Involvement of user communities;
d. Measurement, monitoring, and facilitating openness of GEOSS to improve cross-flow of observations and products;
e. Co-ordination and facilitation of the development and exchange of observations and products between members and relevant international and regional organizations.

Appendix 4:
Catalog of NOAA's Observing Systems

NOAA's Observing System Architecture (NOSA) Database began with an inventory of all NOAA observing systems. Principal investigators for each observing system entered information into common fields. This methodology has allowed for cross-referencing, information sharing, and a concise record of environmental parameters. Appendix 4 is a brief introduction to the vast information contained within the NOSA Database. In the following catalog, the observing systems are arranged alphabetically, by NOAA Line Office.

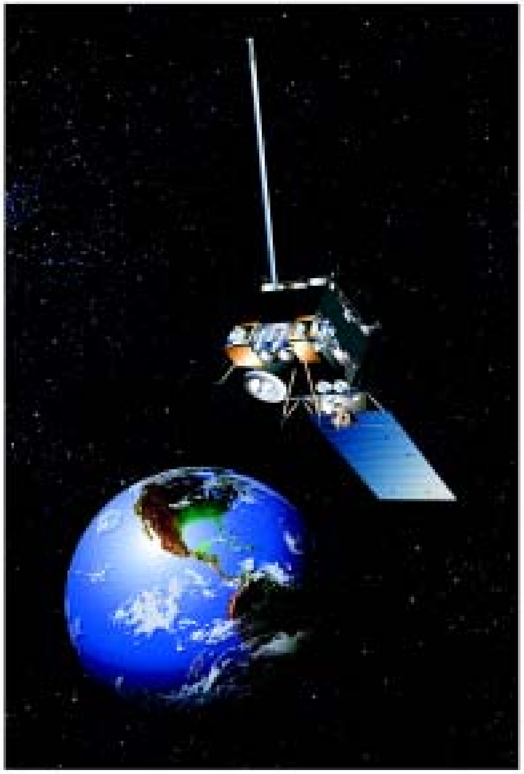
The principal focus of the data call resulting in this catalog was on observing systems, although some data management and requirements information was collected. NOAA will conduct a NOSA Database update in 2004, focusing on data management systems and those observing systems not captured in the initial data call.

National Environmental Satelite, Data, and Information Service (NESDIS)



NESDIS - Doppler Wind Lidar
This system is designed to measure accurate global horizontal wind measurements to improve global and regional numerical weather prediction models and forecasts. Since 1998, NESDIS has sponsored an effort led by the University of New Hampshire to develop and assess the potential of a class of Doppler wind lidars that employ novel optics, high efficiency detectors, and a fiber optic "light recycler" to increase sensitivity and accuracy toward that which would be needed to measure winds from space.

NESDIS - GOES I/M, N/P, R
Geostationary Operational Environmental Satellite, I-M, N-P, R
GOES move in geo-synchronous orbits at an altitude of approximately 35,800 km. They provide a constant vigil for the atmospheric "triggers" for severe weather conditions such as tornadoes, flash floods, hailstorms, and hurricanes. When these conditions develop, these satellites are able to monitor storm development and track storm movements. GOES satellite imagery is also used to estimate rainfall during thunderstorms and hurricanes for flash flood warnings, as well as estimate snowfall accumulations and overall extent of snow cover. Such data help meteorologists issue winter storm warnings and spring snowmelt advisories. Satellite sensors also detect ice fields and map the movements of sea and lake ice, and monitor the space environment around the satellite.



Artist conception of GOES by Allan Kung.

NESDIS - MOBY
Marine Optical Buoy
MOBY is a moored bio-optical buoy that measures downwelling irradiance and upwelling radiance in the ocean's surface waters. Measurements are collected coincident with ocean color satellite overpasses on a daily basis.

NESDIS - NPOESS Integrated Program Office - NPOESS
National Polar-orbiting Operational Environmental Satellite System
NPOESS is a low Earth orbit spacecraft remote sensing platform, hosting up to 14 sensors. It will acquire meteorolgical, environmental, and associated data, including information on cloud imagery, atmospheric profiles of temperature and moisture, and other specialized meteorological, terrestrial, oceanographic, climatic, and solar-geophysical data. It will also provide support to an international search and rescue mission.

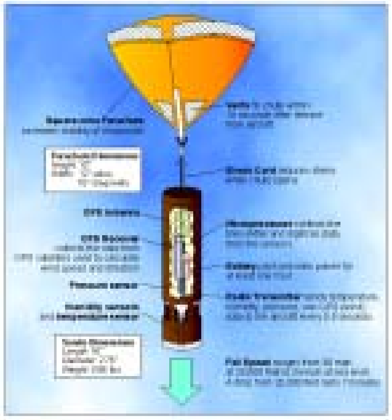
NESDIS - NPOESS Integrated Program Office - NPP
NPOESS Preparatory Project
Environmental remote sensing system used for passive remote sensing of visible, infrared, and microwave radiation. First availability: March 2007. First launch: October 2006. Satellite mission duration: 7 years.

NESDIS - POES
Polar-orbiting Operational Environmental Satellite
[PICTURE BAR, below]
The POES satellite mission provides polar-orbiting platforms to support the environmental observations for imaging and measurement of Earth's atmosphere, its surface, and cloud cover. This includes Earth radiation, atmospheric ozone, aerosol distribution, sea surface temperature, vertical temperature and water profiles in the troposphere and stratosphere; measurement of proton and electron flux at orbit altitude; remote platform data collection; and the Search and Rescue Satellite-Aided Tracking (SARSAT) system. Additionally, POES satellite systems support dedicated microwave instruments for the generation of temperature, moisture, surface, and hydrological products in all weather conditions.

NESDIS - USCRN
U.S. Climate Reference Network
The USCRN Program addresses the climate community's requirements regarding long-term (50+ years) high quality, well documented, climate-related surface air temperature and precipitation observations free of time-dependent biases. This is the first "climate driven" observing network designed for the specific purpose of climate quality observations.

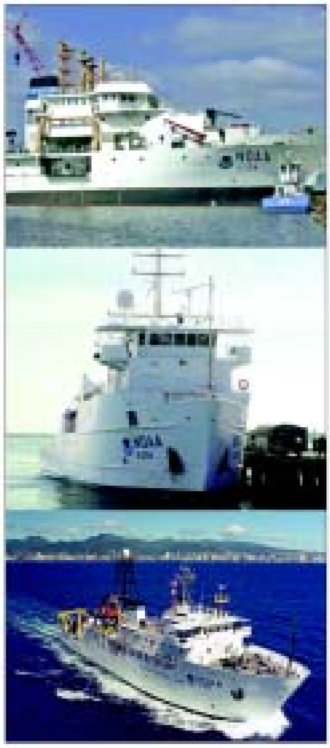
NOAA-M (polar-orbiting operational environmental satellite) from artist conception to first image received after launch.

NOAA Marine and Aviation Operations (NMAO)

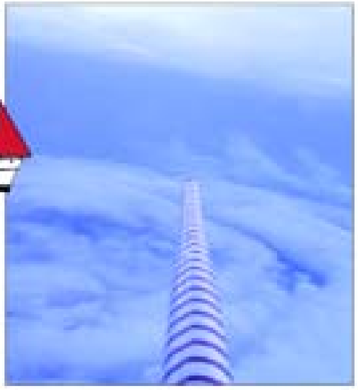


NMAO - AVAPS - GPS Dropsonde Airborne Vertical Atmosphere Profiling System - Global Positioning System Dropsonde
The GPS dropsonde has flown on numerous missions in support of operational weather forecasting and atmospheric research. The AVAPS receives and processes data from up to 4 sondes simultaneously, obtaining a fine, horizontal distribution of soundings.

Top to bottom:
NOAA Ship Hi'Ialakai
NOAA Ship Nancy Foster
NOAA Ship Oscar Elton Sette



NOAA ships and aircraft are critical observing system platforms for collecting oceanographic, atmospheric, hydrographic, fisheries, and coastal data.



Gust probe of NOAA WP-3D pointing at the eye wall of a hurricane.

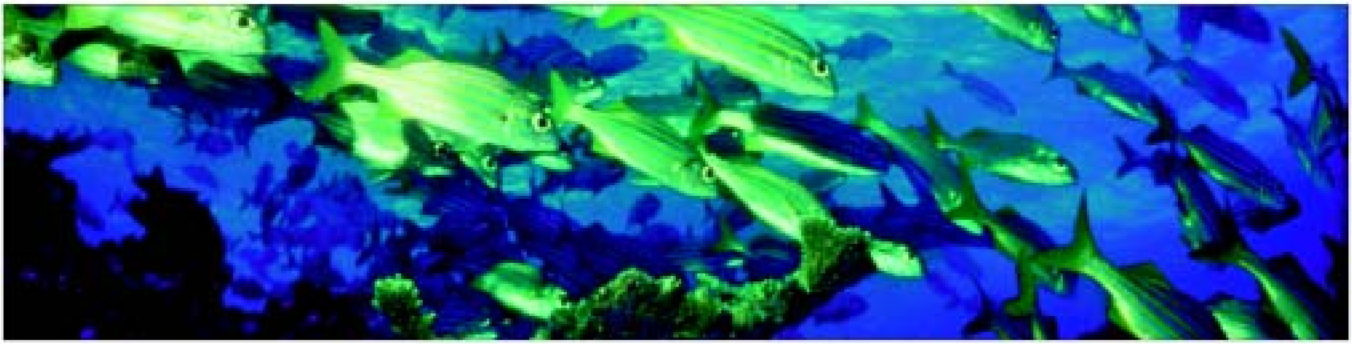
Left to right: NOAA WP-3D on the tarmac. NOAA Gulfstream-IV jet in Anchorage, Alaska, during the 2003 Pacific winter storm mission. MD500 helicopter taking off from NOAA Ship David Starr Jordan *during marine mammal studies.*

National Marine Fisheries Service (NMFS)

NMFS - CREWS
Coral Reef Early Warning System
Moored buoys, subsurface platforms, and drifting buoys provide oceanographic and meteorological observations in and around the tropical coral reefs of the U.S. Pacific Islands. The drifting and moored buoys telemeter their data in near real-time. The data are used for monitoring conditions and alerting researchers to high stress levels at coral reefs.

NMFS - Fishery Dependent Commercial Statistics
This system tracks harvesting of renewable marine resources by U.S. commercial fishing fleets operating throughout the world. Landed weight and value is recorded on a vessel trip basis.

NMFS - Habitat Assessment
These assessments involve characterization and mapping of coastal habitats important to NOAA trust resources by NOAA vessels and other means.



NMFS - LMR Surveys
Living Marine Resource and Ecosystem Surveys
NOAA conducts ship-based surveys to provide information on the abundance and distribution of living marine resources and their ecosystems in the U.S. Exclusive Economic Zone.

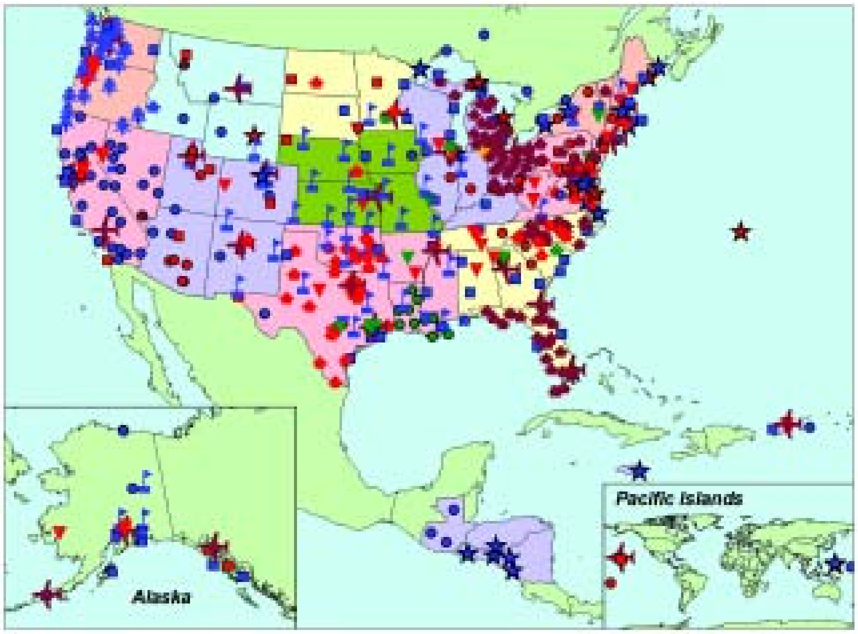
NOAA Ship David Starr Jordan *is one of several NOAA ships that conduct living marine resource and ecosystems surveys.*

NMFS - NOP
National Observer Program
NOAA deploys fishery observers to collect catch data from U.S. commercial fishing and processing vessels. Approximately 20 different fisheries are monitored by NOP annually. NOP works toward improvements in data collection, observer training, safety, outreach, and the integration of observer data with other research.

NMFS - MRFSS
Marine Recreational Fisheries Statistics Survey
The MRFSS is a multi-phase national survey of saltwater recreational fishing, providing data for use in building sustainable fisheries.

NMFS - Protected Resources Surveys
NOAA collects biological and ecological information to identify populations of protected species and to assess the status of each population and the impacts of human activities upon protected species.

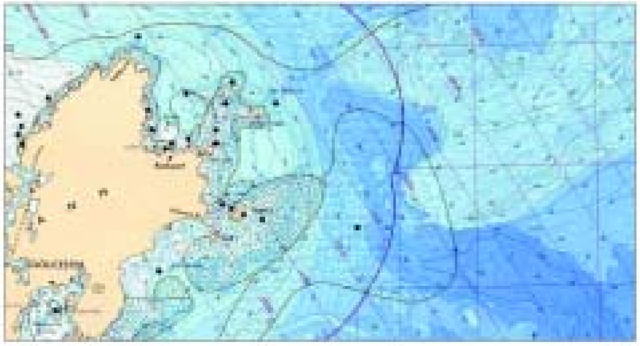
National Ocean Service (NOS)



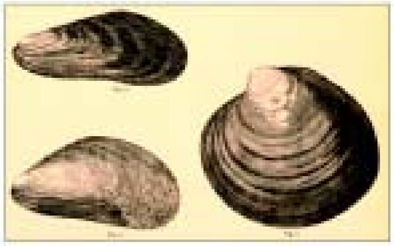
NOS - CORS
Continuously Operating Reference Stations
NOAA coordinates a network of continuously operating reference stations (CORS) that provide Global Positioning System (GPS) carrier phase and code range measurements throughout the U.S. and its Territories. Surveyors, GIS/LIS professionals, engineers, scientists, and others can apply CORS data to position points at which GPS data have been collected. The CORS system enables positioning accuracies that approach a few centimeters relative to the National Spatial Reference System, both horizontally and vertically. New sites are evaluated for inclusion according to established criteria.

CORS coverage, December 2003. Symbol color denotes sampling rates: brown, 1 second; red, 5 seconds; yellow, 10 seconds; green, 15 seconds; blue, 30 seconds.

NOS - Hydrographic Surveying
The principal objectives of hydrographic surveys are data collection and data compilation for nautical charts. Hydrographic survey data support a variety of maritime functions including port and harbor maintenance (dredging), coastal engineering, coastal zone management, and offshore resource development. The primary datum associated with all hydrographic surveys is water depth. However, there is also considerable interest in sea-floor composition due to implications for anchoring, dredging, structure construction, pipeline and cable routing, and fisheries habitat.



Portion of a hydrographic survey chart showing bathymetry in the region of Gloucester, Massachusetts.



NOS - National Status and Trends Mussel Watch
National Status and Trends Mussel Watch monitors chemical contaminants in sediments and bivalve mollusks (e.g., mussels and oysters). Data can be used to determine which coastal regions are at greatest risk in terms of environmental quality. Presently, bivalves are collected every other year and sediments about every fifth year at a network of more than 250 U.S. coastal and estuarine sites.

NOAA Ship Rainier *is one of several NOAA ships that conduct coastal hydrographic survey operations.*

NOS - NCOP
National Current Observation Program
The National Current Observation Program updates the tidal current prediction tables and products provided by NOAA to the public. The current tables contain predictions for more than 2,700 locations throughout the country.

NOS - NWLON
National Water Level Observation Network
The NWLON is a coastal observing network of 175 stations nationwide, including the Great Lakes and Pacific as well as Atlantic Ocean Island Territories and Possessions. The primary purpose is to collect continuous long-term water level observations to a known vertical reference. Data are used for computing tide and water level datums, creating tide prediction tables, and estimating sea level trends. The observations are used in real time for the PORTS® programs as well as for storm surge and tsunami events. Ancillary meteorological and water temperature data are also provided from several locations.

NOS - PORTS
Physical Oceanographic Real-Time System
PORTS® is a program that supports safe and cost-efficient navigation by providing ship masters and pilots with accurate real-time information required to avoid groundings and collisions. This technological innovation has the potential to save the maritime insurance industry from multi-million dollar claims resulting from shipping accidents. PORTS® includes centralized data acquisition and dissemination systems that provide real-time water levels, currents, and other oceanographic and meteorological data from bays and harbors to the maritime user community. PORTS® provides nowcasts and predictions of these parameters with the use of numerical circulation models.

NOS - SWMP
National Estuarine Research Reserve System-Wide Monitoring Program
The National Estuarine Research Reserve System (NERRS) System-Wide Monitoring Program (SWMP) tracks short-term variability and long-term changes in coastal ecosystems. The initial phase of the program began in 1996. This phase focuses on monitoring a suite of water quality and atmospheric information. Future phases will monitor organisms and the changes in land use/habitats. The reserves represent nearly 1,000,000 acres of protected estuarine waters, wetlands and uplands from the five major coastal regions in the United States (West Coast, Northeast and Great Lakes, Mid-Atlantic Coast, Southeast Coast, and the Gulf of Mexico and Caribbean Sea).

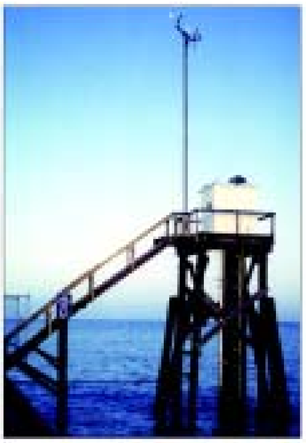
National Weather Service (NWS)

NWS - ARC, LARC
ARC: Automated Remote Collector
The ARC collects data in near real time from a point deemed important by a service hydrologist. A data logger collects a specified set of hydrometeorological parameters from colocated instruments and transmits the data using GOES telemetry. These data support short-term forecast and warning operations.
LARC: Limited Automated Remote Collector
The LARC acquires data from stage and/or precipitation sensors. The LARC is interrogated via telephone and data are made available to users.

NWS - ASOS
Automated Surface Observing System
The ASOS is a fully automated weather observing system. The system provides meteorological information to a wide variety of users.

Examples of 6-meter boat-shaped buoy and 3-meter discus buoy.

NWS - BUOY
National Data Buoy Center (NDBC) Moored Buoy
These are floating buoys, moored at specific locations, but able to drift up to approximately 2 miles in all directions, depending upon water depth, due to slack in the mooring. The mast attached to the deck contains sensors to automatically measure meteorological and oceanographic parameters. Antennas and power panels provide power and communications capabilities via NOAA's GOES system.



C-MAN station, Dauphin Island, Alabama.

NWS - CMAN
Coastal-Marine Automated Network
C-MAN stations are fixed platforms in the coastal zone (land-based or in the water) that measure and report marine weather observations in real time at least once per hour. C-MAN stations may be mounted near piers, on lighthouses, and other platforms with good exposure.

Instrumentation,
and COOP volunteer.

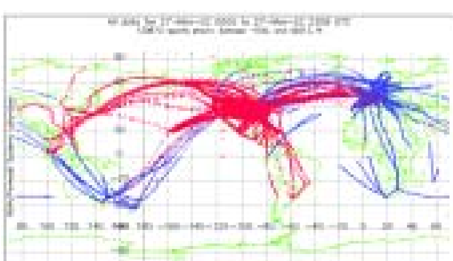
NWS - COOP
Cooperative Observer Program
The Cooperative Weather Observer Program (COOP) is the Nation's largest and oldest weather network. It was established under the Organic Act of 1890 to formalize the collection of meteorological and climate observations in the U.S. COOP observations are collected by nearly 12,000 volunteer citizens and institutions.

DART buoy, NOAA Ship Ronald H. Brown *in background.*

NWS - DART
Deep Ocean Assessment and Reporting of Tsunamis
The DART system consists of a bottom pressure recorder (BPR) located on the sea floor capable of detecting a tsunami as small as 1 centimeter high on the ocean surface. A discus-shaped buoy, 2.5 meters in diameter, is moored at a position close enough to receive data via acoustic link from the BPR. After receiving data from the BPR, the surface buoy relays the information via NOAA's GOES system to ground stations. The ground stations demodulate the signals and disseminate information to NOAA Tsunami Warning Centers (TWC) and the Pacific Marine Environmental Laboratory. TWCs use the data in real time to decide what U.S. coastal communities need to be warned of impending danger from a tsunami.

NWS - FNP
Fischer and Porter Gage
The Fischer and Porter gage is used to collect and record precipitation data.

NWS - LTG
Lightning Detection
A network of sensors detects cloud-to-ground lightning strikes over the conterminous U.S. and 250 km off shore.



NWS - MDCRS
Meteorological Data Collection and Reporting System
MDCRS is a data set from commercial aircraft providing detailed information on the vertical structure of winds and temperature during aircraft ascent, descent, and en-route. The data provide high resolution spatial and temporal atmospheric soundings and enroute data.

MDCRS global coverage from 2000–2002.

NWS - NEXRAD
Next Generation Weather Radar
WSR-88D systems acquire and process Doppler weather radar data. Forecasters and hydrologists use these data to prepare weather and flood forecasts, watches, and warnings. NEXRAD is also used to aid the safety of public and military aviation operations.

National Weather Service office, Morristown, Tennessee, with Doppler radar installation.

NWS - Profiling Radar - Alaska Network
Measures vertical profiles of horizontal wind speed and direction from near Earth's surface to above the tropopause.

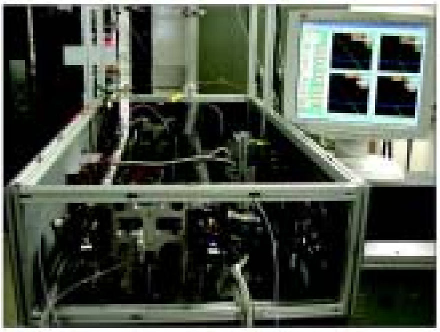
NWS - Rawinsonde
The NOAA Rawinsonde network provides profiles of pressure, temperature, relative humidity, and winds from the surface to more than 30 km high. These data are collected from balloon-borne radiosondes.

NWS - Regional Surface
[PICTURE BAR, below]
These are a compilation of various, regional observing systems or sensors that support goals of the NWS such as forecasts and warnings. In most cases the basic parameters such as temperature, winds, and precipitation are available.

NWS - VOS
Voluntary Observing Ship Program
The VOS Program obtains weather observations from vessels and ships traveling in the normal course of their business. The program relies on volunteer observers and operates at no monetary cost to the vessel. As an international program under World Meteorological Organization auspices, the VOS Program lists 49 countries as participants. The U.S. program is the largest, with approximately 900 vessels actively participating each quarter.

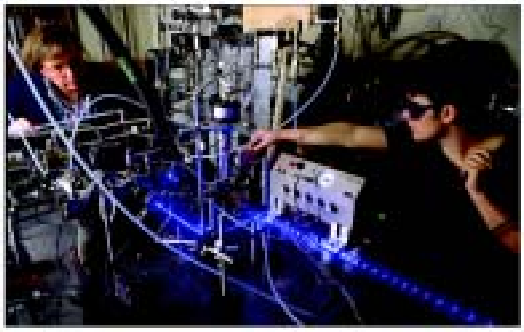
The Radiosonde Surface Observing Instrumentation System includes sensors that measure temperature, humidity, winds, and pressure. Left to right: temperature/humidity shield, wind sensor, and data logger.

Oceanic and Atmospheric Research (OAR)



OAR - AL - CARDS
Cavity Ring-Down Spectrometer
This new observing capability has enabled observations of difficult-to-measure trace gases such as nitrate radical (NO_3) and dinitrogen pentoxide (N_2O_5). A 2002 deployment aboard the R/V *Ronald H. Brown* led to the discovery of the important role of nighttime chemistry in the formation of ozone pollution.

OAR - AL - CIMS
Chemical Ionization Mass Spectrometers
A new observing capability for atmospheric trace gases that are important players in air-quality chemistry, is deployed on the NOAA WP-3D aircraft to study the processes that are important in regional air quality in the U.S.

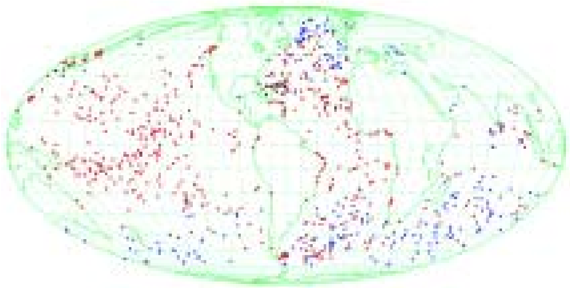


OAR - AL - Laboratory Systems for Investigation of Chemical Reactions and Processes
Development of new observing capabilities begins in the laboratory and culminates in field-ready instruments for the measurement of trace gases and particles that are important in air quality, climate, and the ozone layer. Partners within NOAA and in other agencies and academia collaborate in the deployment of a suite of chemical and meteological instrumentation in focused field studies, using NOAA observing platforms such as the WP-3D aircraft and the R/V *Ronald H. Brown.*

OAR - AL - MIDAS
Miniaturized Differential Absorption Spectrometer
This spectrometer is flown on the NOAA WP-3D aircraft and used at ground sites to measure trace gases and their importance in air quality and climate-related processes.

OAR - AL - PALMS
Particle Analysis by Laser Mass Spectrometry
The PALMS instrument deciphers the “chemical fingerprint” of individual atmospheric aerosol particles. It has enabled the identification of the subset of atmospheric aerosols that are effective as seed particles for cloud formation, information that is important for climate.

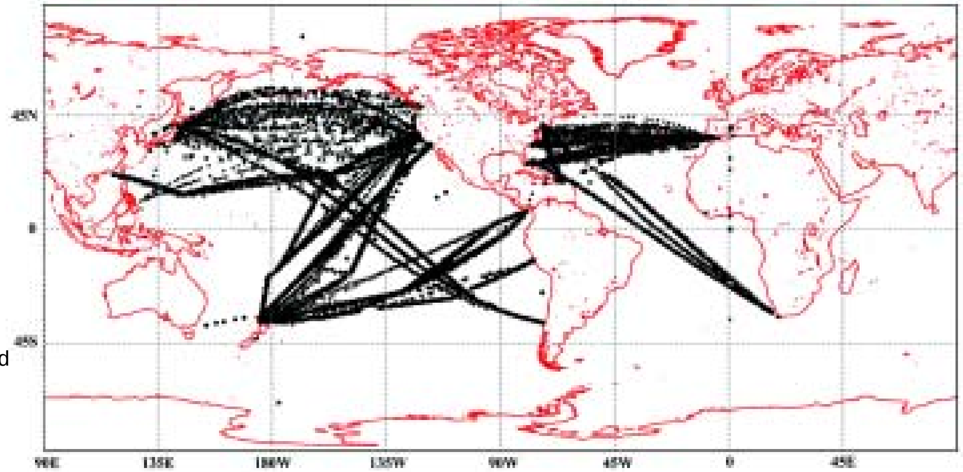
OAR - AL - Wind-Profiling and Precipitation-Profiling Radars
These 915-MHz Doppler radars are used to measure vertical profiles of horizontal wind speed and direction in the lower troposphere. S-band (2835 MHz) Doppler radar systems use backscatter from hydrometeors in the atmosphere to remotely study precipitation parameters. Both contribute to the understanding of climate dynamics and climate variability.



OAR - AOML - ENSO OS Drifting Buoys
El Niño Southern Oscillation Observing System Drifting Buoys
The purpose is to maintain and support the Global Drifter Array and the Global Drifter Center.

Plot of Global Drifter Array. There were 848 buoys in 2003.

SEAS - ENSO OS platforms, with more than 11,100 observations in 2002.



OAR - AOML - ENSO OS SEAS GOOS/VOS/XBT
Real time Expendable Bathythermograph (XBT) observations are collected from Voluntary Observing Ships (VOS) in support of the El Niño Southern Oscillation (ENSO) Observing Network and global climate change research.

OAR - AOML - ENSO OS VOS/XBT
El Niño Southern Oscillation Observing System VOS/XBT Network
The purpose is to maintain and support the global Low Density and Frequently Sampled XBT transects utilizing the Voluntary Observing Ship (VOS) network.

OAR - Argo
Profiling Floats
Argo is an international program to deploy a global array of 3,000 profiling floats to observe the ocean's upper layer in real time. Along with satellites, the Argo array will initiate the oceanic equivalent of today's operational observing system for the global atmosphere.

OAR - ARL - Atmospheric Dispersion Measurement System
This mobile dispersion measurement system uses intentionally-released, harmless tracer gases to directly measure dispersion. The system includes release, sampling, and analysis equipment.

ISIS, Seattle, Washington.

OAR - ARL - ISIS
Integrated Surface Irradiance Study
ISIS is a national network of surface solar irradiance stations representing differing climates of the United States.

OAR - ARL - Mesonet
INEEL Mesoscale Meteorological Network
Mesonet includes 36 meteorological data collection stations located inside and near the U. S. Department of Energy Idaho National Engineering and Environmental Laboratory.

SURFRAD station, Desert Rock, Nevada.

OAR - ARL - SURFRAD
Surface Radiation Budget Network
SURFRAD is a national network of surface radiation budget stations representing differing climates of the United States.

AIRMoN-wet site, Bondville, Illinois.

OAR - ATDD - AIRMoN
Atmospheric Integrated Research and Monitoring Network
The AIRMoN has two distinct sub-networks, AIRMoN-wet and AIRMoN-dry. AIRMoN-wet monitors the wet deposition of certain key air pollutant species, and AIRMoN-dry does the same for dry deposition. Both have been in operation since the 1980s.

OAR - ATDD - ETOS
East Tennessee Ozone Study
ETOS is comprised of a seasonal network of ozone monitors and tower-based meteorological systems to determine local time-varying ozone concentrations at mountain top, ridge top, and valley bottom sites throughout eastern Tennessee. Data are collected by telemetry.

OAR - ATDD - RAMAN Network
Regional Atmospheric Measurement and Analytical Network
This tower network provides meteorological data from mountain top, ridge top, and valley bottom locations in the complex terrain surrounding Oak Ridge, Tennessee.

Close-up of ETOS instrument in its shelter, at the base of a tower.

OAR - CMDL - AERO
Aerosol System
The purpose is to measure aerosol optical properties as a function of size and wavelength at baseline and regional stations.

Aircraft provide platforms for various NOAA observing systems. This Cessna is used in an aerosol sampling program, Ponca City, Oklahoma.

OAR - CMDL - CCGG
Carbon Cycle Greenhouse Gases
The NOAA Carbon Cycle Greenhouse Gases group makes ongoing discrete measurements from land and sea surface sites and aircraft, and continuous measurements from baseline observatories and tall towers. These measurements document the spatial and temporal distributions of carbon-cycle gases and provide essential constraints to our understanding of the global carbon cycle.

View of the Mauna Loa Observatory from the sampling tower; CH4 and CO gas chromatographs at the observatory.

Carbon-cycle measurements are compiled from land, sea, and air. NOAA scientists are involved in many international, cooperative programs in these studies. Left to right: Firn gas collection in Greenland; air sampling instrument that flies on research aircraft; planes readied at Raratonga, Cook Islands; sampling over Fortaleza, Brazil.



OAR - CMDL - Dobson
Measurement of Total Column Ozone using the Dobson Ozone Spectrophotometers
The Dobson Ozone Spectrophotometer has been used to study total ozone since its development in the 1920s. The observations of total ozone (the total amount of ozone in a column from the surface to the edge of the atmosphere) by this instrument is one of the longest geophysical measurements series in existence.

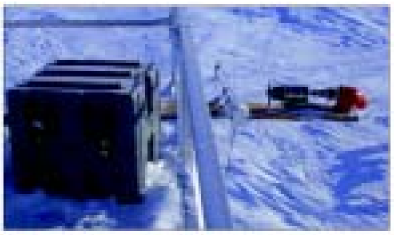
OAR - CMDL - HATS
Halocarbons and other Atmospheric Trace Species
These measurements quantify the spatial and temporal distributions of nitrous oxide and halogen-containing compounds in the atmosphere and the magnitudes of their sources and sinks.

Taking measurements at sunrise, Amundsen South Pole Station, September, 2003.

OAR - CMDL - STAR
Solar and Thermal Atmospheric Radiation Surface Measurements
This system quantifies upwelling and downwelling solar and thermal atmospheric radiation as it relates to climate variability. Observations are made at globally remote and climatically diverse locations around the world.

STAR, Kwajalein Atoll.

Trans-Siberian Observations Into the Chemistry of the Atmosphere (TROICA). Scientists from NOAA, the Max Planck Institute for Chemistry, and the Russian Institute of Atmospheric Physics created a mobile laboratory to measure halocarbon and greenhouse gases along the trans-Siberian railway.



OAR - ETL - 5mm Scanning Radiometer
The 5-mm Scanning Radiometer scans rapidly (every 1 second) in a vertical plane to derive boundary layer temperature profiles. When operated from a ship, air-sea temperature differences can also be derived.

OAR - ETL - 449 Radar
449 MHz Wind Profiling Radar
This is a Wind Profiling and Acoustic Sounding System Radar operating at 449 MHz. The radar can be positioned to observe either in a horizontal or vertical direction. The radar can provide remote sensing anywhere in the world because it is mobile and very powerful.

OAR - ETL - ABAEL
Airborne Aerosol Lidar
ABAEL uses backscatter lidar for aerosol detection via aircraft platforms.

OAR - ETL - Airborne Ozone Lidar
This system is a laser-based active remote sensor (lidar system) for measuring ozone concentration and aerosol optical backscatter in the lower troposphere.

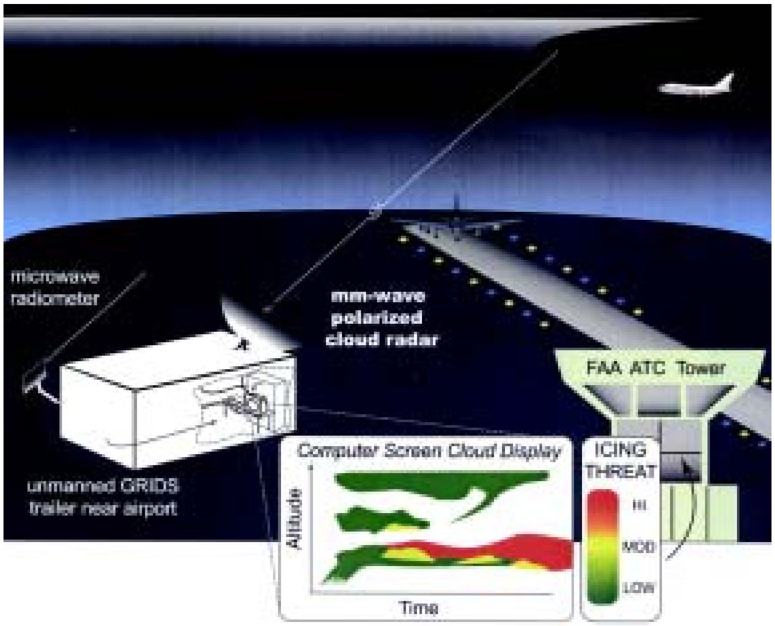
OAR - ETL - BAO
Boulder Atmospheric Observatory
The BAO is a 300m research tower measuring winds, temperature, and RH at 5 levels.

OAR - ETL - Cband Radar (*Ron H. Brown*)
NOAA R/V *Ronald H. Brown* C-band Doppler Radar
This C-band Radar is a 5.6 GHz Doppler radar on board the NOAA research vessel, *Ronald H. Brown*. The radar's 4.3 meter antenna is mounted on top of the ship's main mast within a protective radome and is designed for operations in heavy weather up to sea state 8.

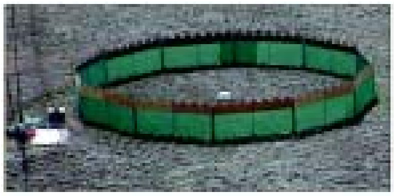
OAR - ETL - DABUL
Depolarization and Backscatter Unattended Lidar
DABUL is an all-weather lidar (laser radar) for cloud and aerosol detection, including backscatter and depolarization profiles.

OAR - ETL - Fish Lidar
This airborne system uses green light to profile distributions of scatterers such as plankton and fish in the upper ocean.

OAR - ETL - GRIDS
Ground-based Remote Icing Detection System
GRIDS is a multi-sensor observing system, developed for the detection of supercooled liquid that would cause icing on aircraft. This system also has applications for cloud physics and climate research, model parameterization and verification, and calibration/validation activities in support of other NOAA activities.



OAR - ETL - Hughes Radiometer
This is a liquid/vapor radiometer system with added surface meteorological information.



OAR - ETL - Infrasound
Infrasonic Observatory
This is a system designed to measure atmospheric infrasound primarily in the 0.5 to 10 Hz frequency range.

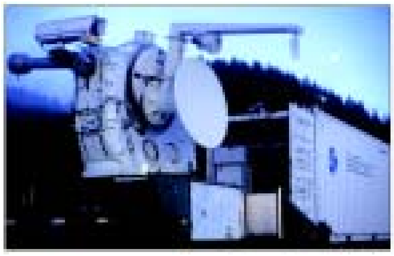
OAR - ETL - IR Radiometer
OAR - ETL - Narrow Band IR Radiometer
This is an infrared radiation sensor for measuring temperature.

OAR - ETL - Lidar - HRDL - ost
High Resolution Doppler Lidar
HRDL is a scanning atmospheric Doppler lidar that provides range-resolved measurements of radial wind speed and backscatter intensity. It is designed to make higher spatial and temporal resolution measurements in the atmospheric boundary layer.

OAR - ETL - Lidar - MOPA - ost
Dual Wavelength Doppler Lidar
Mini-MOPA is a scanning Doppler lidar used in field campaigns to study atmospheric phenomena in the boundary layer.

OAR - ETL - Lidar - TEACO - ost
High Power Doppler Lidar
TEACO2 is a scanning atmospheric Doppler lidar that provides range-resolved measurements of radial wind speed and backscatter intensity.

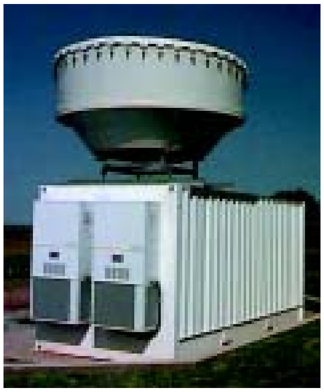
OAR - ETL - Marine Atmospheric Boundary Layer Observation System
This system is deployed on seagoing ships in order to measure air-sea radiative and turbulent fluxes, boundary layer clouds, temperature, humidity, and wind profiles.



OAR - ETL - NOAA/K
Mobile Scanning Cloud Radar
NOAA/K is a dual-polarized, scanning, Doppler radar (short wavelength, 8.66 mm/35GHz), for cloud physics research and climate studies.

OAR - ETL - OPAL
Ozone Profiling Atmospheric Lidar
The Ozone Profiling Atmospheric Lidar (OPAL) observing system provides ozone profiles for the health of the atmosphere and climate change programs. It is used for field campaigns to profile ozone and aerosol backscatter.

OAR - ETL - Platteville - 915 - Profiler
Platteville Tropospheric Profiler
The Platteville Tropospheric Profiler is a narrow-beam, high-power, radar wind profiler operating at 915 MHz. Recently, it has been upgraded to multi-frequency capability.



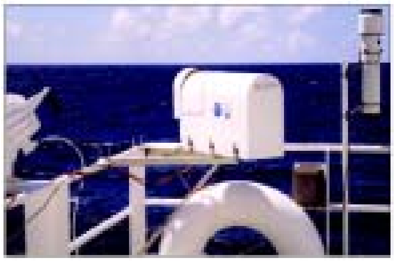
OAR - ETL - Portable Cloud Observatory
This system is comprised of a 35 GHz radar, a 3-channel microwave radiometer, and an infrared radiometer packaged in a seatainer. An integral part of the system is a data processing package and a suite of theoretical retrieval techniques that allows real-time production of cloud microphysical and optical properties.

OAR - ETL - Profiling Radar
Wind and Temperature Profiling Radar
This 915 MHz Doppler radar is used to measure profiles of wind speed and direction in the lower atmosphere.

OAR -ETL- Profiling Radar -
Tethered Aerostat Radar System
This is a wind and temperature profiling radar operating at 449 MHz.

OAR - ETL - PSR
Polarimetric Scanning Radiometer
The Polarimetric Scanning Radiometer (PSR) is used for airborne or ground-based microwave radiometric imaging.

OAR - ETL - Radiometer Container
This is a container fitted with microwave and infrared radiometers for the study of clouds.

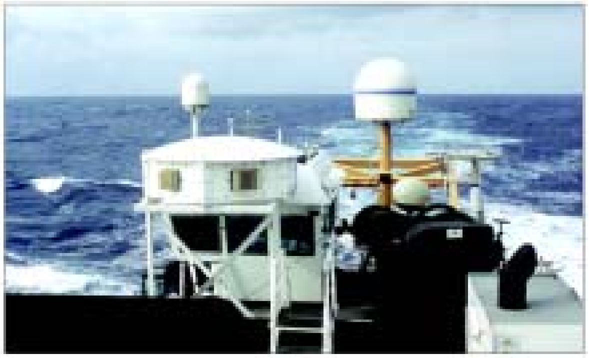


OAR - ETL - Radiometrics Radiometer
This is a liquid/vapor radiometer system.

OAR - ETL - Rawinsonde - MW11, MW15, MW21
The Rawinsonde MW11, MW15, and MW21 observing systems consist of a sounding system. These systems measure temperature, relative humidity, pressure, wind speed and direction of the atmosphere. They use Global Positioning Systems (GPS) to determine wind speed and direction.

OAR - ETL - Sodar
Wind Profiling Sodar
Sodar is a ground-based remote wind profiler which acquires atmospheric boundary layer data.

OAR - ETL - Wind Profiler - RB
Electronically-Stabilized Wind Profiler
This is a 915-MHz clear-air radar used for measuring wind speed and direction from 150 - 3000 m altitude. This system automatically compensates for platform motion.



OAR - ETL - WVDIAL
Compact Water Vapor DIAL Lidar
This is a compact eye-safe autonomous lidar for profiling water vapor in the lower troposphere.

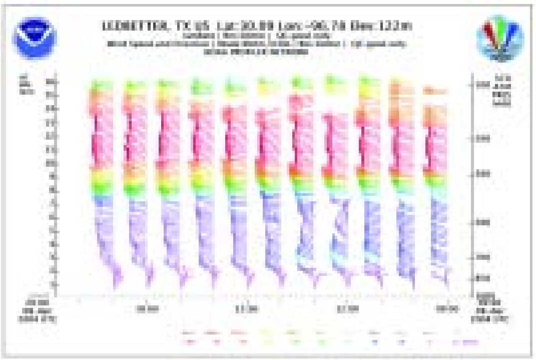
OAR - FSL - GPS Water Vapor Sensor
Global Positioning System Integrated Precipitable Water Sensor

Integrated (total atmospheric column) precipitable water is retrieved under all weather conditions from excess delays in the GPS radio signals caused by water vapor in the lower atmosphere. The system includes GPS receivers and colocated surface meteorologicall sensors belonging to NOAA and other Federal government agencies. GPS receivers belonging to State and local government agencies, universities, and the private sector, densify the network to provide additional detail that further improves NOAA short-range weather forecasts.

A Nationwide Differential GPS (NDGPS) site belonging to the U.S. Department of Transportation.

OAR - FSL - CWOP
Citizen Weather Observer Program

Through CWOP, FSL is organizing data collected from citizen weather stations. This could potentially augment the NWS Modernized COOP Program automated surface weather reports.



OAR - FSL - MADIS
Meteorological Assimilation Data Ingest System

MADIS is a unique network of more than 13,000 stations. MADIS integrates and quality controls surface meteorological data from mesonets operated by many Federal, State, and local government agencies, public utility companies, research organizations, educational institutes, as well as private individuals and corporations.

Above, wind speed and direction plot created with MADIS data from Ledbetter, Texas (site at right). Below: Profilers at Syracuse, New York, and Glennallen, Alaska.

OAR - FSL - CAP
Cooperative Agency Profilers

This system measures vertical profiles of horizontal wind speed and direction (and temperature in many cases) in the lower troposphere to lower stratosphere.

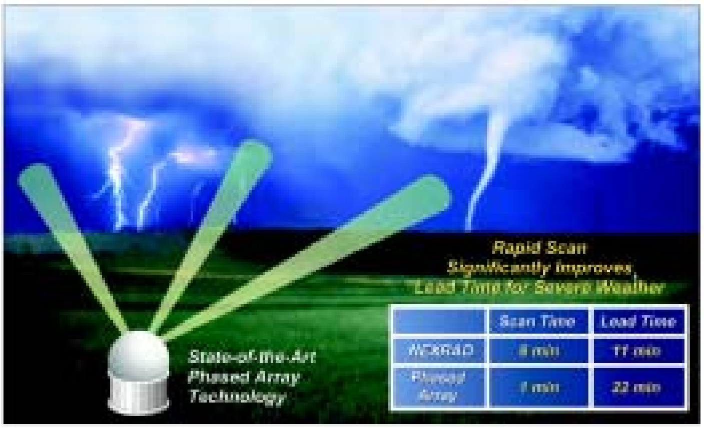
OAR - FSL - NPN
NOAA Profiler Network

The NPN measures vertical profiles of horizontal wind speed and direction from near Earth's surface to above the tropospause.

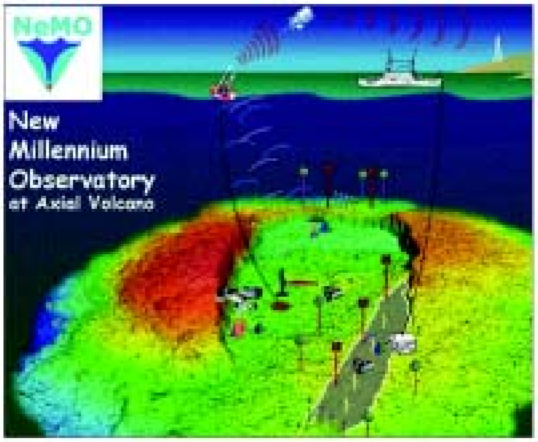
GSLN station, Hululue Island, Maldives.

OAR - GSLN
Global Sea Level Network
GSLN stations are fixed platforms on islands and in the coastal zone that measure and report sea level information in real time using geostationary satellites and the Global Telecommunication System. GSLN provides global sea level information for use in multiple NOAA missions including climate monitoring and prediction, and studies of climate phenomena such as ENSO.

OAR - NSSL - Phased Array Radar
This system adapts SPY-1 radar technology (currently deployed on U.S. Navy ships) for use in spotting severe weather. The phased array radar system technology has the potential to vastly improve the NEXRAD system (high resolution Doppler radar).



OAR - PMEL - FOCI
Fisheries Oceanography Coordinated Investigations
This system takes physical and biological marine measurements in the Bering Sea, Gulf of Alaska, and North Pacific Ocean. The system includes moorings, drifters, tows, and surveys.



OAR - PMEL - NeMO Net
New Millennium Observatory Network
NeMO examines the relationship between volcanic events, chemistry of seafloor hot springs, and the biological communities that depend on them. The site is at the Axial Seamount on the Juan de Fuca Ridge, 250 miles off the coast of Oregon and Washington. An acoustic modem links seafloor instruments to a surface buoy and then data are relayed to shore by satellite.

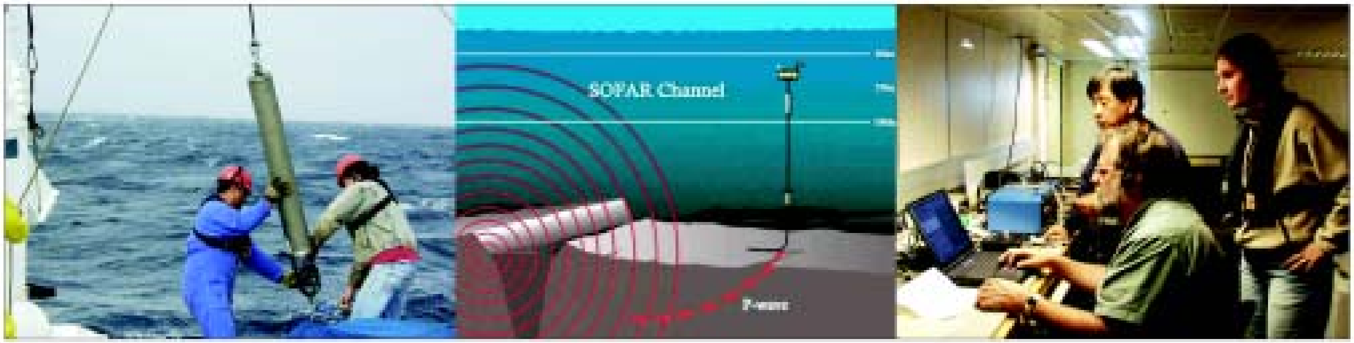
OAR - PMEL - Ocean Acoustic Monitoring System
[PICTURE BAR, below]
The Ocean Acoustic Monitoring System consists of arrays of underwater hydrophones, both autonomous and cabled, deployed at numerous sites around the global ocean, that collect continuous digital acoustic data for ocean observation.

OAR - PMEL - PIRATA
Pilot Research Moored Array in the Tropical Atlantic
PIRATA studies ocean-atmosphere interactions in the tropical Atlantic that are relevant to regional climate variability on seasonal, interannual, and longer time scales. The project is implemented through multi-national cooperation.

OAR - PMEL - TAO
Tropical Atmosphere Ocean Array
The array is a major component of the El Niño Southern Oscillation (ENSO) Observing System, the Global Climate Observing System (GCOS), and the Global Ocean Observing System (GOOS). Support is provided primarily by the United States (NOAA) and Japan (Japan Marine Science and Technology Center), with additional contributions from France (Institut de recherche pour le developpement).

OAR - Stratus
Long-term Evolution of the Coupled Boundary Layers
The Stratus project is obtaining a reliable multi-year dataset of meteorological and subsurface measurements beneath the coast of Chile and Peru. Moorings are put in place for one year, and then retrieved and replaced with another, similar mooring. The buoys have meteorological systems that measure wind speed, wind direction, air temperature, sea surface temperature, barometric pressure, relative humidity, incoming shortwave radiation, incoming longwave radiation, and precipitation. Subsurface instruments attached to the mooring line measure water temperature, conductivity, current speed, current direction, salinity, and precipitation (acoustic rain gauge).

Ocean Acoustic Monitoring System. Left to right: Hydrophone is deployed from the French vessel Le Suroit. *The mooring is designed to place the hydrophone within the oceanic sound channel. NOAA and French researchers acoustically interrogate the newly deployed mooring to refine its position.*



Appendix 5: Acronyms

A&A	Archives and Access
AGM	Annual Guidance Memorandum
AL	Aeronomy Laboratory
ARL	Air Resources Laboratory
AOML	Atlantic Oceanographic and Meteorological Laboratory
ATDD	ARL's Atmospheric Turbulence and Diffusion Division
CEOS	Committee on Earth Observation Satellites
CIO	Chief Information Officer
CLASS	Comprehensive Large Array-data Stewardship System
CMDL	Climate Monitoring and Diagnostics Laboratory
CONOPS	Concepts of Operation
COP	Conference of Parties
DHS	Department of Homeland Security
DMAC	IOOS Data Management and Communication
DOC	Department of Commerce
DoD	Department of Defense
DPP	Data Product Processing
EITA	Enterprise IT Architecture
EME	Ecosystem-based Management Enterprise
EO	Earth Observation (Summit)
EPA	Environmental Protection Agency
ETL	Environmental Technology Laboratory
ENSO	El Niño Southern Oscillation
FSL	Forecast Systems Laboratory
GCMD	Global Change Master Directory
GCOS	Global Climate Observing System
GEO	Group on Earth Observations
GEOSS	Global Earth Observation System of Systems
GIS	Geographic Information System
GOES	Geostationary Operational Environmental Satellite
GOOS	Global Ocean Observing System
IGOS-P	Integrated Global Observing Strategy Partnership
IOOS	Integrated Ocean Observing System
ISDR	International Strategy for Disaster Reduction
ISE	Information Service Enterprise
IT	Information Technology
IV&V	Independent Validation and Verification
IWGEO	Interagency Working Group on Earth Observations
MII	Methodology Innovation and Implementation
NARA	National Archives and Records Administration
NASA	National Aeronautics and Space Administration
NEC	NOAA Executive Council
NESDIS	National Environmental Satellite, Data, and Information Service
NMAO	NOAA Marine and Aviation Operations
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOC	NOAA Ocean Council
NORLC	National Ocean Research Leadership Council
NOS	National Ocean Service
NOSA	NOAA Observing Systems Architecture
NOSC	NOAA Observing Systems Council
NOSDM	NOAA Observation Systems Data Management
NSSL	National Severe Storms Laboratory
NWS	National Weather Service
O&C	Observations and Collections
OAR	(Office of) Oceanic and Atmospheric Research
OCO	Office of Climate Observations
PAE	Program Analysis and Evaluation
PBBES	Planning, Programming, Budgeting, and Execution System
PMEL	Pacific Marine Environmental Laboratory
POES	Polar-orbiting Operational Environmental Satellite
PPI	Program Planning and Integration
UI	User Interface
UNFCCC	United Nations Framework Convention on Climate Change
USCOP	U.S. Commission on Ocean Policy
USDA	U.S. Department of Agriculture
WCRP	World Climate Research Program
WMO	World Meteorological Organization

For more information about NOAA's observing systems, please visit

http://www.noaa.gov

or contact

NOAA Public Affairs
U.S. Department of Commerce
14th Street & Constitution Avenue, NW
Washington, D.C. 20230
202.482.6090

NOAA Fisheries
National Marine Fisheries Service
http://www.nmfs.noaa.gov

NOAA Marine and Aviation Operations
http://www.nmao.noaa.gov

NOAA Ocean Service
National Ocean Service
http://www.nos.noaa.gov

NOAA Office of Program Planning and Integration
http://www.ppi.noaa.gov

NOAA Research
Office of Oceanic and Atmospheric Research
http://www.oar.noaa.gov

NOAA Satellites and Information
National Environmental Satellite, Data, and Information Service
http://www.nesdis.noaa.gov

NOAA Weather Service
National Weather Service
http://www.nws.noaa.gov

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