NOAA's Environmental Data Management:
Integrating the Pieces

An Assessment of NOAA's Environmental Data and Information Management

March 2006

NOAA's Vision

An informed society that uses a comprehensive understanding of the role of the oceans, coasts, and atmosphere in the global ecosystem to make the best social and economic decisions

NOAA's Mission

To understand and predict changes in 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

- Protect, restore, and manage the use of coastal and ocean resources through an ecosystem approach to management
- Understand climate variability and change to enhance society's ability to plan and respond
- Serve society's needs for weather and water information
- Support the Nation's commerce with information for safe, efficient, and environmentally sound transportation
- Provide critical support for NOAA's Mission

Contents

Executive Summary

An Assessment of NOAA's Environmental Data and Information Management delivers (1) an enterprise-wide review of NOAA's current data management, archive, and distribution capabilities, and (2) a plan to address challenges over the coming decade. The report details the successes and continuing challenges NOAA faces in the management of environmental and geospatial data and information acquired to support its mission.

The National Oceanic and Atmospheric Administration (NOAA) has made improvements to the planning, acquisition, archive, and dissemination of Earth environmental data, including data on the atmosphere, ocean, and land. NOAA adopted a structure of four Mission Goals and a Support Mission Goal around which work is planned and organized. NOAA created an enterprise-wide method for planning and evaluating observation and data requirements, and established the NOAA Observing Systems Council (NOSC) to oversee observing systems, data, and information management and planning enterprise-wide. The NOSC formed the Data Management Committee (DMC) to coordinate the development and implementation of data management policy across NOAA. The DMC addresses issues and opportunities requiring coordination among NOAA's Goals and Line Offices, and sponsored this report.

NOAA data, products, and services touch the lives of Americans on a daily basis. NOAA is bringing together the many pieces of Earth's environmental puzzle in an integrated and informative manner. NOAA's lifeblood is more than 300 environmental observation parameters acquired through its satellites, ships, and other observing systems. The Nation depends on these environmental observations and the systems that collect, process, manage, archive, and disseminate these data.

Excellent data management is a core business of NOAA. NOAA is committed to collecting and providing the highest quality data, delivered in a secure and efficient manner. NOAA maintains a stable, long-term archive for future generations. Investments must focus on the people, tools, and technology, and on an integrated approach to observation and data management. NOAA serves a diverse set of users and contributes to a wide range of benefits for our people, our economy, and the planet on which we live.

NOAA's Mission Goals

Protect, restore, and manage the use of coastal and ocean resources through an **ecosystem** approach to management

Understand **climate** variability and change to enhance society's ability to plan and respond

Serve society's needs for **weather and water** information

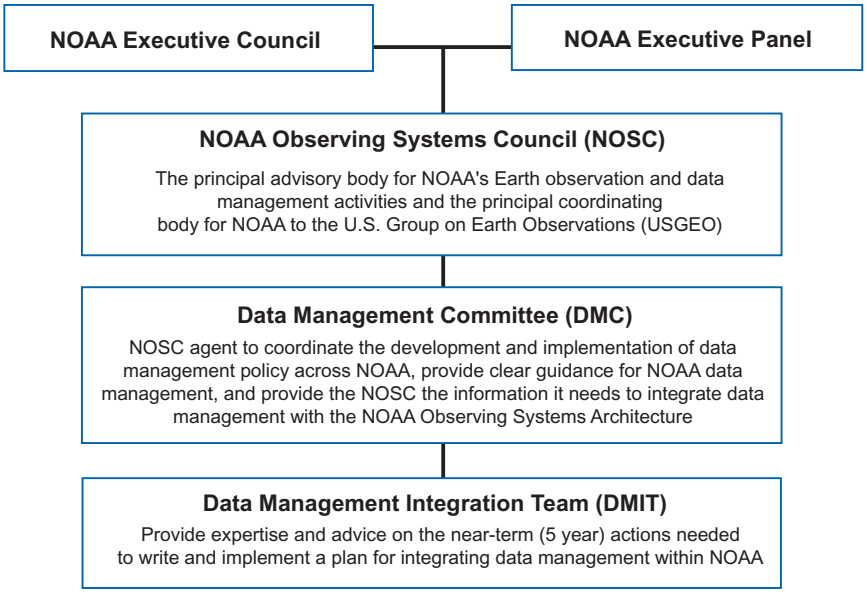
Support the Nation's **commerce** with information for safe, efficient, **and** environmentally sound **transportation**

Provide critical **support** for **NOAA's Mission**

In accordance with Public Law 102-567 Section 106, NOAA completed an assessment of its data and information systems in August 2005. Since the last assessment in 2003, NOAA made significant changes in our business philosophy and developed an overarching strategy for integrated observation and data management. Based on stakeholder input and internal assessments of our mandates and mission, NOAA adopted a program-oriented structure consisting of four Mission Goals and a mission Support Goal around which the agency plans and organizes all of its work.

NOAA's Line and Staff Offices achieve these Goals through activities in 45 Programs. The domains of the four Mission Goals are interrelated, sharing common data, science and technology challenges, and stakeholder interest. Each Goal must consider its relationship with the others in developing and implementing plans and Programs. Similarly, the Support Goal provides vital NOAA-wide services in support of all Goals, such as environmental satellite services, which include some of the greatest data management challenges.

In the two years since the last Report, NOAA made improvements to the planning, acquisition, archive, and dissemination of Earth's environmental data. Under the auspices of the NOSC and DMC, NOAA established additional resources focused on corporate-wide data management and development of a single "system of systems" for accessing NOAA environmental data. A robust and secure Information Technology (IT) architecture is an essential component of NOAA's integrated data system. NOAA developed an IT Architecture Plan which provides a policy basis for the acquisition and use of IT resources. NOAA established a Data Management Integration Team (DMIT) to guide the implementation of this system. The NOSC, DMC, and DMIT, working with NOAA's Chief Information Officer and Technical Director for Integrated Data Management, are currently defining NOAA's integrated observation and data management system.



2005 Data Management Assessment Summary

	Doing with current resources / Need incremental increase / Requires sub-stantial additional resources	End-to-End Environmental Data Management Functions										
		Observation Acquisition & Transmission			Scientific Data Management				Archive & Access			
		5-Year Plan	Maintain & Monitor	Collect & Rescue	5-Year Plan	Calibrate & Validate	Appropriate Formats	Complete Metadata	5-Year Plan	Long-term Preservation	Data Discovery	Access / Disseminate
NOAA Mission Goals	Ecosystems	P			P				N			
	Climate	F			F				F			
	Weather & Water	P			P				P			
	Commerce & Trans-portation	F			P				P			

- A **green cell** indicates that the Goal is accomplishing 100% of the required activity or is able to do so with current resources.
- A **yellow cell** indicates that the activity is partially accomplished or an incremental increase in resources is required to reach the 100% level.
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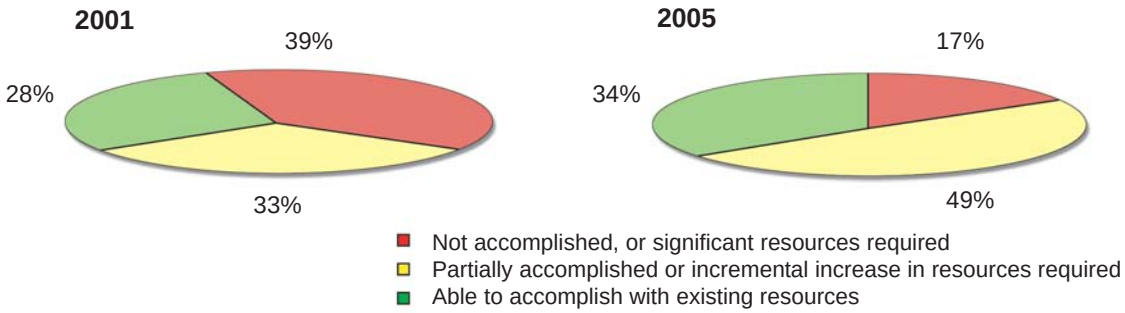
- **5-Year Plan columns** are F, plan completed and in place; P, partly completed; and N, no plan in place.

NOAA's leadership role in the United States Group on Earth Observations (USGEO) and the intergovernmental Group on Earth Observations (GEO) is strengthened by its internal efforts to develop an integrated data management system. NOAA has extensive cooperative efforts with other federal agencies, with international partners, and with private industry. Future efforts are expected to take place under the umbrella of cooperation being facilitated by USGEO and GEO, using complementary tools and processes to share environmental information.

NOAA conducted an assessment of the current state of its data management practices. Based on criteria from Public Law 102-567, NOAA assembled 12 survey questions focused on an holistic, end-to-end observation and data management approach, addressing the five data management, archive, and distribution areas identified in the Public Law. The survey was organized around broad data and information management themes: (1) observation acquisition and transmission; (2) scientific data management; and, (3) archive and access. The survey also addressed contingency planning. NOAA assessed end-to-end data and information management capabilities for 44 of the 45 programs in the NOAA program structure. The 45th program, addressing tsunamis, was established in June 2005 and is currently completing its data management assessment.

The assessment identified common areas of success and need across NOAA Goals. Based on these results, an End-to-End Environmental Data Management Assessment Summary was created. The Summary presents the status of data management activities within the NOAA Goals; however, it is not normalized for differences in Program responses. No value was assigned to "significant" or "incremental" increases in resources. A green cell indicates the Goal is accomplishing 100 percent of the required activity or is able to do so with current resources. A yellow cell indicates the activity is partially accomplished or an incremental increase in resources is required to reach the 100 percent level. A red cell indicates the activity is not accomplished or significant new resources are required. A fully successful Goal acquires high-quality data; analyzes, evaluates, documents, and preserves these data; and provides timely information and products to the end users of the services. The



assessments, when combined with strategic planning on the enterprise level, provide NOAA with an integrated end-to-end approach for Earth environmental data and information management.

Based on the results of the self-assessment, some areas stand out as needing attention enterprise-wide. NOAA must meet the expanding real-time responsibilities at the current high level while addressing challenges in:

- managing the increasing volume and diversity of data;
- extending and filling in the gaps in environmental data records;
- improving accessibility to the long-term archive; and,
- enabling integration of quality observations and products.

These activities all depend on:

- improved descriptions of data, formats, and processing steps.

Most Programs indicated that observations are well calibrated and validated, and the related products undergo quality review based on accepted research or statistical methods. NOAA is doing a better job of collecting and verifying environmental observations, and processing and transmitting these observations than four years ago.

In 2001, NOAA assessed its ability to plan for, collect, ingest, catalog, validate, store, access, and migrate data by major data stream. Comparing the number of red, yellow, and green cells from the 2001 assessment to 2005, one sees a decrease in the percent of red cells and an increase in the percent of yellow and green cells. These advances are due in part to ongoing modernization programs such as the Advanced Weather Interactive Processing System (AWIPS) and the National Weather Service (NWS) Telecommunication Operations Center (TOC).

The long-term NOAA objective is integrated information services delivery. Work in this area is underway today and will require concerted effort for years to come. Customer needs drive the integration of NOAA information across disciplines, timescales, and federal, state, and local agencies. NOAA should provide products, services, and prediction capabilities that deliver specific regional and local environmental information at all time scales relevant to decision makers. In the next few years, NOAA will take steps to accomplish this goal.

NOAA's near-term data management goals are:

- **Identify and address integration gaps.** NOAA is in the process of identifying technological and scientific integration gaps. We will address these gaps and enable integrated access to multi-discipline data and coupled model results so the scientific community can perform systematic comparisons.
- **Create interoperability across NOAA.** NOAA can foster interoperability by integrating key capabilities, loosely combining legacy systems while developing new ways to support access to valuable data assets. NOAA will invest in developing sustainable interoperability across the federal government and partner organizations.

- **Develop and adopt standards for format and terminology.** NOAA subscribes to the value of, and need for, corporate standards. NOAA will define a process for adopting standards that is open and inclusive, favoring existing information technology and scientific standards.

- **Integrate measurements, data, and products.** NOAA will provide easier and more cost-effective access to all of its data and information. NOAA will ensure that data and products are collected and managed in accordance with policies, procedures, and standards that support and enhance integration.

- **Examine future data management requirements.** Data management consists of two major activities conducted in coordination: (1) data management services, and (2) data stewardship. NOAA will examine data management requirements and develop an enterprise plan for managing the Nation's environmental data assets.

NOAA's Near-term Data Management Goals

- Identify and address integration gaps
- Create interoperability across NOAA
- Develop and adopt standards for format and terminology
- Integrate measurements, data, and products
- Examine future data management requirements

As we strive to understand the complexity of Earth's systems, scientists from various disciplines across the globe are engaged in large, multi-national, and multi-disciplinary research teams. Rapid development in communication technologies provides access to national data archives and real-time observations.

Communication technologies and data management techniques will continue to evolve, supporting increased demands for online access to large-array data. These data are an essential component of the enhanced spatial and temporal resolution models now feasible with improved supercomputers.

However, proper data stewardship is not all about systems. It involves an understanding of the data's value by the scientific community and thoughtful management of this information. Both skilled stewards and smart technology are necessary to manage the Nation's environmental information heritage. Without the human element, we will be data rich and information poor.

Based on the data management assessment, NOAA is better prepared now to ensure the reliable and efficient flow of quality data from observation source to real-time products. NOAA faces ongoing challenges in managing increasing diversity and volumes of data, enabling data integration, and addressing real-time dissemination demands. Significant challenges remain in data reprocessing and rescue, essential for extending the environmental record. NOAA is in the initial stages of developing and implementing an integrated data management system, based on common IT architecture and common processes. This will address many of the challenges identified in the assessment. However, proper data stewardship also involves an understanding of the data's scientific value and thoughtful management for future use.

NOAA is bringing together the many pieces of Earth's environmental puzzle in an integrated and informative manner.

NOAA's Mission Goals
Data Management Successes 2003–2005

- NOAA delivers more than 6.5 million free electronic navigational charts online in digital format.
- The Physical Oceanographic Real-Time System provides centralized data acquisition and dissemination for water levels, currents, and other oceanographic and meteorological data from U.S. bays and harbors.
- Improved Space Weather Solar X-ray imager data and product processing provides real-time services and near real-time archive, improving access and preventing data loss.
- The National Digital Forecast Database provides 24-hour digital access to seamless gridded weather forecasts and products nationwide.
- NOAA has new environmental satellites supporting regional and national nowcasting and warnings, as well as global long-range environmental monitoring.
- NOAA provides online geographic information systems data and tools for critical fish habitat in the southeast and Gulf of Mexico, improving ability to respond to the Clean Water Act, Endangered Species Act, and Coastal Zone Management Act.
- NOAA modernizes its fleet, both ship and aircraft, to acquire mission-critical data such as tsunami monitoring data, and also addresses facility improvements.
- NOAA and the Federal Communications Commission extends NOAA Weather Radio to an all-hazards radio network, now sending natural and environmental hazardous event warnings and national security messages.
- The Climate Data Modernization Program enters its sixth year of rescuing at-risk data, extending environmental data records, and improving access to NOAA data.

Part 1: Data and Information Assessment

> Internally, we must connect NOAA's observing systems and data . . . and we must employ a consistent data management strategy that facilitates data discovery and access for our users.
>
> Vice Adm. Conrad C. Lautenbacher, Jr. USN (ret)
> NOAA Administrator
> NOAA 2007 Annual Guidance Memorandum

Data management is a comprehensive, end-to-end process that includes the acquisition, quality control, validation, reprocessing, storage, retrieval, dissemination, and archive of data. This complexity of effort, along with technological advancements, requires adjustments of the data management process over time.

Every two years, in accordance with Public Law 102-567 Section 106 (see Appendix A), the National Oceanic and Atmospheric Administration (NOAA) completes an assessment of its data and information systems. From the results of this assessment, NOAA then assembles modernization and improvement objectives for the 10-year period that follows. The assessment and future objectives are provided to the U.S. Congress through the Secretary of Commerce in brief publication form. NOAA's *Report to Congress on Data and Information Management, 2005* was submitted in the first quarter of 2006.

Due to the outline restrictions of the *Report to Congress*, much of the important information regarding the assessment process was not included in that publication. In 2006, NOAA's Data Management Committee (DMC) requested that an additional, detailed report be completed for their activities in coordinating data management policy. Using the complete assessment results, the DMC could more clearly address data issues and opportunities across NOAA. *An Assessment of NOAA's Environmental Data and Information Management* provides the DMC with information previously not published within the *Report to Congress*.

NOAA's Program Structure

Since the previous assessment in 2003, NOAA has adopted a program-oriented structure consisting of four Mission Goals and a mission Support Goal. NOAA plans and organizes all its work around these Goals. NOAA's Mission Goals were defined in the *NOAA Strategic Plan* (2004). Each Goal is a key component of the federal government's business structure for

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Serve society's needs for **weather and water** information

Support the Nation's **commerce** with information for safe, efficient, **and** environmentally sound **transportation**

Provide critical **support** for **NOAA's Mission**

NOAA's Program Structure

Ecosystems	Climate	Weather and Water	Commerce and Transportation	Supporting NOAA's Mission
Habitat	*Climate Observations and Analysis*	Local Forecasts and Warnings	Marine Transportation Systems	Geostationary Satellite Acquisition
Corals	*Climate Forcing*	*Coasts, Estuaries, and Oceans*	Aviation Weather	Polar Satellite Acquisition
Coastal and Marine Resources	*Climate Predictions and Projections*	*Space Weather*	Marine Weather	Satellite Services
Protected Species	*Climate and Ecosystems*	Hydrology–Rivers, Lakes, and Floods	Geodesy	Aircraft Replacement
Fisheries Management	*Regional Decision Support*	*Air Quality*	*NOAA Emergency Response*	Fleet Replacement
Aquaculture		*Environmental Modeling*	Commercial Remote Sensing Licensing	Marine Operations and Maintenance
Enforcement		*Weather Water Science, Technology, and Infusion Program*	Surface Weather	Aircraft Services
Ecosystem Observations		*Tsunami*		NOAA Headquarters
Ecosystem Research				Line Office Headquarters
				Homeland Security
				Administrative Services
				Financial Services
				Workforce Management
				Acquisitions and Grants
				Information Technology Services
				Facilities

Note: Matrix programs are identified by *blue italic text.*

the benefit and protection of the Nation's general population. The domains of the four Mission Goals are interrelated, sharing common science and technology challenges and stakeholder interest. NOAA's Line and Staff Offices achieve these Goals through activities in 45 Programs. Twenty of these Programs are explicitly designed as matrix programs, involving activities of multiple Line or Staff Offices.

Each Goal considers its relationship with the others in developing and implementing plans and programs. Similarly, the Support Goal provides vital NOAA-wide services in support of all Goals, such as environmental satellite services, which include some of the greatest data management challenges. Therefore, while a given activity may be described under only one Goal, it may rely on data collected and processed by different Goals.

Assessment Process

An Assessment Team was organized in mid-October 2004 to coordinate the *Report to Congress on Data and Information Management*. The Team, consisting of representatives from each NOAA Mission Goal and Line Office, held a series of discussions to clarify standards and procedures for the assessment. The Team referred to P.L. 102-567 (Appendix A) for guidance. The Public Law requires that NOAA assess whether there is adequate capacity within its agency to:

1. manage, archive, and disseminate environmental data and information collected and processed, or expected to be collected and processed, by NOAA and other appropriate departments and agencies;

2. establish, develop, and maintain information bases, including necessary management systems, which will promote consistent, efficient, and compatible transfer and use of data;

3. develop effective interfaces among the environmental data and information systems of NOAA and other appropriate departments and agencies;

4. develop and use nationally-accepted formats and standards for data collected by various national and international sources; and,

5. integrate and interpret data from different sources to produce

2005 Data Management Assessment Summary

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NOAA Mission Goals	Ecosystems	P			P				N			
	Climate	F			F				F			
	Weather & Water	P			P				P			
	Commerce & Trans-portation	F			P				P			

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information that can be used by decision makers in developing policies that effectively respond to national and global environmental concerns.

Based on these criteria, the Assessment Team assembled twelve survey questions focused on a holistic, end-to-end observation and data management approach (see Appendix B). The questions were organized around four broad themes of data and information management: (1) observation acquisition and transmission; (2) scientific data management; (3) archive and access; and, (4) contingency planning.

In December 2004, the Assessment Team presented the survey to all Program Managers within the NOAA Mission Goals. The Managers, through the survey questions and with additional free-form responses, discussed data management capabilities and needs for their specific Program areas. The individual assessments were coordinated by the Assessment Team to ensure consistency throughout the process.

Assessment Results

In the Spring of 2005, the Team worked with results from the surveys, noting trends across NOAA. The assessment surveys identified common areas of successes and areas of needs within NOAA Programs. They also identified common areas of successes and needs across Goals. A 2005 Data Management Assessment Summary chart (above) was compiled for general analysis, based on each Goal's summary chart. The charts present the status of data management activities across NOAA *as of August 2005*. The assessment charts are color-coded based on overall response to survey questions.

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While assessments were undertaken with the assistance of a few individuals involved in the definition of data management activities, no attempt has been made to normalize the assessment charts for differences in Program or Goal responses. No values were assigned to "significant" or "incremental" increases in resources. The charting method is simply a tool to aid in overall data management assessment.

The following pages address the assessment of each NOAA Goal, and include a Goal assessment chart based on survey results. Successes and challenges for individual NOAA Goals are discussed within the narrative.

The assessments, when combined with strategic planning on the enterprise, national, and international level, provide an integrated end-to-end approach for Earth environmental data and information management at NOAA.

Throughout this data management exercise, the NOAA Assessment Team discovered a spirit of cooperation among colleagues in all of NOAA's Programs and Goals. The Team wishes to acknowledge this, and point out that our competent, enthusiastic people are key to successful data and information management.

NOAA's people and infrastructure are at the heart of what NOAA is and does.

Vice Adm. Conrad C. Lautenbacher, Jr. USN (ret)
NOAA Administrator
Statement to U.S. Senate
Committee on Science and Transportation
May 2002

NOAA Mission Goal:

Ecosystems

Protect, restore, and manage the use of coastal and ocean resources through an ecosystem approach to management

An ecosystem is a geographically-specified system of organisms, the environment, and the processes that control its dynamics. People are also an integral part of an ecosystem. NOAA has been tasked to be the lead federal agency in the study and preservation of coastal and ocean ecosystems.

NOAA's Ecosystems Mission Goal works to achieve a balance between the use and protection of coastal and ocean resources, ensuring their health, sustainability, and vitality for today's and tomorrow's generations.

Our scientists, specialists, and external partners contribute to a world-class expertise in many fields—oceanography, marine ecology, marine archeology, fisheries management, conservation biology, natural resource management, and risk assessment. This cooperative effort is leading to improved regional and international ecosystem stewardship.

Ecosystems health is critical to the overall health of the U.S. economy. We are committed to the belief that it is possible to balance sustainable economic development, and healthy, functioning coastal and ocean ecosystems.

• Habitat • Corals • Coastal and Marine Resources
• Protected Species • Fisheries Management • Aquaculture • Enforcement
• Ecosystem Observations • Ecosystem Research

NOAA Ecosystems Programs

Habitat
- protect coastal, marine, and Great Lakes habitat
- improve the quality and increase the quantity of restoration of NOAA trust resources

Corals
- preserve, sustain, and restore coral reef ecosystems

Coastal and Marine Resources
- understand and manage complex environmental, social, and economic dynamics affecting coastal and marine ecosystems

Protected Species
- conservation of species through implementation of the Endangered Species Act, Marine Mammal Protection Act, and other statutes and international treaties and conventions

Fisheries Management
- maintain productive stocks important to commercial, recreational, and subsistence fisheries

Aquaculture
- develop a science- and technology-based regulatory framework for a well-managed and productive U.S. marine aquaculture industry

Enforcement
- ensure compliance with laws and regulations promulgated to conserve and protect living marine resources

Ecosystem Observations
- conduct monitoring and observing activities
- develop resource status assessments and forecasts over time

Ecosystem Research
- develop technologies that will lead to new or expanded use of ocean and coastal resources

Note: NOAA matrix programs are identified by ***blue italic text*****.**

Overview

Within the Ecosystem Goal, data are required to protect, restore, and manage the use of coastal and ocean resources. In the two years since the last assessment, the NOAA Ecosystem Goal made progress toward an ecosystem approach management model, adopting modern information technology, and the use of geographic information system (GIS) tools to meet geospatial requirements. Ecosystem Programs are advancing Internet-based technologies for data acquisition, information management, derived products, and data delivery. The nine Programs of the Ecosystem Goal have reviewed, and are in the process of updating, their respective data activities, and assessing accomplishments, needs, and challenges.

Of the nine Ecosystem Programs, eight use original data to develop information and build products fundamental to understanding the coastal and marine environment. Derived products are used for developing coastal and marine decision support tools, and providing forecasts and analyses needed for managing coastal and marine resources. With the advent of expanded data observations, data acquisition, and emerging computer and Internet technology, NOAA is collecting an ever-increasing amount of data. Expanded holdings present challenges and opportunities for the agency as it implements a matrix approach to data management across Programs, Goals, and Line Offices.

2005 Data Management Assessment

	Doing with current resources Need incremental increase Requires sub-stantial additional resources	End-to-End Environmental Data Management Functions											
		Observation Acquisition & Transmission			Scientific Data Management				Archive & Access				Contin-gency Planning
		5-Year Plan	Maintain & Monitor	Collect & Rescue	5-Year Plan	Calibrate & Validate	Appropriate Formats	Complete Metadata	5-Year Plan	Long-term Preservation	Data Discovery	Access / Disseminate	
Ecosystem Goal Programs	Habitat	P			N				N				N/A
	Corals	P			P				N				
	Coastal and and Marine Resources	P			F				P				
	Protected Species	P			P				P				
	Fisheries Management	P			P				P				
	Aquaculture	P			N				N				N/A
	Enforcement	P			P	N/A			P				
	Ecosystem Observations	P			P				P				
	Ecosystem Research	P			P				P				

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NOAA faces significant challenges related to acquiring, describing, and archiving the biological and ecological data required to protect, restore, and manage living coastal and ocean resources. As indicated by the Ecosystem Goal data management assessment chart, Program Managers identified numerous challenges in data management. The survey suggests there is insufficient data management capability to support Ecosystem Programs in their outcomes, strategies, and performance measures. This supports, in part, the review of the data management capabilities section found in Ecosystem Program Baseline Assessments (PBA) for Fiscal Year (FY) 2007 conducted by the NOAA Observing Systems Architecture System Team. The PBA identified three Programs deficient in data management capabilities. The PBA described the other six Programs "unclear" as to whether data management capabilities could be met. The current data management review indicates the need for modern, integrated data management within the Programs and activities of the Ecosystem Goal. Results of the data management survey are a valuable tool for the DMC as they develop and implement a comprehensive and integrated NOAA data management plan. The plan needs to address the interoperability of different (legacy) data management operating systems. Any implemented system must support the Integrated Ocean Observing System (IOOS) Data Management and Communications Architecture.

Observation Acquisition and Transmission

The assessment chart shows that Observation Acquisition and Transmission within the Ecosystem Goal is a continuing challenge. None of the Programs have fully developed five-year plans in place. Resources are stretched as various Programs attempt to implement the numerous data collection requirements imposed by existing and expanding mandates. A similar circumstance exists with regard to maintenance and monitoring capabilities. Programs replying to the survey indicated a need for additional resources and partnerships to collect observations in a manner sufficient to meet requirements. Other Programs (e.g., Ecosystems Observations) have documented protocols for conducting its major resource assessment surveys (e.g., bottom trawl surveys, acoustic collections) to assure consistency and to evaluate observational biases.

The Collect and Rescue column reflects significant issues NOAA faces in identifying, cataloging, and rescuing historical data sets. For example, NOAA Fisheries has a number of paper-based data collections that are in need of digitizing. There also are a number of early collections stored as digital records on deteriorating media requiring rescue. NOAA works closely with academic institutions, state partners, and foreign nations to recover data. Ecosystem data rescue has been limited to the occasional *ad hoc* research program.

Overall, the Ecosystem Goal Team collects high quality data, provides critical analysis and information, and develops quality products for the stakeholder. At the insular level, certain Programs have shown good to mixed success in meeting data management requirements (e.g., Coastal Marine Resources, Corals, and Habitat). However, with respect to individual data management and services, the majority of Ecosystem Programs are falling short of meeting 100% of data management requirements. This is due in part to expanding and new mandates, often without the associated resources to meet requirements. Exacerbating this situation are legacy data management systems that may not support interoperability across Programs and/or Line Offices. Additional resources are necessary to fully implement acquisition programs and ensure seamless connectivity or interoperability to other NOAA data management systems (e.g., observational data from IOOS, and non-NOAA data holdings).

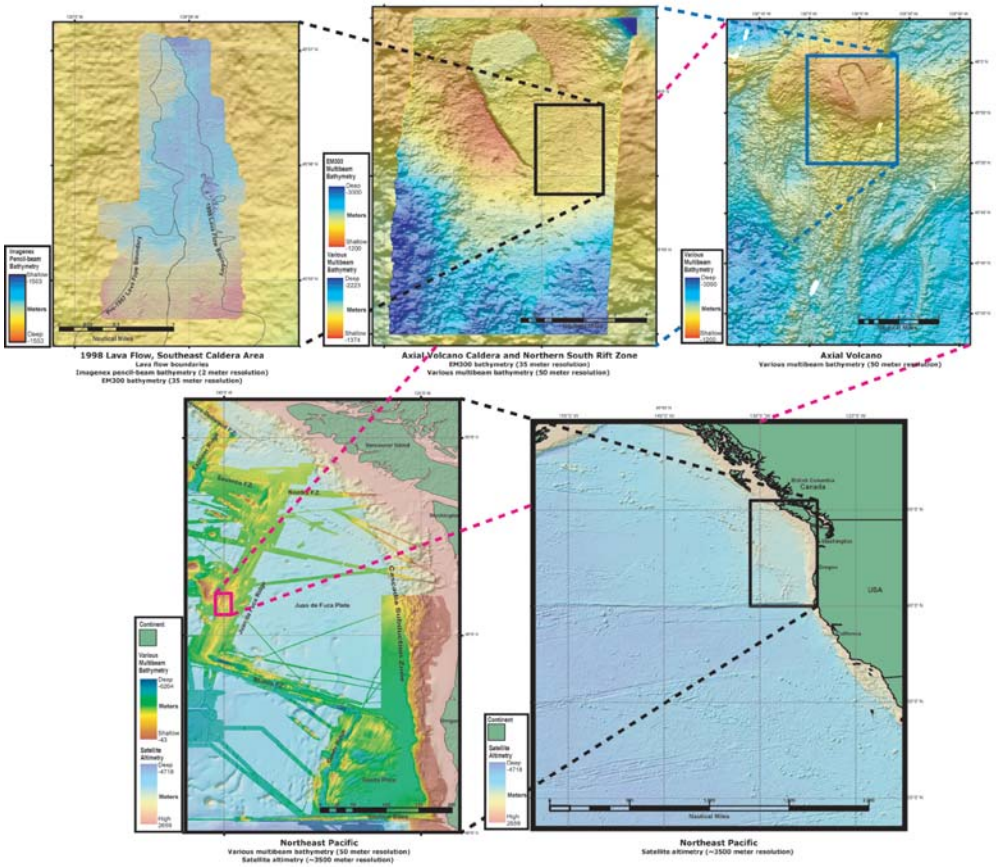
In summary, a common theme among the Ecosystem Goal Programs is the need for additional planning and resources to implement fully their Observation Acquisition and Transmission capabilities. These capabilities could be greatly improved through integrating planning, data maintenance and monitoring, and historical data collection and rescue efforts among the nine Programs.

Scientific Data Management

Scientific data management within the Goal is characterized by

The National Status and Trends (NS&T) Program, managed by the Center for Coastal Monitoring and Assessment, has succeeded in improving data management for the program, and the format in which data are delivered. The Program has been in existence since 1984, and staff have now centralized the majority of the data and many assessments. This required both an internal and external organization effort (including contractors). The information is now available to the public via an online data portal. Previously, information was only available in spreadsheet form. The effort to recover historical data is ongoing, and the Web site will continue to be modified to meet users' needs.

NS&T was established to determine the status of environmental quality in our Nation's coastal and estuarine waters by monitoring contaminants in sediments, benthic fish, and bivalve tissues. The long term nature of the dataset also allows scientists to track changes in coastal environmental quality over time.



Annual visits to the New Millennium Observatory at Axial Volcano have provided the interdisciplinary team with a large amount of data to manage. Each year a cruise report is compiled using dive logs and maps, sample and experiment information, and discipline summaries. All the cruise-related data are input into a GIS and available for the next team.

Once processed, the data are brought into several programs for geographical referencing and analysis. Maps can be created using a variety of programs, providing a way to geographically display several types of data at the same time. The GIS user can query the database several ways, including by at-site samples collected for all years, or all at-site instruments deployed and recovered on a particular year.

Programs that are meeting the full capacity of the stated requirements with the existing resources (e.g., Coastal and Marine Resources), to Programs that require substantial additional resources to undertake activities (e.g., Aquaculture). Referring to the assessment chart, the status of scientific data management appears better poised to fulfill NOAA mission requirements than observation acquisition and transmission.

Some interesting characteristics emerge through this qualitative Program summary. (1) With the exception of the Habitat and Aquaculture Programs, five-year planning is ongoing for most Programs. (2) Most Program Managers are satisfied that their calibration and validation efforts are sufficient with current resources. (3) Five of the nine Programs are concerned that appropriate formats are not in place, and that additional planning and resources will be necessary to standardize formats. (4) While four of the nine Programs are developing appropriate metadata with current resources, all but one of the remaining Programs will require substantial additional resources to develop appropriate standardized metadata. Metadata are "data about data." The term refers to any data used to aid the identification, description, and location of networked electronic resources.

Some of the problems described by the nine Programs are due to historical and on-going collaboration with outside federal and state agencies, universities and research laboratories, and other non-governmental organizations. In these cases, NOAA presently has little or no control over data calibration, formatting, or even metadata standards. Therefore, it will be necessary for the NOAA scientific data management system to be flexible in its incorporation of different calibration/validation standards, formats, and metadata standards.

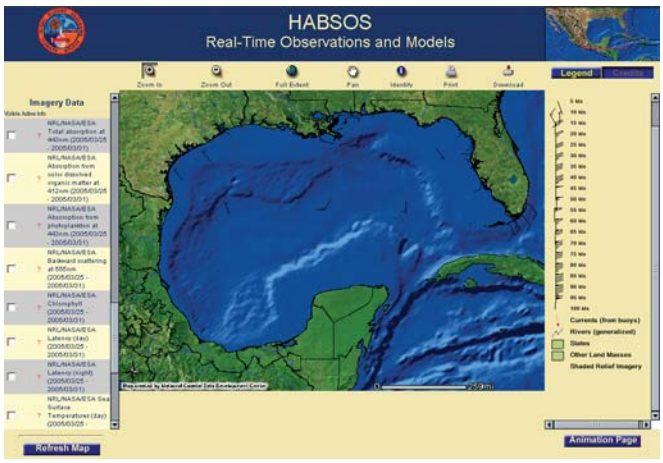
Formatting and metadata requirements need incremental increases in resources, but several Programs continue to improve this process and offer formats defined by the customer base and stakeholder input. While individual Programs may not be capable of fully implementing their entire data management strategy, the

quality of derived products is excellent. Geospatially enabling data collected by the Ecosystem Goal is a high priority, particularly for the Habitat, Protected Species, Ecosystems Observations, and Ecosystems Research Programs. In addition, large and expanding mandates with limited or no funding, coupled with the lack of interoperability with respect to data management, have created shortfalls and gaps in meeting all data management functions. This is particularly true for fishery dependent and fishery independent assessment programs.

In summary, there is a range of capability among the nine Programs. Across the Ecosystems Goal, resources for scientific data management are not evenly distributed among the Programs. Standardization of planning, calibrating, validating, and formatting is necessary. Ecosystems Programs must develop metadata and metadata catalogs within a NOAA framework. Ongoing NOAA DMC planning should be augmented to encourage consistency among the Ecosystem Goal Programs, flexible incorporation of non-native formats originating from outside sources, and standardization of all program-planning approaches.

Archive and Access

Archive and access resources appear to be unevenly distributed. Several Ecosystem Programs will require substantial resources directed to develop and implement a five-year archive and access plan. The Habitat, Fisheries Management, Enforcement, and Ecosystem Observations Programs will require an incremental increase for preservation, discovery and dissemination, while Protected Species and Aquaculture need substantial additional resources. Three of the nine Programs lack a five-year plan. Only three Programs have sufficient resources available for long-term preservation of data. Three of the Programs have sufficient resources and capabilities for data discovery while three need substantial additional resources. As shown in the "Access/ Disseminate" column, observations and related products are available online for only three Programs. Some Programs (e.g., Fishery Management and Enforcement) have substantial proprietary data, requiring limited access and dissemination of data (fishery management and law enforcement officials versus the public). Substantial ecosystem data, within NOAA and from other sources, are archived in numerous digital formats, on paper, and other



NOAA's National Coastal Data Development Center (NCDDC) has made several notable advances in ecosystem and habitat data management. GIS tools and online GIS mapping capabilities were developed for NOAA Fisheries to manage critical habitat data in the southeast and Gulf of Mexico regions, and to display relevant data layers online. NCDDC also developed online mapping and data access capabilities for NOAA's Galveston Bay Laboratory. These capabilities improve NOAA's ability to respond to the Clean Water Act, Endangered Species Act, and Coastal Zone Management Act consultations, and provide gateways to data and information on Galveston Bay essential fish habitat. In addition, NCDDC also developed metadata tools, real-time and near real-time online access to harmful algal bloom data, and improved access to National Estuarine Research Reserve system-wide habitat monitoring program data.

deteriorating media. Since rescue and long-term preservation of these data have tremendous potential for developing better understanding of ecosystems, populations, and species trends and cycles, it is important that NOAA develop integrated long-term planning for data archive and access. Ecosystem data must be assessed for data rescue, either through new dedicated resources, or through the existing Climate Database Modernization Program (CDMP).

Development and implementation of Archive and Access functions within ecosystem data management will result in the sustained preservation of past observations, analyses, products and services. Improved capability to discover, access, and deliver these data and information ensures historical data will assist in sound decision-making within the Ecosystem Goal. Efforts at archiving, cataloging, and delivery of historical data, information, and products are generally not well defined.

Certain Programs (e.g., Coral, Habitat, Coastal and Marine Resources, and Ecosystems Research) have made significant progress in their archive and access activities. However, there are limited resources, expanding program mandates, and only early-stage integration of "Centers of Data," discrete NOAA data nodes, and the established NOAA Data Centers. These challenges impair the capability to provide seamless archive, access, and delivery of ecosystem data to NOAA, other federal agencies, state agencies, stakeholders, and the public.

Advances in information technology data have enhanced data management functions within the Goal. Advances include data storage, Web services, collaborative Web tools for discovery and display, and the addition of geographic information system mapping services.

Contingency Planning

Of the nine Programs within the Ecosystem Goal, two (Corals and Law Enforcement) have fully implemented contingency plans and are operating with available resources. The Ecosystem Research, Ecosystem Observations, Fisheries Management, Protected Species, and Coastal and Marine Resources Programs have contingency planning in development, requiring an incremental increase in resources to complete. Contingency planning is not applicable to the Habitat and Aquaculture Programs.

NOAA 2005–2010 Strategic Plan
Long-Term Ecosystems Strategies:

- Engage and collaborate with our partners to achieve regional objectives by delineating regional ecosystems, forming regional ecosystem councils, and implementing cooperative strategies to improve regional ecosystem health.
- Manage uses of ecosystems by applying scientifically sound observations, assessments, and research findings to ensure the sustainable use of resources and to balance competing uses of coastal and marine ecosystems.
- Improve resource management by advancing our understanding of ecosystems through better simulation and predictive models. Build and advance the capabilities of an ecological component of the NOAA global environmental observing system to monitor, assess, and predict national and regional ecosystem health, as well as to gather information consistent with established social and economic indicators.
- Develop coordinated regional and national outreach and education efforts to improve public understanding and involvement in stewardship of coastal and marine ecosystems.
- Engage in technological and scientific exchange with our domestic and international partners to protect, restore, and manage marine resources within and beyond the Nation's borders.

Summary and 10-Year Objectives

Effective ecosystem approach to management requires a coherent, integrative effort incorporating diverse NOAA data systems; each may possess different technologies and varied capabilities. Efficient ecosystem data management and data services require an enterprise data policy and infrastructure that crosses Mission Goals, Line Offices, Programs, and Program components.

Based on our review of the NOAA Ecosystem Goal input, it seems clear that the Goal's nine Programs are in early stage development toward a more integrated, consistent approach to data management and access. Resources allocated to Programs are unevenly distributed, and Program planning ranges from none to complete.

There is an historical paucity of data management integration among the Ecosystem Goal Programs. The Programs suffer from inconsistent data formatting, duplication of effort, issues pertaining to data ownership and proprietary data sharing, and a customer base that is limited to historical, and perhaps even local, levels. Also, due to the need for better integration and coordination among Programs, as well as the need to adapt quickly to rapidly advancing computer and Internet capabilities, the NOAA Ecosystem Goal is not currently capable of responding to a much larger potential customer base while better serving its historical customer base.

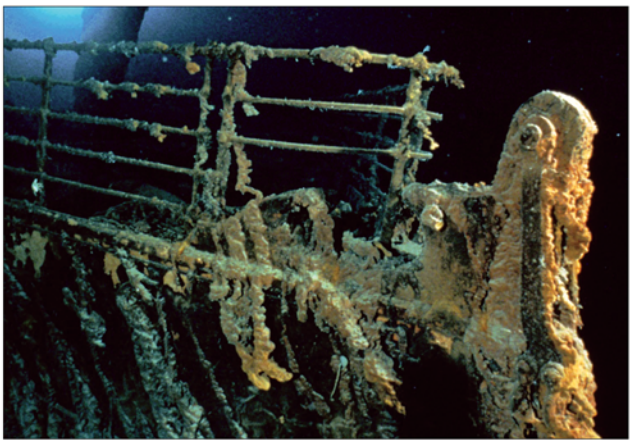
Developing an integrated, enterprise approach to data management and access requires replacing incremental historical data management and access methods with a strategic, progressive approach. It is incumbent upon NOAA's DMC and the individual Ecosystem Programs to develop a comprehensive plan rather than maintain the current policies. The basis of a strategic, progressive approach is to combine successful past and current data management policies with innovative enterprise approaches to develop a completely new plan. The overall strategy to move the NOAA Ecosystem Goal to integrated data management is:

- **Immediate to one year out**. Develop an integrated enterprise data management plan through the NOAA DMC. Allocate data management resources to oversee implementation within the Ecosystem Goal.

- **Near term (one to five years).** Implement the NOAA data management plan across all Ecosystem Goal Programs, and across all NOAA Goals.

- **Long term (five to ten years)**. Expand to interagency data management among coastal and marine science and management agencies.

Over the past two years a cross-NOAA Line and Program Office team has addressed data and information management needs for the Ecosystem Research Program's Office of Ocean Exploration (OE). The team has developed: (1) a customized system for recording metadata and data during expeditions; and, (2) a data management system for OE projects. The team also developed a Web-base digital atlas that provides a means to query and display information from OE expeditions, and a video data management system. The team includes representatives from OE, the NOAA Central Library, and NOAA's National Data Centers.



View of the bow of Titanic, *June 2004. Dr. Robert Ballard and a team of scientists from NOAA and other institutions worked from the NOAA R/V* Ronald H. Brown *in a non-invasive study of Titanic's deterioration.*

NOAA Mission Goal:

Climate

Understand climate variability and change to enhance society's ability to plan and respond

Climate shapes the environment, natural resources, economies, and social systems that people depend upon worldwide. Although humanity has learned to contend with some aspects of climate's natural variability, it is ill-prepared to deal with abrupt climate change.

Major climate events, combined with the stresses of population growth, economic growth, and land-use practices, impose serious consequences on society. NOAA's information, products, and services enable society to better understand and respond to changing climate conditions.

Together with our partners, we conduct visionary research that considers both climate variability and long-term climate change. We describe the state of the climate system through integrated observations, analysis, and data stewardship.

Decisions about mitigating climate change can alter economic and social structures on a global scale. We are committed to delivering climate information in ways that may help minimize risks and maximize opportunities for decisions in agriculture, public policy, natural resources, water and energy use, and public health.

• Climate Observations and Analysis • Climate Forcing
• Climate Predictions and Projections • Climate and Ecosystems
• Regional Decision Support

NOAA Climate Programs

Climate Observations and Analysis

- promote a tiered and integrated observational network providing sustained global and U.S. monitoring of key climate-related variables
- provide analyses to separate climate variability and change as a result of natural processes and from human activities

Climate Forcing

- provide understanding of atmospheric and oceanic carbon dioxide trends that may be directly applied to climate projection and policy decisions regarding climate change
- characterize observations for inputs to climate models

Climate Predictions and Projections

- provide a seamless suite of climate outlooks and projections on intraseasonal, seasonal, interannual, and multi-decadal time scales
- enable regional and national managers to better plan for the impacts of climate variability and change

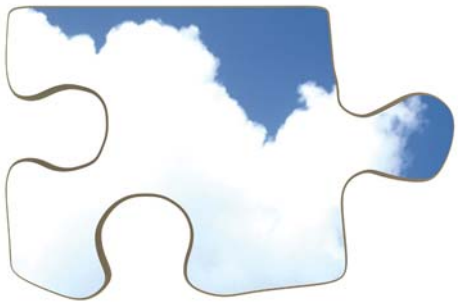
Climate and Ecosystems

- develop biophysical indicators and models to predict the probable consequences of global climate change on marine systems and living resources
- monitor changes in coastal and marine ecosystems

Regional Decision Support

- design and manage stakeholder-influenced, interdisciplinary research
- merge the talents of researchers and practitioners to move products from experimental to operational

Note: NOAA matrix programs are identified by ***blue italic text*.** All Climate Programs are matrixed.



Overview

Climate observations, monitoring, evaluation, and forecasting are critical to economic sustainability and environmental stewardship, as well as planning and responding to the quality-of-life changes that society will encounter in the 21st Century and beyond. In the two years since the last assessment, the NOAA Climate Goal has made significant improvements in the quality of observations and is delivering data more efficiently, in part due to improved quality control procedures. NOAA has also improved data quality by increasing its spatial and temporal coverage. NOAA's five Climate Goal Programs conducted an assessment of all data management activities and determined areas of success and continuing challenges.

Observation Acquisition and Transmission

NOAA currently operates observing systems that measure more than 300 environmental parameters. Observation platforms include satellites, ground-based monitoring systems, ocean buoys, ships, and aircraft. As indicated by the data management assessment chart, well-developed five- and ten-year plans, prepared in conjunction with NOAA's Support Mission Goal, exist for all Programs and observing systems including extensive plans for satellite observing platforms.

In general, climate observations are adequately monitored and systems are well maintained. Deficiencies in real-time climate variability monitoring can be addressed by allocating significant new resources for the

		End-to-End Environmental Data Management Functions											
Doing with current resources		Observation Acquisition & Transmission			Scientific Data Management				Archive & Access				
Need incremental increase													
Requires sub-stantial additional resources		5-Year Plan	Maintain & Monitor	Collect & Rescue	5-Year Plan	Calibrate & Validate	Appropriate Formats	Complete Metadata	5-Year Plan	Long-term Preservation	Data Discovery	Access / Disseminate	Contin-gency Planning
Climate Goal Programs	Climate Observations & Analysis	F			F				F				
	Climate Forcing	F			F				F				
	Climate Predictions & Projections	N/A	N/A	N/A	F				F				
	Climate & Ecosystems	P			P				P				N/A
	Regional Decision Support	N/A	N/A	N/A	P				P				

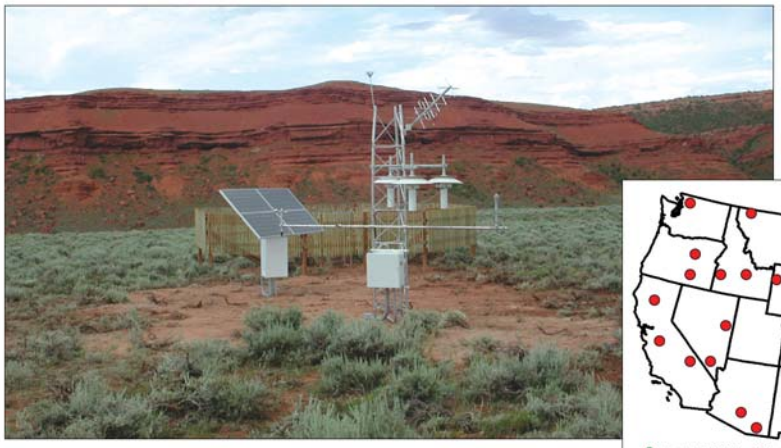
- A **green cell** indicates that the Goal is accomplishing 100% of the required activity or is able to do so with current resources.
- A **yellow cell** indicates that the activity is partially accomplished or an incremental increase in resources is required to reach the 100% level.
- A **red cell** indicates that the activity is not accomplished or that significant new resources are required.
- **5-Year Plan columns** are F, plan completed and in place; P, partly completed; and N, no plan in place.

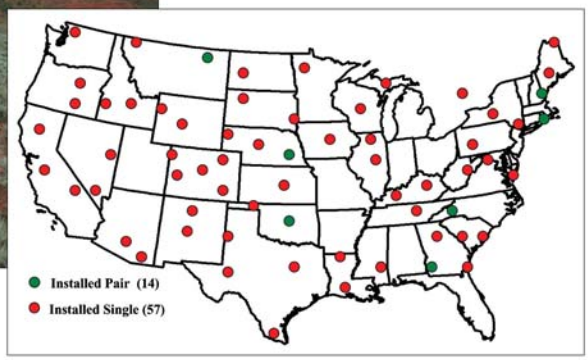
modernization of the Cooperative Observing Program through NOAA's Environmental Real-time Observation Network. Emerging new requirements for real-time climate variability monitoring, including drought (a specific requirement of the National Integrated Drought Information System) can only be adequately addressed in the current NOAA observing systems by locating significant new resources. Implementing a well-defined observations "requirements" process will enable NOAA to prioritize needs and resources.

The CDMP's mission is to rescue climate and environmental data, make these data more accessible, and insure preservation for future generations. The major emphasis is on data conversion. Digitized records from paper or microform media extend the climate record back in time or fill in missing periods. These new digital data are accessible via the Internet. In 2005, NOAA is supporting 30 CDMP projects across all five NOAA operational Line Offices, plus 21 projects for the National Climatic Data Center (NCDC). Funding for these tasks is determined through a proposal process. CDMP is also finding foreign data sources that are critical to completing and expanding NOAA global databases. Stable funding for data rescue is essential to NOAA's ability to extend climate and environmental databases back in time, providing researchers with digital data to help in making decisions concerning climate and environmental trends and impacts.

As part of a new initiative, NOAA is now developing the U.S. Climate Reference Network (USCRN), a network of climate stations. Its primary goal is to provide future, long-term, homogeneous observations of temperature and precipitation that can be coupled to long-term, historical observations for the detection and attribution of present and future climate change. Data from the USCRN will be used in operational climate monitoring activities and for placing current climate anomalies into an historical perspective.

Although Regional Decision Support and Climate Predictions and Projections collect observations, these Programs also rely on data and data products produced by other NOAA Programs.





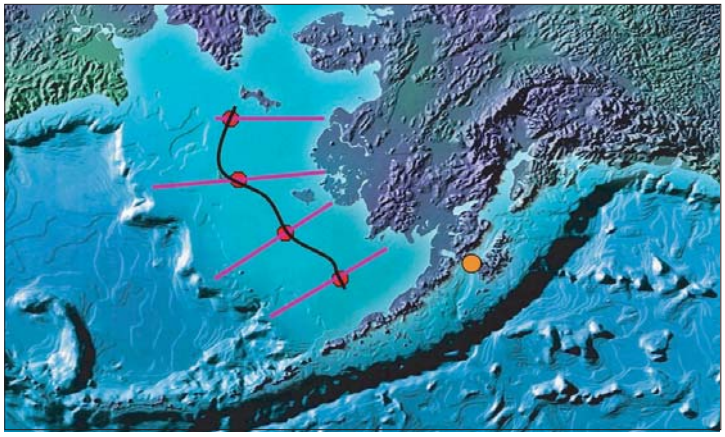
USCRN site at Red Canyon Ranch, Wyoming. Below, current sites of USCRN, excluding Alaska.

NOAA commissioned the U.S. Climate Reference Network (USCRN), which now contains 72 stations across the conterminous U.S. and Alaska. The USCRN, in its first full year of operation, is already providing significant data, reducing scientific uncertainty on long-term temperature and precipitation trends—from 5% to 3.5% for temperature and from 16% to less than 10% for precipitation. This verification of climate observations improves the tracking of temperature and precipitation trends, providing more insight into climate variability and change. A total of 110 stations are planned.

Scientific Data Management

The various climate observing systems are linked through international collaborations such as the Global Climate Observing System (GCOS), World Weather Watch, IOOS, and Global Ocean Observing System (GOOS). To move toward a more integrated ecological observing and data system for the planet, NOAA research is advancing the application of present observing systems and data products while participating in the development of new systems. All of these systems need to be cross-linked to maximize their information content and utility. NOAA must ensure that observations are available in formats appropriate to the user community, by supporting data integration across platforms, disciplines, and time-scales. Much remains to be done to ensure that all NOAA observations of long-term value to the Nation are delivered to, and archived at, one of the NOAA National Data Centers (NNDC). As indicated in the data assessment chart, complete metadata (data describing the data) is a continuing challenge. Metadata are poor for many observing systems and often not delivered to a data center. These factors diminish the maximum value and cost benefit of the observations.

Effective utilization of climate data and information and long-term stewardship requires the ability to



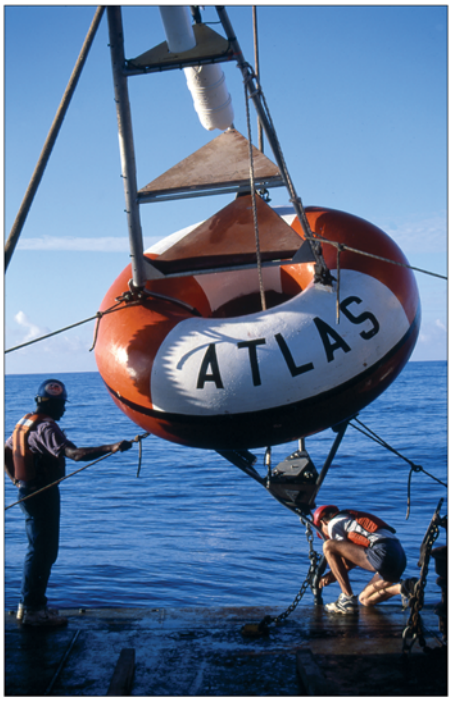
Biophysical moorings have been deployed by the North Pacific Climate Regimes and Ecosystem Productivity to detect changing ocean climate conditions in the Bering Sea. Column-integrated temperatures at some locations in the Bering Sea have risen as much as 3°C in the last nine years.

manage the Nation's climate records and provide relevant utility to a wide range of customers. Scientific stewardship can be characterized as maintaining scientific integrity and long-term utility of climate records by monitoring, improving quality, and extracting key variables from new observations and historical records. The concept of scientific stewardship within NOAA means providing environmental data and information services necessary to answer global change science questions of the highest priority.

Data reports from all of the global ocean networks (e.g., ships, tide gauge stations, drifting and moored buoys, profiling floats) will be collected in near real time at a single "data assembly center," NOAA's National Data Buoy Center (NDBC). The NDBC will be responsible for automated quality control accomplished in near real-time and operational distribution via Global Telecommunication System and the Web. Delayed mode quality control will be accomplished at several distributed centers of expertise.

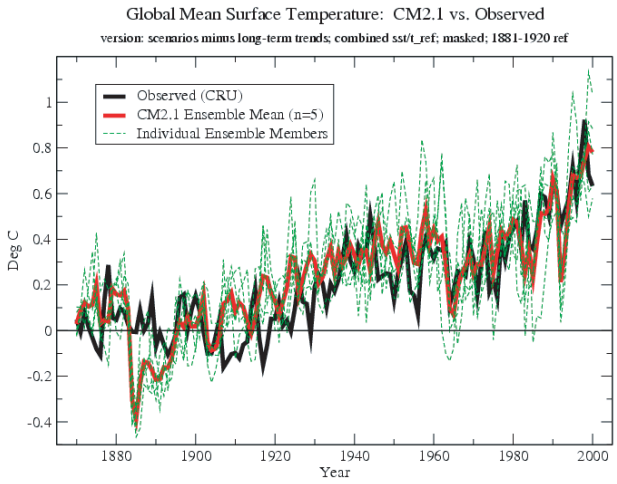
Following delayed quality control, the data will be delivered to NNDC and their collocated World Data Centers for archive and distribution. The biophysical moorings deployed by the Climate and Ecosystems Program need to be modernized and improved by making the *in situ* moorings telemeter data available in real time to the laboratory. This would allow real-time access to the data and monitoring of data quality.

Effective data collection and distribution systems must be in place to support scientific research in government, commercial, educational, and private sector communities. Since implementation of these systems will result in the generation of massive volumes of data, data management issues must also be addressed. To accomplish this, NOAA is developing an integrated, national environmental data access and archive system. The system will support ingest, archive, access, and distribution of its environmental data and information. As shown in the data management assessment chart, the Climate Goal has had mixed success in calibrating,

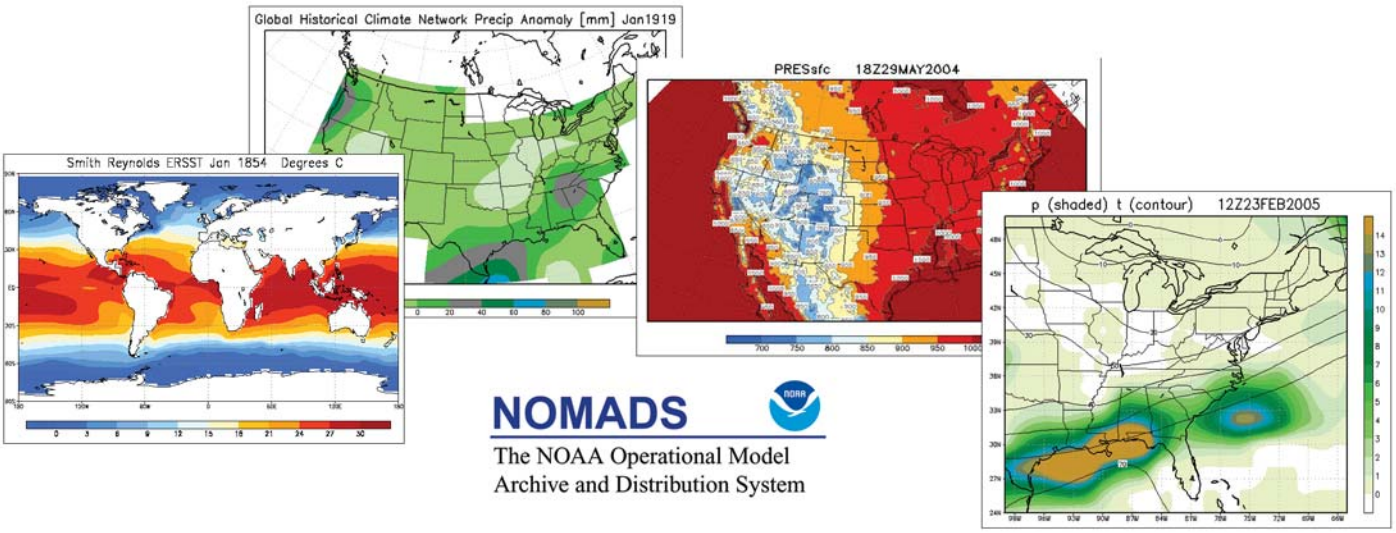


Deployment of a Tropical Atmosphere Ocean (TAO) buoy. These buoys are anchored to the ocean floor at depths ranging from 2000 to 5000 meters.

The TAO Project provides real-time data from moored ocean buoys for improved detection, understanding, and prediction of El Niño and La Niña. Oceanic and atmospheric data are transmitted several times a day to NOAA's polar orbiting satellites. The success of this project has demonstrated that building and sustaining long-term ocean observing systems are possible.



High-quality observation datasets are critical in testing climate models used to make projections of future climate. The graph shows that the current generation of models does a good job of simulating the evolution of global mean temperatures for more than 100 years. The next challenge is to utilize the datasets to improve models so that this level of agreement can be achieved at the regional level.



In order to better understand and predict complex inter-related Earth systems, NOAA led a collaborative effort to develop a process to evaluate climate models and data in a systematic, format-neutral environment. The resulting system, NOMADS, uses established and emerging technologies to access and integrate model and other data stored in geographically-distributed archives. Developed by computer and research scientists, NOMADS enables sharing and intercomparison of model results, and comparison of model results, with observations. It is a major community effort spanning multiple federal agencies and academic institutions.

validating, formatting, and describing data. Some key areas include calibrating and validating observations for Regional Decision Support, and the availability of climate data in appropriate formats with complete metadata to enable integration across platforms and observing systems.

Archive and Access

Over the next 15 years, current and planned remote sensing observing systems will produce volumes of environmental data on an unprecedented scale. NOAA must make data from these systems available to support a myriad of users. By the year 2017, plans for the current environmental observation satellite campaigns and numerous *in situ* observation programs will increase the total data volume (primary and backup copies) to more than 140 petabytes. This presents a particular challenge for long-term preservation and data discovery in the Climate Observations and Analysis Program.

NOAA climate researchers from various disciplines are increasingly engaged in large, multinational teams. To support these efforts, we need a software and data management infrastructure that spans not only NOAA, but also all relevant agencies and institutions. Improved data access services need to be further developed in NOAA so that users can identify and acquire the information necessary to make decisions on time scales from daily (e.g., weather), through seasonal (e.g., El Niño), to decadal (e.g., global change).

As shown in the assessment chart, the Climate Goal, especially the Regional Decision Support Program, faces some significant challenges in planning and implementing the necessary data discovery, access, and dissemination services. NOAA's Comprehensive Large Array-data Stewardship System (CLASS) Project and other pilot projects such as the NOAA Operational Model Archive and Distribution System (NOMADS) are designed to enhance NOAA's capability to predict and assess decadal to centennial climatological changes and improve our understanding of our Earth system. These projects provide various environmental data and information

The U.S. has sustained 67 weather- or climate-related disasters over the last 26 years (1980–2005) in which overall damages/costs reached or exceeded $1 billion. Using an inflation/weath index, total costs for the 67 events were more than $500 billion.

archive and access services to the Nation through the effective application of modern and scalable techniques and technology.

Contingency Planning

All NOAA Line Offices and data centers are required to develop and maintain a Continuity of Operations Plan (COOP) for their location and operation. These must comply with existing statutes, executive orders, mandates, applicable laws, and regulations. These plans address:

- establishing temporary headquarters for emergency planning;
- steps required to resume mission-critical functions should the facility become uninhabitable;
- offsite storage for mission-critical data and information; and,
- ability to access offsite data.

There are projects underway within NOAA, especially within NOAA's National Data Centers, that protect vital data and information by replicating it at other NOAA sites. This method is much preferred to storing back-up data on magnetic media housed on tape racks at an off-site location, since other NOAA facilities would be able to provide immediate access to the data should the primary site become disabled.

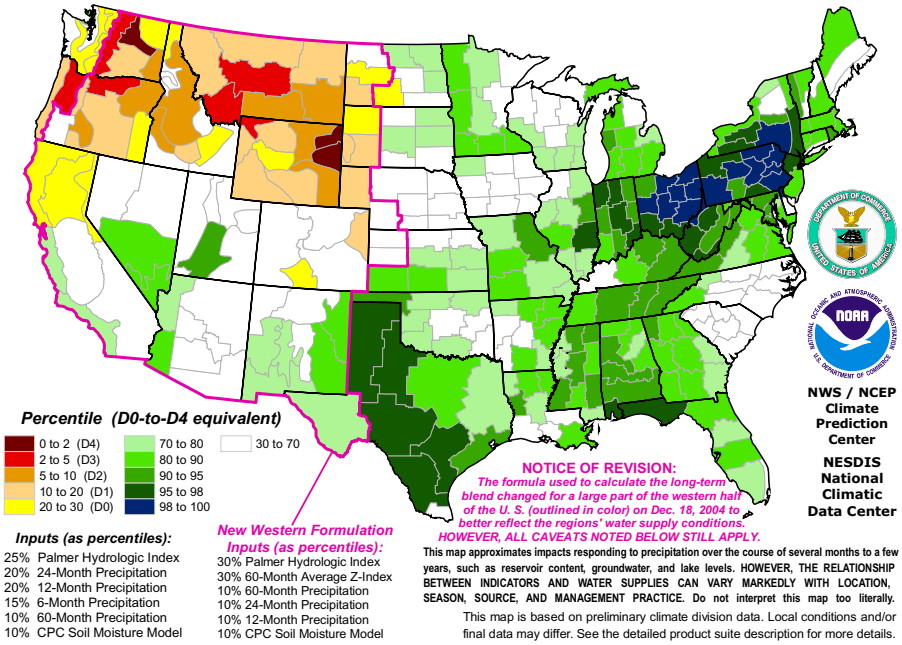
Eventually, all of NOAA's data will be replicated and readily accessible at other NOAA sites. Within the Climate Goal, all Programs have complete contingency plans except for Climate and Ecosystems, and Regional Decision Support. These two Programs are in the process of completing their plans.

Summary and 10-year Objectives

NOAA's Climate Goal has improved the quality of observations and is delivering data more efficiently, in part due to improved quality-control procedures. Through data rescue programs such as CDMP, it has also improved data quality by

NOAA 2005–2010 Strategic Plan Long-Term Climate Strategies:

- Improve the quality and quantity of climate observations, analyses, interpretation, and archiving by maintaining a consistent climate record and by improving our ability to determine why changes are taking place.
- Improve the quantification and understanding of the forces bringing about climate change by examining relevant human-induced increases in atmospheric constituents.
- Advance sub-seasonal to inter-annual climate predictions and climate change projections by improving analyses of the climate system, using ensembles of multiple, high-end climate and Earth system models.
- Develop the ability to predict the consequences of climate change of ecosystems by monitoring changes in coastal and marine ecosystems, conducting research on climate-ecosystem linkages, and incorporating climate information into physical-biological models.
- Develop and contribute to routine state-of-the-science assessments of the climate system for informed decision-making.
- Work with customers in order to deliver climate services and information products involved in health, safety, environmental, economic, and community planning that increase the effective application of this information.
- Coordinate among NOAA Line Offices the transition from investigator-driven research projects to operational facilities, capabilities, and products.
- Support educational efforts to create a more climate-literate public by developing climate educational materials, involving teachers in the research process, and generating tools to allow climate information to be used in decision making.



Objective long-term drought indicator blend percentiles, April 16, 2005. This product from NOAA approximates drought-related impacts that respond to precipitation on time scales ranging from several months to a few years, such as reservoir stores, irrigated agriculture, groundwater levels, and well water depth. Long-term climate data are critical to these products.

increasing spatial and temporal coverage. Most Programs are acquiring, managing, archiving, and providing access to data and information with current resources. However, significant improvements are needed for data discovery, and in enabling data integration. Improved corporate guidelines, standards, and procedures to adequately address metadata requirements must be established. This is a significant shortcoming that if not properly addressed, will result in the diminished use and value of observations and assessments. Confidence in the fidelity and quality of data is greatly enhanced by documenting the entire end-to-end continuum from observations through data management and the generation of products and support services. NOAA Administrative Order 212-15 (see Appendix A) addresses documenting data quality, and when used with the Federal Geographic Data Committee (FGDC) and International Organization for Standardization 19115, addresses many aspects of metadata documentation.

The 10-year objective is to deploy 100% of the global atmospheric, ocean, terrestrial, and space (solar) observing systems. An improved end-to-end data management system will measure atmospheric- and ocean-essential climate variables, with the goal of integration and quality-control processing, and other data management functions necessary to enhance understanding of the climate system.

These observing systems will be an integral part of the Global Earth Observing System of Systems (GEOSS) as described in *Strategic Plan for the U.S. Integrated Earth Observation System* (2005). The Implementation Plan Task Team 201-1 addresses the deficiencies in observations outlined in *The Second Report on the Adequacy of the Global Observing Systems for Climate in Support of the United Nations Framework Convention on Climate Change* (World Meteorological Organization, 2003). To address these priorities, the NOAA DMC is analyzing the steps necessary for a sustainable data management framework to integrate NOAA's vast collection of observations as well as its knowledge and research.

The key to the success of NOAA's observing systems will be the expanded use of an integrated data management framework that will apply a common set of data management services for research and operations. These services also include quality-control procedures for each given variable measured, regardless of the individual observing system. The training of future research and applications scientists, and developing and implementing new processing techniques pose the greatest challenges for analysis of the climate system.

NOAA Mission Goal:

Weather and Water

Serve society's needs for
weather and water information

Floods, droughts, hurricanes, tornadoes, tsunamis, and other severe weather events cause $11 billion in damages each year in the U.S. Nearly one-third of the U.S. economy is sensitive to weather and climate. Ninety percent of all presidential-declared disasters are weather and water related.

NOAA's role in understanding, observing, forecasting, and warning of environmental events is ever expanding. We have established cooperative efforts with other federal and state agencies, and private sector partners. Together, we provide decision makers with key observations, analyses, predictions, and warnings for a range of weather and water conditions, including those related to water supply, hazards, air quality, and space weather.

We are committed to conducting sound, scientific research, and providing integrated observations to those who manage environmental resources. We are also committed to preserving historical data used to develop our weather and water models, statistics, and environmental indicators. NOAA's efforts have led to breakthroughs in prediction and preparedness, enhancing the safety and security of our citizens.

• Local Forecasts and Warnings • Coasts, Estuaries, and Oceans • Space Weather
• Hydrology–Rivers, Lakes, and Floods • Air Quality • Environmental Modeling
• Weather Water Science, Technology, and Infusion • Tsunamis

NOAA Weather and Water Programs

Local Forecasts and Warnings
- end-to-end forecast process
- delivers essential NOAA services through Weather Forecast Offices, Weather Service Offices, and data collection offices

Coasts, Estuaries, and Oceans
- provide understanding of the air–ocean–land interface

Space Weather
- timely and accurate operational space weather forecasts, warnings, alerts, and data

Note: NOAA matrix programs are identified by ***blue italic text*.**

Hydrology—Rivers, Lakes, and Floods
- develop and deliver flood watches, river and flash flood warnings, and river and lake level forecasts

Air Quality
- provide information on processes and impacts of poor air quality
- provide potential solutions and tools to support effective decision making

Environmental Modeling
- provide models and model-based estimates of current and future states of the environment, based on observations and scientifically-based modeling techniques

Weather Water Science, Technology, and Infusion
- conduct visionary research critical for managing future environmental and societal threats
- perform research and development that leads to the transfer and knowledge and new concepts, as well as exploring the unknown

Tsunami
- tsunami hazard assessment, warning guidance, mitigation, and research
- international coordination of regional and global tsunami warning systems

Overview

NOAA's Weather and Water Mission Goal provides decision makers with environmental information essential to public safety and the Nation's economy. The data and products include observations, analyses, predictions, and warnings. The eight Weather and Water Programs (listed above) support NOAA's other Mission Goals, and six of the programs are matrixed, cutting across Line and Staff Offices.

In the two years since the last assessment, the Goal improved planning for observation acquisition and transmission. Data are generally well calibrated, validated, and delivered in appropriate formats. However, in the course of the data management assessment, the Weather and Water Goal Team identified several data challenges:

- Scale end-to-end data management infrastructure to support: (1) access to, and processing of, high-resolution observations; and, (2) distribution of products generated within the goal.
- Expand and support digital products and services that are readily interoperable with GIS.
- Develop an integrated Data Management and Communications (DMAC) plan in order to enhance synergies between Programs and track observing sensor performance Goal-wide.

These challenges are reflected in the mix of yellow and green matrix cells in the data management assessment chart. The Weather and Water Goal is in a transition phase, bringing new Programs into operational status (Air Quality, Space Weather, and Tsunami).

	Doing with current resources / Need incremental increase / Requires sub-stantial additional resources	End-to-End Environmental Data Management Functions											
		Observation Acquisition & Transmission			Scientific Data Management				Archive & Access				Contin-gency Planning
		5-Year Plan	Maintain & Monitor	Collect & Rescue	5-Year Plan	Calibrate & Validate	Appropriate Formats	Complete Metadata	5-Year Plan	Long-term Preservation	Data Discovery	Access / Disseminate	
Weather and Water Goal Programs	Local Forecasts & Warnings	F			P				P				
	Coasts, Estuaries, & Oceans	F			P				P				
	Space Weather	F			F				F				
	Hydrology, Rivers, Lakes, & Floods	P			P				P				
	Air Quality	P			P				P				
	Environ-mental Modeling	P			P				P				
	Science, Technology, & Infusion	F			P				P				N/A
	Tsunami	P			N				P				

- A **green cell** indicates that the Goal is accomplishing 100% of the required activity or is able to do so with current resources.
- A **yellow cell** indicates that the activity is partially accomplished or an incremental increase in resources is required to reach the 100% level.
- A **red cell** indicates that the activity is not accomplished or that significant new resources are required.
- **5-Year Plan columns** are F, plan completed and in place; P, partly completed; and N, no plan in place.

It is also simultaneously sustaining and modernizing the other Programs during rapid changes in technology. The Weather and Water Goal has a clear vision for expanding and improving service to the Nation. In many cases we are on track to achieve our vision, while in other cases, additional resources will be needed.

Observation Acquisition and Transmission

The Weather and Water Goal is an extensive producer and user of observations. Its Programs utilize observations to calibrate sensors, verify official forecasts and warnings, analyze atmospheric data, and improve understanding of environmental processes. All Programs are developing, or have developed, five-year plans for observation acquisition and transmission.

Weather and Water Goal Programs are transitioning from traditional *system* requirements and implementation to an integrated approach to observing requirements, architecture, and operation. This will reduce potential system overlaps and enhance synergies between Programs and Mission Goals. Programs are reassessing their data management plans for observations to incorporate this integrated observing system architecture. Development of comprehensive plans are complete for four of the seven Weather and Water Programs. The remaining Programs have partially completed plans. All Programs have completed baseline assessments for out year requirements through FY 2012.

The Maintain and Monitor component is generally in "yellow" status, requiring additional resources. Weather and Water's ability to monitor transmission and receipt of observations is generally good.

Radome, NOAA National Weather Service Weather Forecast Office, Pueblo, Colorado

Archive Level II data are high resolution, real-time output data from the Next Generation Weather Radar (NEXRAD) system. For years, these data were written to 8 mm tape at local NOAA Weather Forecast Offices and sent through the U.S. mail to the National Climatic Data Center for long-term archiving. To modernize the distribution of these data, NOAA's National Weather Service, along with its partners, has implemented an innovative use of collaborative communications technology at the high-speed federal Internet2 network infrastructure. This allows NOAA to deliver significantly greater amounts of high quality radar data to a geographically diverse group of users. Archive Level II data are currently collected from more than 130 NEXRAD sites.

However, the ability to track and identify observing sensor problems does not yet exist as an "integrated" capability within Weather and Water. The Programs are generally very good at ensuring that observations are collected and stored in NOAA's long term archive. Rescue of observation datasets is not a significant problem in most cases. In fact, one systemic data rescue problem within the Local Forecasts and Warnings Program—collecting Archive Level II radar data—has been resolved with the innovative use of the U.S. Government's high-speed Internet2 network infrastructure. Areas remain where Programs need additional resources to address problems. For example, non-NOAA observations used as the basis for NOAA products and services do not always get systematically archived. An example is Agricultural Research Service high-resolution precipitation observations. Programs must identify and coordinate archival of essential non-NOAA data with the data provider. In the future, as products and services are down-scaled and performance measure targets become more challenging, enhanced observation coverage and density of observations will be necessary.

Scientific Data Management

Weather and Water Programs are performing well in Scientific Data Management, but areas for improvements are noted in several activities. Overall, the Programs use

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The Weather and Water Mission Goal operates data management systems that are essential for NOAA, other federal government entities, and private sector partners.

Telecommunications Operations Center (TOC). This is the Nation's data portal for NOAA, other federal, and private sector real-time environmental data.

National Centers for Environmental Prediction (NCEP) Central Operations. This super-computing facility assimilates satellite and *in situ* observations, and produces predictions of atmospheric, climate, air quality, space, and hydrologic processes.

Hydro-meteorological Automated Data System (HADS). HADS decodes proprietary binary observations sent through the GOES data collection platform into uniform standard formatted observations.

Meteorological Assimilation Data Ingest System (MADIS). MADIS collects surface Mesonet data from more than 13,000 stations (most from non-NOAA sources), standardizes formats, generates data quality statistics, and redistributes data.

National Data Buoy Center (NDBC). NDBC provides testing, calibration, quality monitoring, metadata collection, and near real-time dissemination to NOAA and non-NOAA partners for the Marine Observing Network.

internationally-approved formats and protocols for data exchange and document observations and guidance publicly. However, documentation of scientific data management plans, calibration/validation, and metadata all need additional resources to meet data management standards.

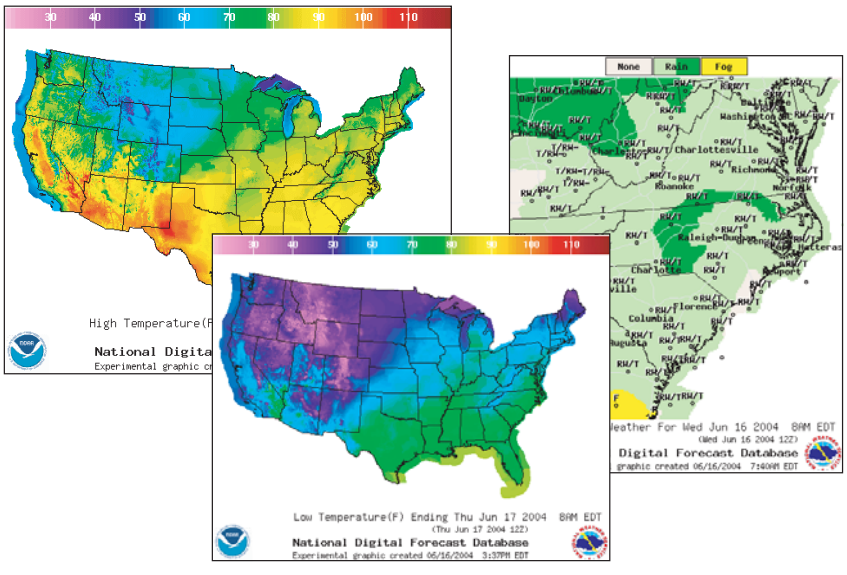
The Weather and Water Goal must ensure data management resources are identified in plans for recently developed and future products. These will provide the needed end-to-end infrastructure to support them. Two examples of new and emerging products requiring additional planning resources are the Coast, Estuaries, and Oceans Program Weather and Research Forecast (WRF) model, and water resource data assimilation activities of the Hydrology Program.

Calibration and validation of observations, products, and forecasts are done throughout Weather and Water Programs. Mission-critical observing system sensors are monitored, and engineering changes made to individual malfunctioning sensors. Observing system data quality is also monitored centrally within the National Centers for Environmental Prediction (NCEP) Central Operations and at field sites by operational meteorologists. Even with this significant amount of monitoring activity, only the most noticeable erros can be corrected or eliminated. Problems and trends in observing system performance are not always available to all operational interests, nor do these trends get systematically entered into the climatic data record. Development of Integrated Surface Observing System (ISOS) and Integrated Upper-air Observing System (IUOS) data management plans will enhance data monitoring coordination within the Programs.

Areas needing additional resources include observing sensor calibration and validation data for non-NOAA observations. In response to uncertain observation performance and calibration, the Science, Technology, and Infusion Program has developed the Meteorological Assimilation Data Ingest System (MADIS). MADIS integrates data from NOAA and many non-NOAA sources. MADIS also generates statistics that characterize long-term stability and accuracy of non-NOAA observing systems.

Validation and verification of Weather and Water Goal analyses, forecasts and warnings are critical for continued improvement to Program products and services. Most existing products have established criteria, but newer services will require additional resources to establish robust validation and verification processes. Examples of programs in this situation include some Space Weather products and Local Forecasts and Warnings Program digital services currently in development.

The need for interoperability of Weather and Water observations and products has long been established



After more than 10 years of development, NOAA's National Weather Service (NWS) has deployed an initial operating capability for the National Digital Forecast Database (NDFD). NDFD moves the NWS from an era of manually-edited text forecast for individual counties to a meteorologist-in-the-loop, national, digital database at 3 mile (5 km) resolution. NDFD allows users to directly query the database using eXtensible Markup Language, even on cell phones and Internet appliances.

NDFD provides a 24-hour access to gridded forecasts of weather elements (e.g., cloud cover, maximum temperature). The database contains a seamless mosaic of digital forecasts received from Weather Forecast Offices and NCEP. Customers and partners can customize a wide range of text, and graphic, gridded, and image products for their particular enterprise.

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URGENT - WEATHER MESSAGE
NATIONAL WEATHER SERVICE QUAD CITIES IA IL
IAZ089-099-ILZ016>018-024>026-034-035-MOZ010-030045-
/X.UPG.KDVN.FR.Y.0001.050503T0500Z-050503T1400Z
/X.EXA.KDVN.FZ.W.0002.050503T0500Z-05053T1400Z
DES MOINES-LEE-HENRY-BUREAU-PUTNAM-MERCER-HENDERSON-WARREN-
INCLUDING THE CITIES OF...BURLINGTON...FORT
MADISON...KEWANEE...PRINCETON...HENNEPIN...ALEDO...
1131 AM CDT MON MAY 2 2005
...FREEZE WARNING IN EFFECT FROM MIDNIGHT TONIGHT TO 9 AM
CDT TUESDAY
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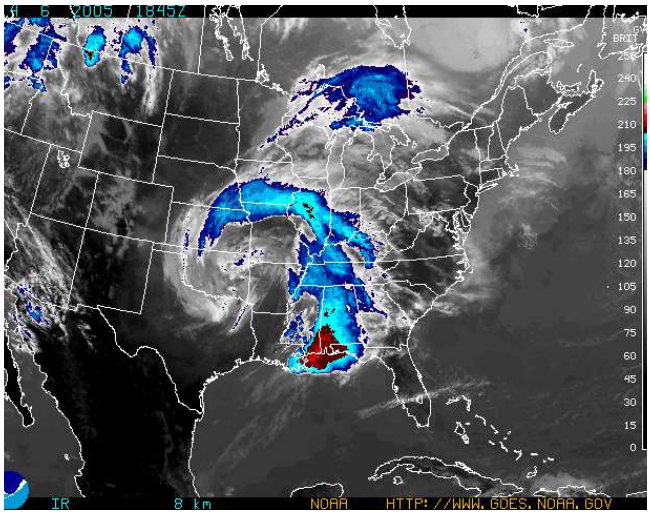
The Valid Time Event Code (VTEC), implemented in early 2005, documents product metadata associated with watches, warnings, and advisories. In the example above, the fourth and fifth lines contain the VTEC information. VTEC standardizes weather products for both internal and external use, such as Web pages and TV crawls. It allows start-to-finish tracking of weather information.

with our national customers and international partners. All Programs adhere to industry norms for format, timeliness, and quality. However, as NOAA's mission evolves and our focus shifts from traditional products and services to include air and water quality and ecosystems, traditional meteorological product formats must be re-examined. The Weather and Water Programs are coordinating an expanded product suite that includes emerging open standards such as those coordinated through the FGDC and the Organization for the Advancement of Structured Information Standards. While there is much activity in collecting metadata from Weather and Water Programs, integrating and archiving data into accessible databases linked with the original data is a challenge. The development and execution of ISOS and IUOS DMAC plans will enhance metadata collecting and archiving, but will require additional resources. Resources will also be required within the Environmental Modeling Program to document changes to model resolution, assimilation, algorithm, physics, and performance.

Archive and Access

Weather and Water programs have a history of robust operational archive and access capabilities. Observations, forecasts, and warning dissemination capabilities must support exponential increases in requests for information during national emergencies such as land-falling hurricanes. Observations, forecasts, and warnings are the basis for the Nation's official climate record. Therefore, most observations and products have formal archive agreements in place with NOAA's NCDC to ensure that these data are available to support legal, climate, and economic interests. Similar informal agreements with NOAA's National Geophysical Data Center (NGDC) and National Oceanographic Data Center (NODC) are being reviewed for Space



Geostationary Operational Environmental Satellite (GOES) East-CONUS sector, infrared image.

The NOAAPORT Satellite Broadcast Network (SBN) provides one-way satellite communications of hydrometeorological data and information throughout the United States. NOAA's National Weather Service is modernizing the SBN, with infusion of commercial off-the-shelf hardware, software, and communications technologies integrated into NOAA operations. The centerpiece of expansion has been the development of Digital Video Broadcast–Satellite (DVB-S), which will enable the SBN to transmit over a single, linearly-scalable satellite channel. Another component of SBN expansion has been the increased usage of advance product compression technologies. In addition, SBN bandwidth will be scaled up by 71%. Through DVB-S, both NOAA and the public will be able to access a significant amount of valuable, high quality, environmental observations and forecasts.

Weather and Tsunami data and information. In most cases "data discovery" for retrospective (not real-time) observations, forecasts, and warnings can be queried using Web-based tools.

The most significant issue in the next five years is data volume growth of environmental modeling guidance products. This presents challenges for disseminating and archiving these data. Plans are completed for the expansion of computing resources and bandwidth required to create and disseminate forecast guidance between the NCEP supercomputing facility and the TOC. Additional planning and resources are required for transferring forecast guidance from the TOC to Local Forecast and Warning field offices, storing these at NCDC, and archiving the growing suite of digital products.

Additional resources will be required for long-term archive of new products and services, including those from the Space Weather and Tsunami Programs, observations from the NOAA Profile Network and Deep-ocean Assessment and Reporting of Tsunamis, and Coasts, Estuaries, and Oceans WRF model output. Non-NOAA observation data (from regional associations and other federal agencies) used in NOAA products also need additional resources to support storage and retrieval.

The Weather and Water real-time operational mission mandates maintenance of a highly available, flexible, interoperable, and efficient dissemination infrastructure. The communications infrastructure is currently strong, but as the scope of the product suite expands, today's infrastructure will need additional resources to keep pace with the ever-growing demand for products.

Contingency Planning

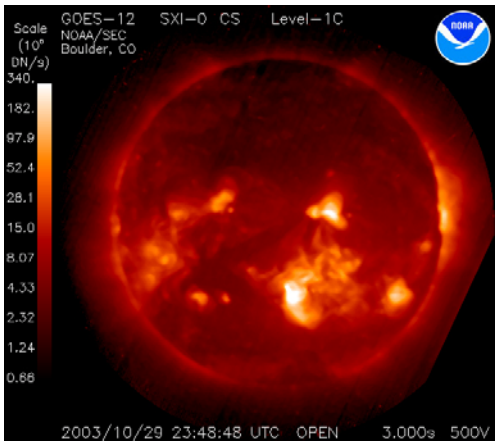
Overall contingency planning for collection and dissemination of Weather and Water Goal observations, forecasts, and warnings is good, but will require incremental resources to meet targets for end-to-end data availability. The extent of infrastructure requiring backup is substantial, but a significant effort has been expended to ensure that the Weather and Water Goal can withstand degraded operations by multiple systems while continuing to provide critical information to decision makers.

The Weather and Water Goal has recently demonstrated its ability to perform during national emergencies by participating in the following drills:

- Forward Challenge 04, a federal-wide Continuity of Government exercise;

NOAA 2005–2010 Strategic Plan
Long-Term Weather and Water Strategies

- Improve the reliability, lead-time, and effectiveness of weather and water information and services that predict changes in environmental conditions.
- Integrate an information enterprise that incorporates all stages from research to delivery, seeks better coordination of employee skills and training, and engages customers.
- Develop and infuse research results and new technologies more efficiently to improve products and services, streamline dissemination, and communicate vital information more effectively.
- Work with private industry, universities, and national and international agencies to create and leverage partnerships that foster more effective information services.
- Build a broad-based and coordinated education and outreach program by engaging individuals in continuous learning toward a greater understanding of the impacts of weather and water on their lives.
- Employ scientific and emerging technological capabilities to advance decision-support services and educate stakeholders.



The Space Weather Program developed a data processing and archiving system for the new Solar X-Ray Imager on GOES-12. The plans were formulated with input and resources from both the research and operational branches of NOAA's Space Environment Center (SEC) and the archiving organization, NOAA's NGDC. SEC acquires data using satellite dishes in Boulder, Colorado. SEC then processes the data and generates products for the real-time, operational, Space Weather Forecast Center. Sixty days of data are stored at SEC. In addition, the data are sent in near real-time to the permanent data archive at NGDC. The two independent systems provide backup and redundancy for the captured data and products. To date, no critical data have been lost.

- quarterly backup exercises at the NASA IV and V facility in Fairmont, West Virginia, using the NCEP backup Central Computing System, which provides full backup capabilities for all NCEP numerical forecast products;
- numerous backup exercises among Local Forecast and Warning Program field offices and the Department of Defense Forecast Center; and,
- hurricane exercises at field offices in coordination with local emergency management agencies.

In addition to the completion of the backup supercomputing facility in Fairmont, Weather and Water is improving its posture to respond to threats by planning for a TOC backup facility. The projected Initial Operating Capacity is FY 2007.

Summary and 10-year Objectives

NOAA's Weather and Water Mission Goal is, in many respects, the nexus of much of the observations and information generated within NOAA. Through the Weather and Water Mission Goal, raw environmental observations are fused into useful analyses and predictions that enhance the Nation's public safety and economy. We have responded well to the challenge of growing observation complexity and volume by significantly improving computing, bandwidth, applied research, and training in an effort to fully exploit observing system investments. This balanced portfolio of investments has yielded steady improvement in climate, water, and weather prediction accuracy. These improvements benefit virtually every facet of people's lives and the economy.

America's vulnerability to weather and flooding is rising as more of the population moves into areas prone to these hazards, and national and global economies become increasingly complex. Approximately 40% of Americans—about 100 million people—currently reside along our coasts. The risk to dense coastal populations was demonstrated with deadly consequences in 2004 as four hurricanes made landfall in Florida, and then again with the tragic and catastrophic Indian Ocean tsunami.

To keep pace with evolving threats to the economy and society, we must improve and expand our products and services. To achieve this outcome, Weather and Water must balance investments in enhanced baseline observing systems such as the WSR-88 Doppler for dual polarization, National Polar-orbiting Operational Environmental Satellite System (NPOESS), and GOES-R with those infrastructure investments needed to process, distribute, monitor, and assimilate and archive these data for maximum effectiveness.

The 10-year goal resulting from balanced, cost-effective investments will be a transformed observing system that is an integrated, comprehensive system-of systems, with an advanced data assimilation capability. This ultimately will deliver a seamless suite of digital climate, water, and weather products and services that meet the public's demand for timeliness, accuracy, and accessibility.

NOAA Mission Goal:

Commerce and Transportation

Support the Nation's commerce with information for safe, efficient, and environmentally sound transportation

NOAA's products and services are essential to the safe and efficient transport of people and goods on the water, in the air, and on the land.

In support of the Commerce and Transportation Mission Goal, NOAA acquires a wide array of data, ranging from periodic to continuous—from the ocean to the land and the atmosphere—using both fixed and mobile platforms.

NOAA provides real-time observations and analyses of temperature, wind, pressure, clouds, turbulence, and icing. Accurate navigational data are provided to mariners, and to port and harbor developers.

NOAA responds to hazardous material spills to protect the Nation's coastal environment. We also assist in search and rescue, and provide weather and disaster warnings to citizens who may be in harm's way.

We are committed to improving the accuracy and timeliness of our marine forecasts; providing advanced navigational charts and real-time oceanographic information; and maintaining a consistent and accurate positioning network. We are also committed to working with our national and international partners to promote beneficial science for all aspects of commerce and transportation, including innovative use of remotely-sensed data.

• Marine Transportation Systems • Marine Weather • Aviation Weather
• Surface Weather • Geodesy • NOAA Emergency Response
• Commercial Remote Sensing Licensing

NOAA Commerce and Transportation Programs

Marine Transportation Systems

- provide products, information, tools, and services for the safe, efficient, and environmentally sound flow of goods and people through the marine transportation system

Geodesy

- maintain a consistent national coordinate system
- support mapping, charting, navigation, and scientific applications of spatial data

Surface Weather

- provide timely weather and hazard information on a scale that supports improvements to safe and efficient transportation

Aviation Weather

- provide accurate aviation convection, icing, turbulence, and cloud ceiling/ surface visibility products to the Federal Aviation Administration

Marine Weather

- depict upper ocean and lower atmosphere data and information
- create warning and advisory products and services

NOAA Emergency Response

- provide an integrated source of scientific data, observation, prediction, and response for emergencies threatening life, commerce, or the environment
- coordinate across all NOAA emergency activities including those for natural hazards, fire weather, and extreme biological event forecasting

Commercial Remote Sensing Licensing

- license the operations of U.S. commercial remote sensing satellite firms
- ensure that these are operated in a manner consistent with U.S. national security, homeland security, and foreign policy interests

Note: NOAA matrix programs are identified by ***blue italic text***.

Overview

Within the Commerce and Transportation Goal, data are presently required to support safe and efficient navigation in our skies, on land, and while transiting our Nation's waters. In the two years since the last assessment, the Commerce and Transportation Goal made significant improvements in data delivery. Electronic navigational charts are now available free of charge to the public over the Internet. To date, more than 6.5 million charts have been downloaded. In addition, we formed partnerships with private industry to deliver up-to-date charting products maintained on a weekly basis. GIS are being used successfully to display and deliver data to wider and more diverse user groups. The seven Programs of the Commerce and Transportation Goal reviewed all data activities, assessing needs, accomplishments, and challenges.

Observation Acquisition and Transmission

Some types of data required to accomplish the Goal mission include water levels, currents, water depths and coastal elevations, navigationally-significant features both in the water and on land, positioning information, and sea floor bottom characterization. Certain Commerce and Transportation Programs use original data that are acquired, managed, and archived by different NOAA Goals. For instance, aviation and marine weather rely on data acquired by the Weather and Water and the Climate Goals. Water level and coastline relief data collected for Marine Transportation Systems support the Ecosystem

		End-to-End Environmental Data Management Functions											
		Observation Acquisition & Transmission			Scientific Data Management				Archive & Access				
		5-Year Plan	Maintain & Monitor	Collect & Rescue	5-Year Plan	Calibrate & Validate	Appropriate Formats	Complete Metadata	5-Year Plan	Long-term Preservation	Data Discovery	Access / Disseminate	Contin-gency Planning
Commerce & Transportation Goal Programs	Marine Transporta-tion System	F			P				P				
	Geodesy	F			P				P				
	Surface Weather	P			N				N				
	Aviation Weather	N/A	N/A	N/A	F				F				
	Marine Weather	N/A	N/A	N/A	F				F				
	NOAA Emergency Response	N/A	N/A	N/A	P				P				
	Commercial Remote Sensing	*NONE*											

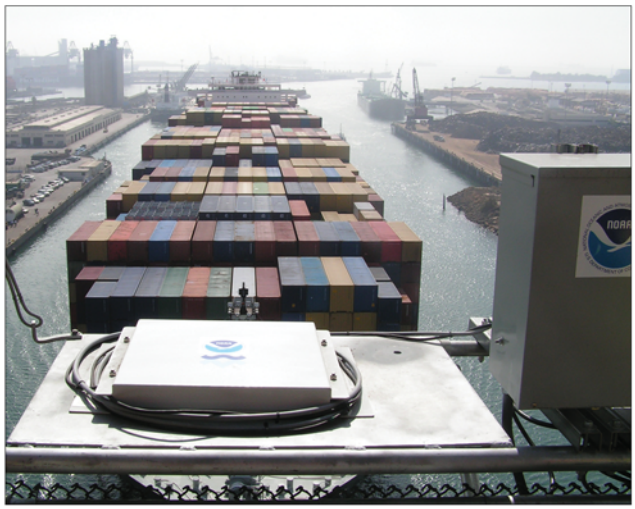
- A **green cell** indicates that the Goal is accomplishing 100% of the required activity or is able to do so with current resources.
- A **yellow cell** indicates that the activity is partially accomplished or an incremental increase in resources is required to reach the 100% level.
- A **red cell** indicates that the activity is not accomplished or that significant new resources are required.
- **5-Year Plan columns** are F, plan completed and in place; P, partly completed; and N, no plan in place. .

Observations Program, Coast, Estuaries, and Oceans Program, and Tsunami Program. NOAA fully supports the concept of "collect once, use many times." This includes enabling access so that data can be used by a multitude of users for a multitude of needs.

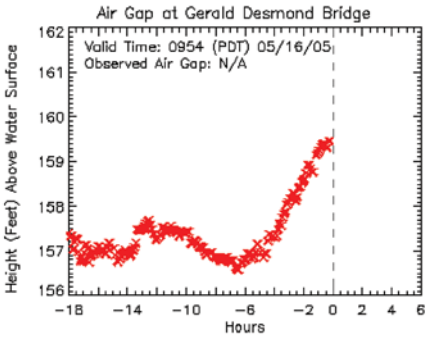
With the many recent advances in technology, significantly larger data sets are being acquired in support of nautical charting and tsunami inundation modeling during the performance of hydrographic surveying and shoreline delineation. Currently, large-volume, multibeam sonar data of two to four gigabytes per day per vessel and large airborne laser data sets are being acquired. Data handling, processing, quality control, and significant depth sounding selection issues are a major concern.

An investigation is underway to determine the best methods to handle the digital side scan sonar and bottom backscatter datasets. These data are acquired in support of nautical charting efforts (10 gigabytes of data per day per vessel). The data are relevant to the Department of Defense, Department of Homeland Security, the many entities studying fisheries, geologists, and a myriad of other users. The Commerce and Transportation data management assessment chart reflects the challenges posed by acquiring, processing, and quality controlling greatly increased volumes of data.

In the near future, NOAA will be engaging Federal, State, and local agencies, academia, and private industry partners to join NOAA and the Federal Highway Administration in assessing surface weather transportation needs. To mitigate the adverse impacts of localized weather conditions, travelers need weather advisories based on timely, fine-resolution weather observations along the Nation's roadways. Local effects such as fog, blowing and drifting snow, ice, high winds, and other



The MSC *Texas* makes its way under the Gerald Desmond Bridge into Long Beach, California. The newly built ship is almost 1,100 feet long and 140 feet wide, and able to carry enough cargo to completely fill a 1 million-square-foot shopping center with products stacked eight feet high. In the forefront of the picture is the NOAA-developed air gap sensor affixed to the bridge. The air gap, part of the PORTS suite of sensors, relays to the mariner in real time the distance between the bottom of the bridge and the water surface. This information is used to determine whether the vessel can safely pass under the bridge without striking it.



hazardous weather conditions impact travel conditions with very short notice.

In building this National Surface Weather Observing System, data management issues include standardizing methods of data gathering, archiving and exchange; assessing the refinements needed to meet surface transportation needs (e.g., performance standards, densification, accuracy); and technology for data sharing and transmission. One of the data sources is from the Road Weather Information Systems existing across the country. To date, only a handful of State data have been incorporated and collected by NOAA. The entire effort, from data collection to archive and dissemination, will require a substantial influx of resources.

Until now, NOAA has faced a long, uphill battle to ensure that data acquired in the past have not deteriorated or become inaccessible. NOAA's CDMP has been invaluable over the past five years by providing assistance in scanning old and fragile paper records, and copying data from deteriorating digital sources such as microfiche and negatives onto long-term approved media. Hydrographic survey data, water level records, current information, and shoreline manuscripts have been "rescued" and are now available electronically to the public.

NOAA still has a large inventory of historic aerial analog photographs used in nautical and aeronautical charting efforts that are aging rapidly. Some of the film is very fragile. NOAA's aerial photography represents a national treasure of information. Film collections for both the U.S. coastline and major airports date back to the 1930s. These analog collections portray aerial imagery prior to satellite availability. Coastal managers, urban planners, legal representatives, the public and many others currently use this imagery. Long-term preservation and contingency planning, including storage and conversion to complete digital data, are necessary for proper aerial photography stewardship. This effort will require substantial additional resources. CDMP is investigating the feasibility of beginning this rescue effort. Additional resources will be required to serve these high-resolution data to the user community.

Scientific Data Management

Work is ongoing across Commerce and Transportation programs to ensure accurate, timely, and consistent data and products. Some programs are well established and others are in their infancy. The National Water Level Observation Network, and Physical Oceanographic Real-Time System (PORTS) have successful 24/7 monitoring systems in place that quality control many different types of data and stops availability to the public when suspect data are detected. Other programs are continuing to improve and automate, where possible, the validation of data, and to offer data in appropriate formats as defined by customer needs.

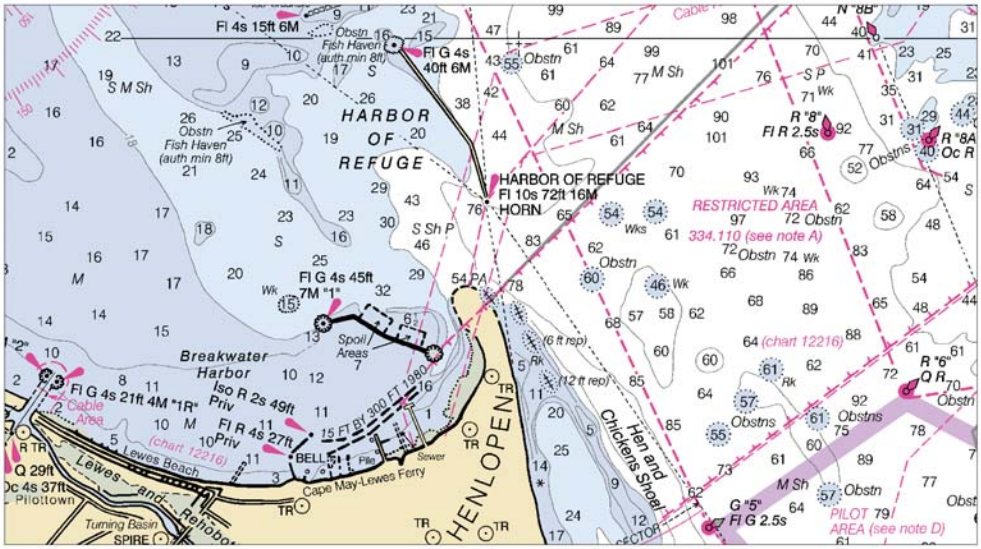
There are many different vertical reference datums used by organizations, including NOAA, to collect geospatial data—particularly data collected in coastal regions. This is a major impediment to integrating these data. A datum is the reference level to which geospatial data is gathered. In the interest of charting for navigation safety, NOAA collects its hydrographic data to a vertical datum of Mean Lower Low Water and shoreline data to Mean High Water. However, other parts of NOAA and many other agencies and entities, routinely acquire geospatial data at a variety of vertical reference datums for different purposes. This is particularly true for data collected in coastal regions.

To address the problem, NOAA has developed a vertical datum (VDatum) transformation tool. VDatum translates geospatial data among vertical reference systems and removes the most serious impediments to data sharing. This allows for the easy and accurate transformation of elevation data from one vertical datum to another. VDatum will give NOAA and other mapping agencies the capability to seamlessly integrate geospatial data for a number of critical applications for the benefit of the U.S. public. Work on this tool proceeds at a slow rate, as additional resources are required.

NOAA produces and maintains a suite of approximately 1,000 nautical charts. A nautical chart enables the mariner to fix positions and plot an efficient course while avoiding rocks, wrecks, shoals, reefs, tide rips, and other known hazards. NOAA is building a database that supports the production of electronic navigational charts (ENCs) and will be used to modernize the production of all of NOAA's navigational products. It is also being designed for direct access by non-navigational users who want to access specific data themes in the coastal U.S. and to download data in the format of their choice. This database is an important part of the U.S. geospatial data holdings. It will represent the only geospatial database of coastal information (e.g., shoreline, bathymetry, navigational features) that is kept up-to-date for changes to these features.

Building a system to maintain this database and loading it with the best available navigational data continues to be a difficult and resource-intensive task. The next steps should be accomplished as a partnership between industry and NOAA. However, such a partnership will put an even greater demand on resources. The challenge ahead is to build a system that will streamline production and ultimately improve productivity and quality while continuing to create products crucial to mariners, boaters, and other users.

With the growing use of electronic navigational systems on board vessels and GIS employed daily across the country, historical ways of storing and delivering data have been examined. NOAA's United States Coast Pilot consists of nautical books that cover a variety of information important to



Portion of Delaware Bay Nautical Chart. Charts are now available in both paper and electronic form. Electronic Navigational Charts (ENCs) offer the mariner an outstanding tool to more safely transit in our Nation's waterways. The ship position is displayed in real time on the ENC, with zoom-in, zoom-out and feature identification capability.

M/V *Selendang Ayu*, broken in two on Unalaska Island, Alaska, in December 2004. NOAA data were used in NOAA's Office of Response and Restoration models to determine where oil and soybeans (the vessel's cargo) could impact in this environmentally-sensitive and important area. Dispersion models are often used to determine protection strategies for NOAA resources and where to deploy cleanup capabilities.

navigators of coastal and intracoastal waters and the Great Lakes. Issued in nine volumes, they contain supplemental information, all in text form, that is difficult to portray on a nautical chart.

A Coast Pilot is being developed that will be continually updated, promoting safe navigation for 100,000 professional mariners, the Department of Defense, and up to 12 million recreational boaters. Successful completion of this project requires the implementation of a database publishing system and geographic referencing of the textual data. Upon completion, Coast Pilot will offer seamless integration into a variety of NOAA products, including the ability to be geo-referenced to NOAA ENCs, Print-on-Demand Charts, and any other products wishing to include Coast Pilot data without duplication of effort. Private industry value-added products are easier to develop with digital Coast Pilot data.

Efforts are underway to build complete metadata records for Commerce and Transportation data, databases, and products. The challenge of data management for scientific stewardship purposes is to ensure that the data remain accessible and relevant and have the associated metadata that links to every data point. Long-term data sets not only document the past, but can be used to predict or assess impacts for the future. Data continuity is a major challenge in prediction or impact assessment. For example, sea level data must be free of significant data gaps, and have the same vertical reference over time. Maintenance and calibration records must accompany the data. Intercomparisons of old and new technologies must be available as new sensor technologies are implemented. The data management challenge is to not only to store data for history, but also keep data alive for the research community to continually exercise and apply to societal needs.

Archive and Access

Within Commerce and Transportation Programs, an area historically overlooked in data management plans has been long-term archival of collected data. That is changing. Plans that never existed before are now being formulated. When a new project proposes to acquire data, the viability of these data is ensured, for now and into the future. Technological advances in data storage, computing power, and the Web allows for ease of data dissemination. The opportunity exists to offer data, products, and tools to assist customers in decision making on a local, regional, and global basis. Data users are more familiar with GIS capabilities, and are actively looking

Customers require data in a timely basis. At times, NOAA ship personnel review hydrographic survey data with local officials within days of acquisition.

for comprehensive and varied data sources.

Commerce and Transportation Programs have some great successes in data archive and access. These have resulted from close partnerships among NOAA's operational and production components and the NOAA Data Centers. Climatic data in support of aviation and marine weather have a clearly defined path from collection to archive at NCDC. Hydrographic survey data have been well preserved, and are available from NGDC. "Mirror" data servers are being established to ensure uninterrupted data access to the outside user and to serve as data backup systems. One such system was established in 2005 for continuing operations between NOAA's National Geodetic Survey and NGDC. For those areas where archive and dissemination paths have not been established, discussions are underway, and the need for incremental or substantial resources is being identified.

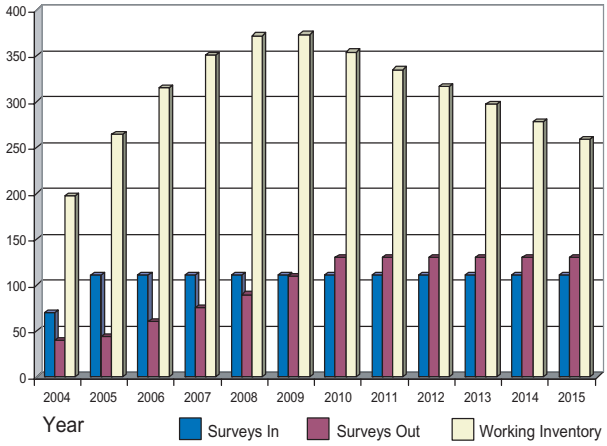
During the course of a response to marine incidents, data generated by NOAA are used to communicate information to decision makers, other responders, scientists, or the public. These data may be in the form of photos, model output, weather forecasts, graphic displays, summary reports, or specific survey results. For hundreds of incidents since 1979, data exist only in paper format—in boxes or folders stored in offices or warehouses. Data used to support modeling for specific incidents exist in multiple formats ranging from floppy disks to data on servers. Converting modeling data to present technology has been completed on a time-available basis. Much data still remain to be converted.

A comprehensive plan is needed to properly archive these historical and modeling data in electronic format. A complete inventory of available data must be completed prior to determining the level of effort required to rescue these data. Some data are available in an online, searchable database. For example, historical spill data (images and documents) from large incidents are available for viewing up to 1999. Data for smaller incidents or post-1999 have not been processed for public accessibility. Also, the technology for sorting and searching this database is outdated. Even with these limitations, this is a much-visited database. However, resources are required to improve its accessibility and usability.

The Environmental Sensitivity Index program also needs a plan to address emerging dissemination needs and long-term archiving. Data are presently disseminated as paper atlases, downloadable PDFs of specific maps, mailed CDs (with cost recovery), and as shapefiles for use in geographic information systems. There is no consistent standard and testing for the long-term preservation

NOAA 2005–2010 Strategic Plan
Long-Term Commerce and Transportation Strategies:

- Expand and enhance advanced technology monitoring and observing systems, such as weather and oceanographic observations, ice forecasts and nowcasts, hydrographic surveys, and precise positioning coordinates, to provide accurate, up-to-date information.
- Develop and apply new technologies, methods, and models to increase the capabilities, efficiencies, and accuracy of transportation-related products and services.
- Develop and implement sophisticated assessment and prediction techniques, products, and services to support decisions on aviation, marine, surface navigation efficiencies; coastal resource management; and transportation system management, operations, and planning.
- Build public understanding of the science and technology involved and the role of the environment in commerce and transportation through outreach, education, and industry collaboration.



Hydrographic survey inventory at NOAA's Seattle processing branch. Hydrographic survey methods have led to significant increases in data volume. Processing these data is resource-intensive and lagging behind acquisition rates. Software tools currently being tested may alleviate this problem.

of spill response data. Work is beginning on the plan to correct these gaps. Initial archiving plans are underway for large data sets of side scan sonar sea floor bottom "imagery" (mosaics) and backscatter information. The next steps for stewardship and development of useful, derived products have yet to be completed. Imminently huge cumulative volumes (on the order of petabytes) of data are anticipated, without specific resources identified to support long-term stewardship. Metadata and associated search and retrieval mechanisms have not yet been designed. Resources will also be required to allow for the dissemination of an entirely new class of data, with its idiosyncratic character and its unexplored customer base.

Contingency Planning

Contingency planning efforts are ongoing in the Commerce and Transportation Goal. Mirrored sites are being established, leading to protection of certain data sets. Other data such as side scan sonar and multibeam, due to their potential data volume and flux, will most likely be treated as large-array data sets, and be archived and mirrored in CLASS. Although contingency plans have been developed for all critical datasets, incremental to substantial resources will be required for the implementation of many of these plans.

Summary and 10-year Objectives

Over the past five years, there has been a concerted effort to educate NOAA personnel on data management needs and requirements. In the past, data acquisition activities were fully defined in project instructions but, in many cases, the life cycles of those data were not clearly laid out, nor funding procured to ensure the health of the data for the future. Change is occurring; awareness of data management requirements has risen within NOAA through outreach, increased communications, and training. Discussions on metadata, archival requirements, data integration, and open source are now commonplace. The datasets supporting our Nation's commerce and transportation needs are more accessible now than they have ever been in the past. This is due to technological advances and also NOAA's desire to meet both user requirements and government directives such as E-Gov and Geospatial One Stop.

Fully automated real-time data processing, analysis, data management, and product distribution systems must be created that are extensible and flexible, and can respond to existing and next-generation measurement technologies. All present and future program data need uniform, cross-referenced metadata (e.g., attributes, maximum resolution scales, accuracy tags), data conversions to geospatial database-ready formats, Web-searchable indices, primary and backup data warehouses, and attention to long-term digital and analog preservation. For all critical online data sets, mirrored data management systems must be installed in order to eliminate a single point of failure.

Data integration is of primary importance across NOAA and with other federal and local agencies. It is imperative that we have the ability to use data to support multiple needs, providing access and derived products useful to secondary users of the data. Ongoing focused research and development will continue to maximize the quality and efficiency with which NOAA acquires, manages, and distributes its data and associated products and services to ensure they are accurate, reliable, secure, and readily accessible to meet the stringent demands of the transportation sector.

NOAA Mission Goal:

Supporting NOAA's Mission

Provide critical support for NOAA's mission

An effective and efficient support structure is necessary for us to achieve our Mission Goals. This support includes NOAA's data collecting platforms and information technology systems, as well as NOAA's management and administration.

NOAA environmental satellites, ships, and aircraft are the backbone of the global Earth observing system, providing many critical mission support services. Safe facilities and state-of-the-art information technologies are essential to NOAA's operations and service delivery. Mission support also includes integrating NOAA homeland security capabilities into national plans, and maintaining emergency response readiness.

We are committed to organizational excellence through management and leadership across a "corporate" NOAA, and in service to the Nation. As mission needs evolve, support services will remain strong.

• Geostationary Satellite Acquisition • Polar Satellite Acquisition • Satellite Services
• Aircraft Replacement • Fleet Replacement • Marine Operations and Maintenance • Aircraft Services
• NOAA Headquarters • Line Office Headquarters • Homeland Security
• Administrative Services • Financial Services • Workforce Management • Acquisitions and Grants
• Information Technology Services • Facilities

NOAA Mission Support Sub-Goals

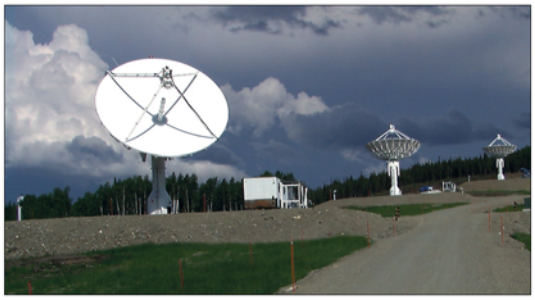
Satellite Services Sub-Goal
- Geostationary satellite acquisition
- Polar satellite acquisition
- Satellite services

Fleet Services Sub-Goal
- Aircraft replacement
- Fleet replacement
- Marine operations and maintenance
- Aircraft services

Note: Homeland Security is a matrixed program.

Leadership Sub-Goal
- NOAA Headquarters
- Line Office headquarters
- *Homeland Security*

Mission Support Sub-Goal
- Administrative services
- Financial services
- Workforce management
- Acquisitions and grants
- Information technology services
- Facilities



NOAA Command and Data Acquisition Center, Fairbanks, Alaska

Overview

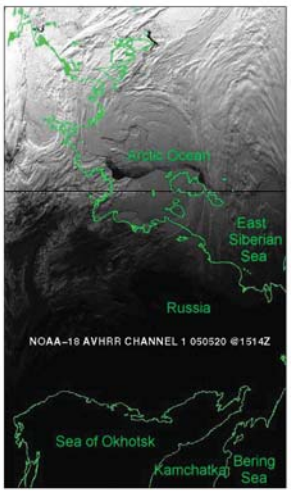
The Mission Support Goal provides the support structure for NOAA's four Mission Goals. NOAA's observational platforms, data-processing systems, computing and communication systems, financial and administrative offices, and approach to management provide the foundation for evolving mission needs. The Goal is organized into four Sub-goals (above) that are integral parts of NOAA's strategic planning.

The Mission Support Goal also applies NOAA expertise and services to other areas, including national security. NOAA is uniquely positioned to provide essential products and services to ensure U.S. ports and coasts remain open and are protected. In addition, NOAA—in partnership with other agencies, organizations, and emergency responders—provides a coordinated suite of hazards-related services. NOAA's outreach, education, and training programs are also vital in hazards mitigation and emergency preparedness.

The Mission Support Goal assessed NOAA's physical support (i.e. observational platforms and facilities), and determined Goal successes and resource needs. Contributions to national security, including cooperative efforts with other agencies, were also examined. NOAA's overall contingency planning was reviewed. Specific data and information management and technology issues are discussed within other Goal assessments.

NOAA Satellites

As the Nation's civilian satellite agency, NOAA's orbital assets serve dual roles as platforms for observation sensors as well as communications systems linking surface-based observing systems. Continuous global satellite coverage is essential to maintain the health and safety of our



NOAA-18, launched in May 2005, carries a five-channel Advanced Very High Resolution Radiometer imager. All spacecraft mechanisms, monitored via ground telemetry in the NOAA Launch Control Room in Suitland, Maryland, were successfully deployed. The image on the right is the first image produced by NOAA-18 a few hours after being launched from Vandenberg Air Force Base in California. The spacecraft underwent a comprehensive on-orbit verification period through July 2005.

Nation. NOAA satellites also provide critical environmental data fundamental to the understanding of Earth processes. In the last two years, NOAA launched two new Polar-orbiting Operational Environmental Satellites (POES), NOAA-17 and NOAA-18. Resource assessment is continual as new programs move forward.

NOAA uses a formal satellite requirements-management process to identify validated environmental satellite observation requirements and allocate these to specific observational systems. These include satellite-based observations of all regions of Earth's atmosphere; Earth's oceans, coasts, and inland waters, and land masses; and, observations of the sun and near-Earth space environment. Early planning, accompanied by rigorous risk-reduction activities, are essential for satellite programs. Equally important is the thorough establishment of a comprehensive scientific data stewardship program that includes long-term access and archive infrastructure. End-to-end management starts with the requirements process and ends with the access and archive of these data. Challenges come with the high volume of data, and the need for innovative access technologies. Resource assessment is continual as new programs move forward.

NOAA Ships and Aircraft

NOAA is also responsible for the largest fleet of research and survey ships operated by a federal agency. NOAA's fleet supports a wide range of marine activities, including fisheries and coastal research; nautical charting; and long-range ocean and climate studies. NOAA aircraft provide varied research and survey capabilities, including those used for water resource management, coastal mapping, and marine mammal surveys. These aircraft are unique in their ability to support NOAA's hurricane surveillance and atmospheric research programs. NOAA's fleet, combined with chartered government, university, and private commercial sources, enables NOAA to carry out its responsibilities under the Magnuson-Stevens Fishery Conservation and Management Act, Marine Mammal Protection Act, Endangered Species Act, and Hydrographic Services Improvement Act. NOAA ships and aircraft are cost-effective and have demonstrated a sterling safety record. The fleet

NOAA Ship Ronald H. Brown *is a multipurpose research vessel capable of supporting physical, chemical, and biological oceanography; atmospheric and climate research; marine acoustics; marine geology and geophysics; bathymetry; and a host of multidisciplinary environmental investigations in coastal and deep ocean regions.*

NOAA WP-3D Orion on the tarmac. WP-3D are equipped with scientific instrumentation, radars, and recording systems for both in situ *and remote sensing measurements of the atmosphere, Earth, and its environment. These aircraft are on standby or deployed for hurricane research and reconnaissance 120 days each year.*

The NOAA Aircraft Operations Center (AOC) took on an intense hurricane season in 2004, and came out flying high. Four major hurricanes struck Florida within a six-week period (September through October): Charley, Frances, Ivan, and Jeanne. AOC continued operations despite having to evacuate each time. The House and Senate twice recognized the work of NOAA and AOC during these 2004 hurricanes.

operates well beyond the normal service life of comparable research and survey craft. The NOAA Fleet Modernization Plan, currently under review, documents program requirements for successful continuation of NOAA's multi-disciplinary missions, including replacing aging ships and aircraft.

Facilities

NOAA operations are conducted in more than 800 facilities in the United States and its Territories. Of these, 437 are NOAA-owned. The new NOAA Satellite Operations Facility in Suitland, Maryland, is nearing completion. The Satellite Operations Control Center provides command, control and communications for GOES, POES, and the Department of Defense's Defense Meteorological Satellite Program (DMSP). It is also home to the computer facility processing satellite data supporting meteorology, oceanography, and solar-terrestrial sciences.

By the end of 2006, NOAA will have completed expansions to the Pacific Tsunami Warning Center, supporting a 24x7 operation, and expansions to the National Data Buoy Center's industrial building, providing additional floor space for the tsunami warning buoy production effort, and complete construction of a backup TOC, providing critical continuity of operations.

The average age of NOAA-owned facilities is more than 35 years. In addition, due to NOAA's overall mission, many facilities housing NOAA operations are located near the coasts, resulting in exposure to severe weather, salt, and sand. The aging of the NOAA real estate portfolio results in numerous issues including energy efficiency, hazardous materials mitigation, and the increasing cost of repairs, renovation, and reconstruction necessary to meet the demands of the current mission. These issues are addressed in the NOAA Facilities Master Plan currently under review. The plan defines a quantitative description of the current real property inventory, the 17 major projects planned or currently under construction, and a master inventory of repair and alterations. The plan identifies strategic solutions.

NOAA and Homeland Security

As NOAA is increasingly integrated into national security planning, new and compelling dimensions are added to the need for sound data management practices. NOAA leverages expertise, capabilities, and assets to advance the state of national readiness. NOAA identified the following set of Priority Mission-Essential Functions as directly supporting national functions.

- Provide timely observations, forecasts, watches, and warnings of severe weather and hydrometeorological and electromagnetic events.
- Provide control and timely access to global environmental data from satellites and other sources to promote, protect, and enhance the Nation's economy, security, environment, and quality of life.
- Ensure the Nation's food supply receives essential protein produced and processed by the fishing industry; provide law enforcement activities to protect and conserve the Nation's marine resources; and support national security emergencies.

- Provide geodetic, hydrographic, and oceanographic data and services to promote safe navigation of commerce and transportation.

NOAA has identified more than 50 capabilities that advance the Nation's security efforts. NOAA applies these already existing programs and technologies in new and innovative ways to assist the U.S. Department of Homeland Security (DHS). In addition, NOAA has actively partnered with many other federal, state, and local agencies addressing security and emergency response issues.

Maritime and Navigation Response

The National Security Presidential Directive–41/Homeland Security Presidential Directive–13 mandates the development of a National Strategy for Maritime Security. Eight Policy Action Working Groups are developing the National Strategy and implementation plans. One of these, Maritime Domain Awareness (MDA) will ensure interagency coordination of homeland security policy and requirements in marine areas.

NOAA assisted the U.S. Coast Guard and U.S. Navy in implementing the MDA. The *National Plan to Achieve Maritime Domain Awareness* has been developed to facilitate and support sound decision-making. The Plan defines MDA as "the effective understanding of anything associated with the global maritime domain that could impact the security, safety, economy, or environment of the United States." This National Plan embraces much of NOAA's everyday mission. The Plan clearly recognizes the value of utilizing existing data systems and information sharing across classification boundaries.

NOAA and the U.S. Coast Guard also entered into an agreement to develop, install, operate, and maintain marine two-way communications systems on NOAA data buoys to relay Automated Identification System (AIS) data through satellite links to the Coast Guard for vessel tracking. AIS is a shipboard system that broadcasts vessel data such as name, course, speed, and call signal to other AIS vessels and stations to avoid collisions at sea. The installation of satellite relays on NOAA data buoys will expand the Coast Guard capability to monitor and track vessels approaching U.S. Territorial waters well beyond the previous limit of line of site.

At the request of the U.S. Navy, NOAA's Shallow Water Survey Craft Project now provides specialized side scan sonar imagery in 34 strategic commercial shipping ports. NOAA hydrographic ships and Navigation Response Teams (NRTs) currently have the capability to collect high-resolution depth data and imagery and routinely perform hydrographic multibeam and side scan sonar surveys, updating NOAA navigational charts that support our Nation's commerce. NOAA outfitted several NRT vessels with a selected suite of hull-mounted sonar systems and associated navigation, data collection, data processing, and data storage systems to enable NOAA to respond more quickly to coastal emergencies. NOAA is also collaborating with the Coast Guard in a pilot program to use hydrographic survey technology for mine detection in restricted port areas. NOAA's survey data serves as a baseline of pre-existing objects. This enables more effective mine countermeasures in a threat condition.

"Maritime Domain Awareness is achieved by (1) collecting, analyzing, and disseminating data, information, and intelligence to decision makers, and (2) applying functional and operational knowledge in the context of known and potential threats. A United States Government MDA capability that is integrated, interoperable, and efficient, coupled with continually improving knowledge is required to meet today's mission requirements."

—from *National Plan to Achieve Maritime Domain Awareness*

High-resolution depth data support multiple NOAA and DHS activities.

An additional NOAA capability with dual application is the Vessel Monitoring System (VMS), which uses global positioning system, satellite communications, and a secure network to monitor fishing vessel compliance. Marine enforcement and homeland security may soon use this evolving capability to support two-way message communications between vessels and tracking suspicious vessels at sea. The expanded VMS would relay near real-time data to the Coast Guard for enforcement and homeland security programs.

Aerial Remote Sensing

In addition to the NOAA satellite assets, NOAA continues to use Light Detection and Ranging elevation data and high quality aerial photography in support of homeland security surveys. These technologies can be used to protect critical infrastructure, aid in disaster response and recovery efforts, verify dispersion modeling, and provide high-resolution maps in support of special security events.

Hazards Alerts, Forecasts, and Dispersion Modeling

NOAA broadcasts warnings, watches, forecasts, and other hazard information 24 hours a day via a nationwide network of radio stations. NOAA Weather Radio (NWR), working with the Federal Communications Commission's Emergency Alert System, serves as an all-hazards public warning system. In June 2004, NOAA signed an agreement that allows DHS to send critical DHS-originated emergency messages directly through the NWR. "All hazards" messages now include:

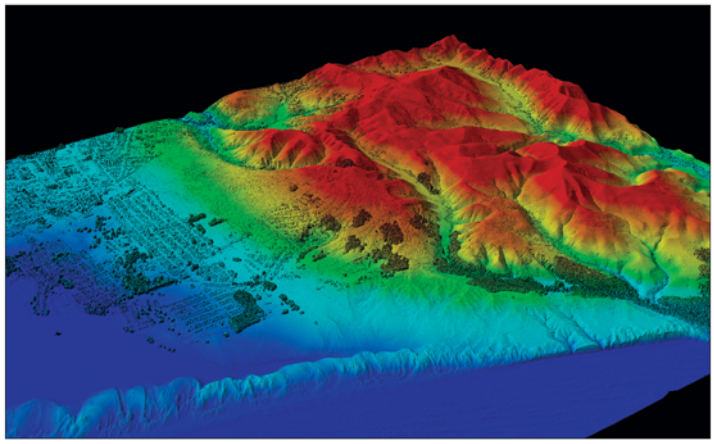
- natural events (e.g., tornadoes, hurricanes, floods, mud slides, volcanic activity, earthquakes);
- technological accidents (e.g., chemical spills, biohazardous releases, oil spills, nuclear power plant emergencies, maritime accidents, train derailments);
- AMBER alerts; and,
- terrorist attacks.

To complement NWR's new national security messaging capabilities, NOAA, DHS, and the U.S. Department of Education are initiating a pilot program that will provide NOAA NWR receivers to public schools in 10 to 15 cities, and two to three rural states.

NOAA has linked its three operational air dispersion models to support emergency planners and first responders in detecting and tracking chemical and biological weapons in the atmosphere. In addition, NOAA continues to help emergency responders plan for possible (or mitigate existing) chemical or biological spills near the coast. NOAA is also integrating real-time weather models and hazardous plume predictions to provide the DHS with the capacity to use reverse 911 technologies. The NOAA Weather Forecast Office in Sterling, Virginia, will be able to provide DHS with toxic plume dispersion information and geographically-specific areas. These real-time weather models and air and water dispersion models predict the movement of hazardous materials, and their environmental human impact.

Monitoring stations have been installed in Washington, D.C. to support one of the first dispersion

Central California
1-meter resolution Lidar Digital Terrain model



NOAA uses Light Detection and Ranging (LIDAR) technology for high-resolution topographic mapping. LIDAR is an active sensor that transmits laser pulses to a target and records the time it takes for the pulse to return to the sensor receiver. The LIDAR sensor, integrated with GPS and inertial measurement unit technology, are mounted to the bottom of aircraft. LIDAR images provide crucial safety information at emergency event sites, such as unstable structures and debris fields. NOAA also uses LIDAR to assess post-storm damage to beaches and structures, and map airspace obstructions for the Federal Aviation Administration.

Increased awareness of hazardous weather and its potential impacts are vital to the public and emergency managers. NOAA maintains direct contact with these groups, providing formal and informal training on many topics, increased data availability, information management, and feedback to effectively adapt to evolving needs. The outreach supports NOAA's Mission Goals, and also involves the public in co-ownership of homeland security efforts. As an example, "Introduction to Hurricane Preparedness" is training that is jointly sponsored by NOAA and the Federal Emergency Management Agency (FEMA, Department of Homeland Security). The course targets local and state personnel responsible for hurricane mitigation and response. Course topics include hurricane meteorology, hurricane hazards, and hurricane planning activities.

forecasting systems specifically designed for urban areas. Collectively, these stations, known as DCNet, collect and analyze standard meteorological data (as well as wind speed, direction, and turbulence data) at frequent intervals to help define downwind areas of potential high risk. In doing so, DCNet allows users to gain a better understanding of how hazardous trace gases and particles are dispersed in urban areas.

Interagency Cooperation

Another important component of NOAA's national security efforts involves forming collaborative partnerships with other federal, state, and local entities. This includes the Interagency Modeling and Atmospheric Assessment Center (IMAAC), NOAA Fisheries Office for Law Enforcement (OLE), and the Homeland Security Operations Center (HSOC). NOAA is now helping to organize and coordinate federal emergency response through the IMAAC, which will provide decision makers with custom products and a single point of contact for all-hazards dispersion modeling predictions and assessments. NOAA OLE agents support investigative, security, and search and recovery efforts in collaboration with other federal agencies. Since June 2004, NOAA staff members have supported the HSOC, which provides operational communications, information, and resource coordination for domestic incident management. Specifically, NOAA provides environmental/ weather forecasts and air dispersion vulnerability assessments to HSOC. NOAA works closely with partners before, during, and after emergency situations.

Contingency Planning

NOAA requires sound data management practices and robust contingency planning to enable execution of the above services and capabilities. It is the policy of the United States, as stated in Federal Preparedness Circular 65, *Federal Executive Branch Continuity of Operations, June 15, 2004*, to have a comprehensive and effective program to provide continuity of functions under all circumstances. COOP includes plans and procedures that "provide for the safekeeping of vital records and databases; identify alternate operating facilities; provide for interoperable communications and validate capability through test, training, and exercises. All agencies are required to have in place a viable COOP capability to ensure continued performance of essential functions from alternate operating sites during any emergency or situation that may disrupt normal operations."

NOAA's Homeland Security Program Office (HSPO), within the office of the Chief Information Officer, manages the COOP for NOAA. Responsibilities assigned to the HSPO include coordination of all plans, programs, and policies regarding homeland security. In addition, the HSPO promulgates policy and direction on NOAA continuity requirements and assures capabilities through a series of training, drills, alternate operating facilities, and implementation of management practices providing command and direction.

As a scientific agency, NOAA's operations depend on the infrastructure supporting acquisition

of data, connectivity, information processing, interpretation, and delivery of resultant findings to supported activities. Identification of environmental changes requires access to current observational data and access to baseline data from archived data on environmental conditions. The operational nature of NOAA's Priority Mission Essential Functions requires either uninterrupted service, or in some instances, reinstatement of services within a few hours. To assure uncompromised access to required observations, archive datasets, models and other systems, NOAA is exploring the implementation of NOAANET designed to both enhance daily operations and ensure continued access to systems and data.

NOAA has supported, and will continue to support the Nation with its hazardous material spill response capabilities; atmospheric and waterborne dispersion forecasting; vessel monitoring systems, and support for communities and emergency responders. NOAA is also ready to serve the Nation through its NOAA ships, aircraft, global observing systems, and professional law enforcement officers.

NOAA 2005–2010 Strategic Plan
Long-Term Mission Support Strategies:

- Provide timely and effective acquisition and delivery of satellite-derived information that supports requirements from the Mission Goals.
- Provide applied research to ensure the quality, reliability, and accuracy of current and future satellite products and services to support the Mission Goals.
- Use effective and efficient approaches to meet NOAA requirements for ship and aircraft support.
- Provide timely and accurate policy, guidance, and information on safety issues affecting NOAA, its customers, and its contractors.
- Formulate and maintain policies, procedures, plans, and processes, including inspections and training, to safely collect data using ships, boats, aircraft, and divers.
- Coordinate NOAA's homeland security-related plans, programs, and policies to enhance NOAA-wide program response, risk management, continuity of operations, and other contingency planning, and program infrastructure.
- Plan for, construct, and maintain facilities, including co-locating facilities among NOAA entities and external partners to allow for consolidation of services.
- Lead agency-wide efforts in education and outreach, public affairs, legislative affairs, international affairs, and legal affairs.
- Develop and maintain an Information Technology Enterprise that does the following: fully supports the life cycle of NOAA's programs; is secure, reliable, and cost-effective; encourages information sharing; and complies with all applicable policies.
- Implement a strategic approach that attracts and maintains a competent and diverse workforce and creates an environment that develops, encourages, and sustains employees as they work to accomplish NOAA's strategic goals.
- Adopt a functional management model to deliver administrative and financial services that will establish direct lines of accountability from headquarters business line managers to all NOAA financial and administrative staff located in the field.
- Employ a planning, programming, budgeting, and execution system to enhance NOAA's capabilities and to guarantee effective delivery of needed products and services.
- Improve the efficiency, accountability, and transparency of administrative programs and services through process optimization and customer satisfaction assessment.

Part 2: Improvement Strategies

We must have the agility to respond to emerging needs as we continue to provide services vital to the Nation.

Vice Adm. Conrad C. Lautenbacher, Jr. USN (ret)
NOAA Administrator
NOAA 2007 Annual Guidance Memorandum

What we do in the next 50 years may determine Earth's environmental destiny. However, what we do in the next 10 years may determine what is possible in the next 50. NOAA is working with local, national, and international partners to strengthen cooperation in, and integration of, Earth observations.

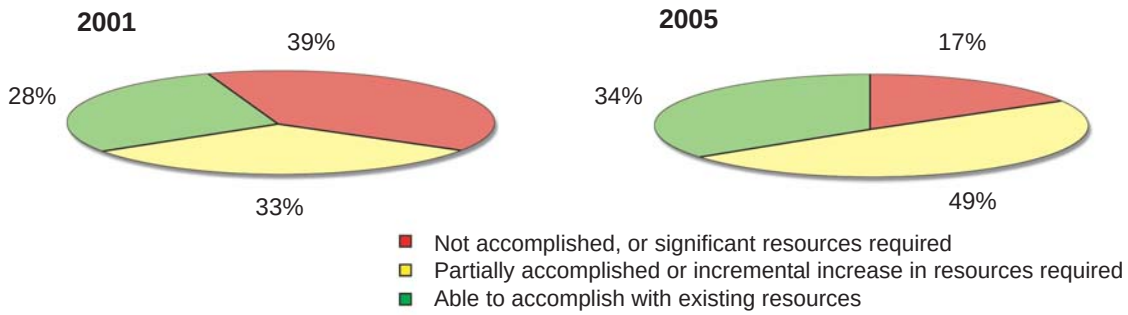
Successes

Based on the data management assessment, NOAA is doing a better job of collecting and verifying environmental observations, and processing and transmitting these observations as compared to four years ago. Observations are generally well calibrated and validated, and the related products undergo quality review based on accepted research or statistical methods. NOAA has seen significant improvements in corporate planning for observations and data management and began developing an integrated Earth observing and data management system. In 2001, NOAA assessed its ability to plan for, collect, ingest, catalog, validate, store, access, and migrate data by major data stream. Comparing the number of red, yellow, and green cells from the 2001 assessment to 2005, one sees a decrease in the percent of red cells and an increase in the percent of yellow and green cells. These advances are due in part to ongoing modernization programs such as AWIPS and NWS TOC.

Challenges

NOAA still faces significant data stewardship challenges. The rapid pace of technological change and a greater number of users with more sophisticated requirements are both challenges and a required part of the solution. The assessment of data and information management indicates, while progress has been made across virtually all Goals, there are continuing challenges in several key areas. NOAA must continue to meet real-time responsibilities at the current high level while addressing the

Status of NOAA data management, based on the 2001 assessment (by NOAA Line Offices) and the 2005 assessment (by NOAA Goals and Programs).



2005 Data Management Assessment Summary

	Doing with current resources / Need incremental increase / Requires sub-stantial additional resources	End-to-End Environmental Data Management Functions										
		Observation Acquisition & Transmission			Scientific Data Management				Archive & Access			
		5-Year Plan	Maintain & Monitor	Collect & Rescue	5-Year Plan	Calibrate & Validate	Appropriate Formats	Complete Metadata	5-Year Plan	Long-term Preservation	Data Discovery	Access / Disseminate
NOAA Mission Goals	Ecosystems	P			P				N			
	Climate	F			F				F			
	Weather & Water	P			P				P			
	Commerce & Trans-portation	F			P				P			

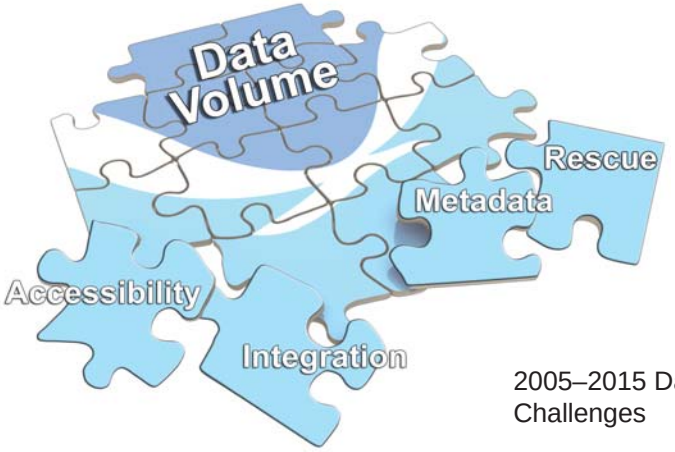
- A **green cell** indicates that the Goal is accomplishing 100% of the required activity or is able to do so with current resources.
- A **yellow cell** indicates that the activity is partially accomplished or an incremental increase in resources is required to reach the 100% level.
- A **red cell** indicates that the activity is not accomplished or that significant new resources are required.
- **5-Year Plan columns** are F, plan completed and in place; P, partly completed; and N, no plan in place.

following challenges:

- **Data Volume.** Manage the exponentially growing volume and diversity of data.
- **Rescue.** Collect data at risk to extend and fill in gaps in environmental data records.
- **Accessibility.** Improve accessibility to the long-term archive, and provide clear discovery of data and information products.
- **Integration.** Enable integration of quality observations and products by adopting standards and standards protocols.
- **Metadata.** Improve descriptions of data, formats, and processing steps to ensure long-term utility.

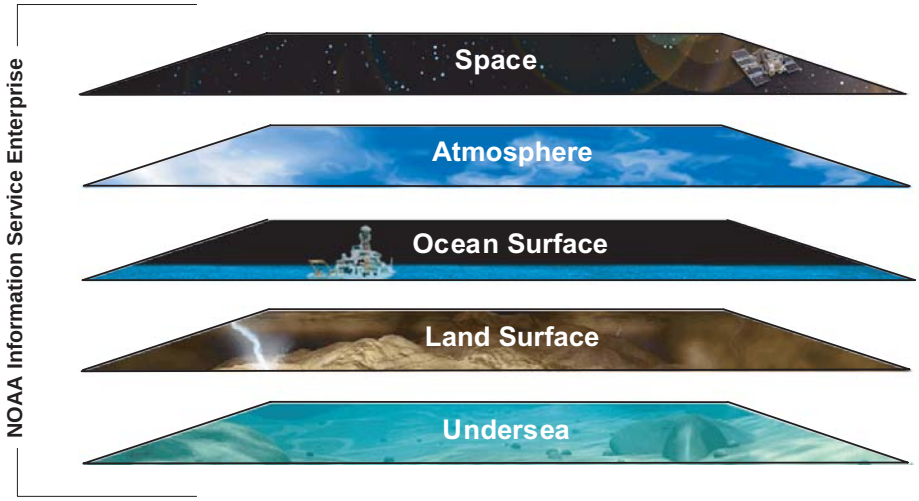
Manage Greater Data Volume and Diversity

NOAA's role in understanding, observing, forecasting, and warning of environmental events is expanding. New technologies and observing systems underpin the environmental information and products that serve society. NOAA faces challenges both from the increases in remotely sensed data brought about by instrumentation and communications technology, and from the diversity of data required to engage effectively in managing the Nation's coastal and marine living resources. NOAA expects a doubling of data every year for the next several years from new environmental observing systems spanning NOAA's observational domains. Satellite operators, including NOAA, are developing more powerful instruments for remote sensing of the atmosphere, oceans, land, and space. These



2005–2015 Data Management Challenges

systems are expected to collect and transmit data at the rate of approximately 20 megabits per second (mbps), an order of magnitude increase from the current rate of data transfer (1–2 mbps). To collect, process, transmit, store, distribute, and use this increased volume of data effectively, NOAA, in concert with our partners in the private and public sector, must pursue technological improvements in communications, data compression, processing, and archiving.

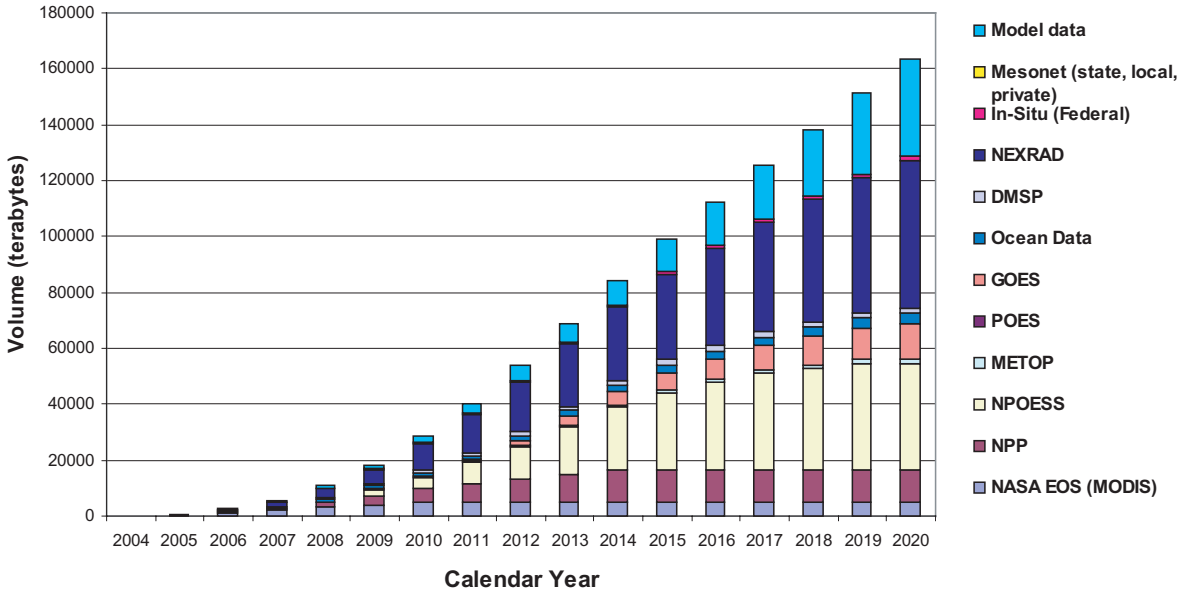


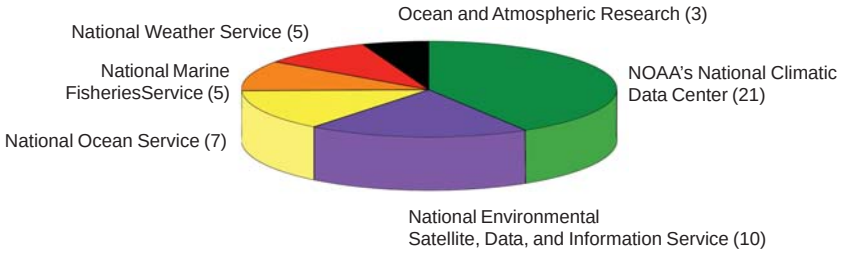
NOAA's Observation Domains

Current estimates from CLASS predict data archive growth to more than 160,000 terabytes (TB) by 2020. NOAA is addressing increases in the data archive with technological advances from the private sector such as high-density, robotic tape systems. However, significant challenges remain in describing, integrating, reprocessing, and enabling both real-time and archival access to these data so society can derive the full benefit of these national assets.

As shown in the 2005 Data Management Assessment Summary chart (previous page), NOAA also faces significant challenges related to acquiring, describing, and archiving the biological and ecological data required to protect, restore, and manage living coastal and ocean resources. To engage in an ecosystem-based approach to the Nation's coastal and marine resources, NOAA needs comprehensive fisheries-related environmental observations, continued research on protected species and marine mammals, and studies on climate change and environmental variability. NOAA is working with public and private partners, including the IOOS Regional Associations to provide data access, transport, and delivery for the Pacific Coast Ocean Observing System (PaCOOS). PaCOOS is the ecosystem observing backbone of IOOS for the California Current Large Marine Ecosystem.

Large-array data growth expected over 15 years. Current estimates predict data archive growth to more than 160,000 TB by 2020.





NOAA's 2005 CDMP Projects

Extend the Environmental Record

In addition to managing the increasing flow of data, NOAA must ensure its data and resulting products are accurate. This includes the reprocessing of past data and identifying and filling gaps to create high-quality long-term records of our environment. NOAA faces challenges in reprocessing data—addressing changes in instrumentation and observing capabilities.

In addition, much of the older data are stored on deteriorating or poorly accessible media. NOAA's CDMP partners with the private sector for the digitization of at-risk data. In 2005, NOAA supported 51 CDMP projects. NOAA resources are required to prepare data for digitization, and to review data quality after digitization, before making data available online. Both skilled stewards and smart technology are necessary to extend the environmental record.

Improve Accessibility

To realize the full benefit of its data, NOAA must support Earth observing systems with robust data transmission and complex, but flexible, data management systems. Developments in communication technologies by the commercial sector over the last decade have led to significant gains in the ability to access national data archives and real-time observations. However, exponential future growth in observations, model guidance, and demand for real-time access to these products will require continuous technology investments to protect recent gains.

NOAA faces a major challenge in enabling interoperability between legacy systems and emerging data systems. This lack of system interoperability, across NOAA and across agencies, hampers the collaborations enabled by technological gains. As super-computers enable increases in the temporal and spatial resolution of models, and demands increase for online access to large-array data, communication technologies and data management techniques must also evolve. Modernizing NOAA's data management through such programs as the Environmental Data Systems Modernization and TOC will address many of these challenges.

NOAA faces challenges from new environmental observation programs related to living marine resources, space and terrestrial weather, tsunami, and other environmental hazards. Many of these data system challenges will be addressed in the context of the national integrated ocean, surface, and upper-air observing systems. Technology and system developments will support the Federal Enterprise Architecture (FEA), and the U.S.

India's nighttime lights from three years (1992, 1998, and 2003) in a color composite. Color tones indicate changes in lighting between years.

NOAA reprocesses historical data from the U.S. Air Force Defense Meteorological Satellite Program for multiple uses. The lights provide a unique capability for detecting human settlements and activities such as fires, gas flares, and heavily lit fishing boats. The data are being used to model global population, density, the distribution of impervious surface area, and in estimating land development rates.

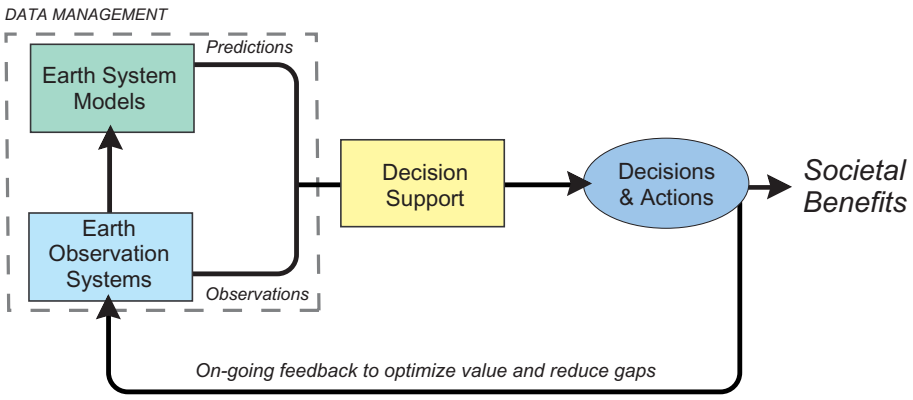
Group on Earth Observations (USGEO), and Group on Earth Observations (GEO) activities. Implementing these frameworks will take time, effort, and resources.

Enable Integration

NOAA is working with local, national, and international partners to strengthen cooperation in Earth observations. NOAA must enable integration of data across its observational domains and timescales to guarantee the best coverage and quality of Earth observing data. Integration and interoperability will be achieved through common protocols, hardware, and software, as well as the use of data and metadata standards. NOAA has begun this process by adopting a common enterprise-wide IT architecture, but significant work remains over the next decade. One major obstacle to integration is the lack of scientific lexicons describing data and observation parameters from NOAA's diverse observing environments and disciplines.

Improve Data Description

One of the major challenges of data management is ensuring the data collected remain accessible and usable. Acquiring data is no longer the major hurdle. Managing, validating, integrating, understanding, and reprocessing data are the new challenges. Scientists and policy-makers expect ready access to online data, including data mining tools, and the documentation necessary for understanding data (i.e., the where, when, how, and why describing data and instrumentation, including limitations, processing, and calibration methods). Documenting data is critical in preserving its usefulness through time.



As new sensor technologies are implemented, intercomparison of old and new technologies must be available. The data management challenge is not to store the data for history, but to keep data alive for the research community to continually exercise and apply to societal needs. Our Nation makes a large initial investment in the acquisition of data, an information asset NOAA must safeguard for current and future generations. Sustained and integrated Earth observations, supported by science and technology, will lead to societal benefits.

NOAA is better prepared now to ensure the reliable and efficient flow of quality data from observation source to real-time products. NOAA faces ongoing challenges in managing increasing diversity and volumes of data, enabling data integration, and addressing real-time dissemination demands. Significant challenges remain in data reprocessing and rescue, essential for extending the environmental record.

NOAA is in the initial stages of developing and implementing an integrated data management system, based on common IT architecture and common processes. This will address many of the challenges identified in the assessment. However, proper data stewardship also involves an understanding of the data's scientific value and thoughtful management for future use.

Near-Term Implementation Goals

NOAA's long-term objective is integrated information services delivering effective, efficient decision-support information where and when needed. Work in this area is underway today and will require concerted effort in the future. Customer needs drive the integration of NOAA information across disciplines, time scales, and federal, state, and local agencies. NOAA should provide products, services, and prediction capabilities delivering specific regional and local environmental information at all time scales relevant to decision makers. NOAA will take steps to accomplish this goal, including addressing the data management challenges identified

in the assessment. To accomplish this, NOAA will focus the next few years on the following implementation goals.

Identify and address integration gaps

NOAA is in the process of identifying technological and scientific integration gaps. NOAA will address these gaps and enable improved access to multi-disciplinary data and coupled model results so the scientific community can perform systematic comparisons.

Create interoperability across NOAA

NOAA can foster interoperability by integrating key capabilities, loosely combining legacy systems while developing new ways to support access to valuable data assets. NOAA will invest in developing sustainable interoperability across the federal government and partner organizations.

Develop and adopt standards for formats and terminology

NOAA subscribes to the value of, and need for, corporate standards. NOAA will define a process for adopting standards that is open and inclusive, favoring existing information technology and scientific standards.

Integrate measurements, data, and products

NOAA will provide easier and more cost-effective access to all of its data and information. NOAA will ensure data and products are collected and managed in accordance with policies, procedures, and standards that support and enhance integration.

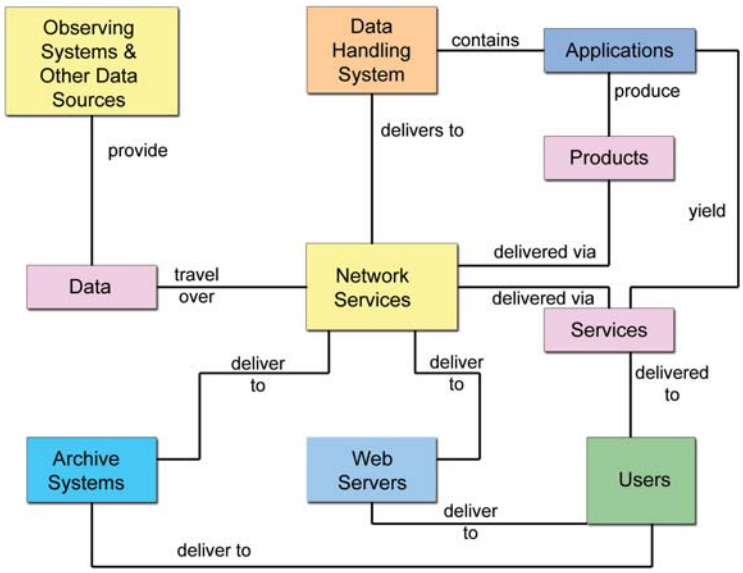
Examine future data management requirements

Data management consists of two major activities conducted in coordination: (1) data management services, and (2) data stewardship.

- **Data management services** occur at all phases of data collection and include adhering to agreed-upon standards; ingesting data, developing collections, and creating products; maintaining data bases; ensuring a permanent, secure archive; providing both user-friendly and machine-interoperable access; assisting users; migrating services to emerging technologies; and, responding to user feedback.

- **Data stewardship** consists of the application of rigorous analyses and oversight to ensure that datasets meet the needs of users. This includes documenting measurement and processing practices (metadata); providing feedback on observing system performance; validating datasets through intercomparisons; reprocessing (e.g., incorporate new data, apply new algorithms, perform bias corrections, integrate/blend datasets from different sources or observing systems); and, recommending corrective action for errant or non-optimal operations.

These activities constitute a comprehensive end-to-end process of movement of data and information from the observing system sensors to data users, including the acquisition, cataloging, documentation, quality control, validation, reprocessing, storage, retrieval, dissemination, and archival of data. NOAA will examine data management requirements to improve our management of the Nation's environmental data assets.



NOAA's IT Enterprise Network

Technological Components

NOAA's near-term goals address the challenges of integration and accessibility. In order to accomplish these goals and achieve the long-term objective of integrated data and information management, NOAA must also address the data volume, data gaps, and metadata challenges identified in the assessment. NOAA has specific programs, such as CLASS, TOC, and CDMP, to address some of these challenges, but must direct additional resources as required through the programming, planning, budgeting, and execution process.

The basis of NOAA's modernization plan is a robust, secure, common IT infrastructure supporting Web-based applications to acquire, process, and deliver data and information. NOAA is developing a baseline architecture for data management systems, with agency-wide information gathering underway at the beginning of FY 2006. Likewise, NOAA will analyze the data management systems, identify gaps and overlaps, establish priorities, and develop the data management systems target architecture.

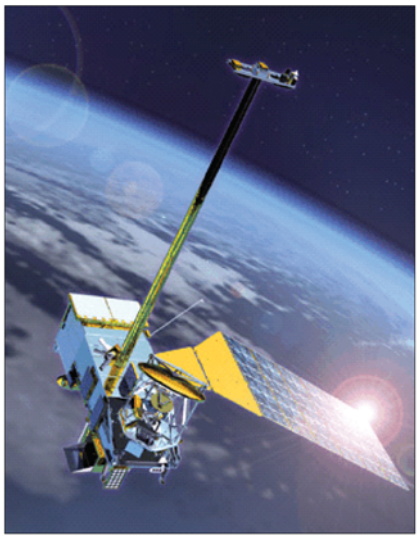
NOAA is preparing an enterprise-wide data management plan. The plan aims to retain existing systems where practical, while building a standards-based software infrastructure linking systems together. This service-oriented software architecture loosely couples independent programs to create scalable, extensible, interoperable, reliable, and secure systems. NOAA is committed to providing easy access to integrated data and information. One method to achieve this is to provide data in common spatial formats. NOAA is working with other federal agencies to develop a geographic information system profile for FEA.

NOAA is preparing for the explosive large-array data growth expected over the next 15 years. Current estimates predict data volume will grow to more than 160,000 TB by 2020. Efforts to address this increase in large array data on a program-level basis include the TOC, CLASS, the Earth Observing System (EOS) Data Archive, and the NPOESS Data Exploitation Project. Future NPOESS products will be developed and tested in preparation for NPOESS operations. By 2008, the NPOESS Preparatory Project (NPP) will provide prototypical products.

While looking toward the future, NOAA also recognizes that application of tools and processes in the near-term is critical. Initial emphasis is on improving methods to share and manage the data in our current holdings. NOAA is concurrently investing in technology components such as spatially enabled databases, Web-accessible open geographic information systems, and virtual data centers—enabling access to geographically dispersed databases through common software tools—to improve browse, visualization, and access to environmental data NOAA-wide. NOAA is also focusing on improving data compression and spectral management to improve transmission of, and access to, large volumes of data in real-time.

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 meteorological, 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. Current launch date is 2009, with the NPOESS Preparatory Project launch during 2006.



Facility Requirements

Modern facilities and IT infrastructure are essential for collecting and processing the environmental data required to accomplish NOAA's mission. In addition, changes and advances in IT infrastructure and facilities, including data collection platforms, impact NOAA's data management methods and capabilities. Technological improvements and NOAA's data management capabilities must advance together. During FY 2003–2005,

NOAA's David Skaggs Research Center, Boulder, Colorado

NOAA improved observing systems, platforms, and facilities. These improvements are discussed in Part 1, Mission Support Goal (page 45).

Implementation Activities

To accomplish our objectives, NOAA has further refined its corporate-wide processes over the last two years. These processes set the stage for modernization and improvement across the agency. NOAA revised its Strategic Plan, established the Offices of Program Planning and Integration, and Program Analysis and Evaluation. NOAA also established the Planning, Programming, Budgeting, and Execution System process. We are linking our business processes to our programmatic decisions and investment planning. Integrated information and data management, a Cross-cutting Priority in the 2005–2010 NOAA Strategic Plan, will be a consideration in those determinations. NOAA's process to assess required capabilities, compare them with current capabilities, and then examine the resulting shortfalls is becoming more mature. Each program carefully examines observing requirements and ranks their contribution to the achievement of NOAA's mission goals. Working with data users, NOAA has identified more than 300 unique observing environmental requirements. The users are involved directly in developing our requirements in NOAA's Consolidated Observation Requirements List. NOAA is prioritizing requirements and mapping requirements to systems. NOAA is also capturing attribute values to assist in meeting expectations of users in terms of frequency, timeliness, and accuracy—all-important factors that measure and manage information and data within an enterprise information system.

Modernization Programs

NOAA has several new and ongoing modernization programs focused on improving the acquisition, transmission, management, archive, and dissemination of its environmental data. These include AWIPS, TOC, Environmental Data Systems Modernization, the EOS Data Archive and Access, and CDMP, CLASS, and NPP. Under the DMC, NOAA's Data Management Integration Team is developing a data management plan to address key issues of integration, open formats and standards, a common data dictionary, and data flow. The systems will be consistent with, and supportive of, emerging national and international frameworks. Key criteria evaluated for compliance with these IT frameworks are change, integration, convergence, and business alignment. NOAA is making improvements in all of these areas, using open standards and protocols, consistent business rules, standard interfaces, sustained security, connectivity, and interoperability managed across the enterprise.

Integrated Observation and Data Management System

During FY 2006, NOAA will begin designing an integrated observation and data management system. The target architecture builds on existing systems, leveraging new technologies and standards-based development to integrate data across NOAA's observing environments, enabling NOAA's Mission Goals to provide timely and accurate products and information. The target architecture will be achieved through a series of steps, repeated annually, designed to gather, validate, prioritize, review, and execute the best options to establish a sustainable and affordable integrated observation and data management system.

NOAA will take full advantage of opportunities presented by the Internet to build a service-oriented software infrastructure that will enable data sharing and application interoperability. This approach will minimize impact while enabling effective and efficient integration of NOAA's current systems, many of which are critical to the national interest and must continue to function with no interruption of essential services. This approach relies on a well-ordered, standards-based data and information infrastructure—

including the supporting IT infrastructure.

Information Management Guide

Drawing on its experience in developing the IOOS DMAC plan, NOAA is preparing a guide on integrated information management to serve as a single point of reference for data management. The guide will include all relevant NOAA, national, and international standards. NOAA's IT infrastructure design is intended to:

- Keep hardware and software product mix and configuration as simple as possible;
- Make the ongoing maintenance and configuration management of security implementations as efficient as possible; and,
- Promote interoperability among implementations.

NOAA anticipates the future integrated system and evolving technology will make access to environmental data and information as easy and effective as accessing documents on the Web today. The integrated observation and data management system will be NOAA's contribution to the USGEO Integrated Earth Observation System (IEOS).

Balanced Capabilities

The target system will also look carefully at balanced capability across the IT enterprise, so that the increases in collection capability are also complemented with related increases in assimilation, modeling, and distribution capabilities in order to address user requirements. Our integrated modeling capability development maps back to user requirements, and forward to the development or acquisition of standard toolsets and products. NOAA intends to examine toolsets and data management processes being developed for the NPOESS and GOES-R systems, and include them in the core standard toolsets and data management processes.

CLASS is a critical capability and a key component of the infrastructure supporting NOAA's integrated observation and data system, providing permanent, secure storage, and safe, efficient Web-based data discovery to large-array data sets. NOAA will also examine the potential downstream expansion of CLASS infrastructure to include observing system data beyond its current intended use.

Work is ongoing across many other NOAA programs to ensure accurate, timely, and consistent data and products. Examples include PORTS, MADIS, and NOMADS.

PORTS now monitors its 24/7 oceanographic observation systems, performing automatic quality control on many different types of data and stopping availability to the public when suspect data are detected. In response to uncertain real-time observation performance and calibration, NOAA developed MADIS to integrate meteorological data from NOAA and many non-NOAA sources. MADIS generates statistics that characterize long-term stability and accuracy of observing systems, improving and automating data validation. NOMADS will complete the archive of numerical weather prediction products from NCEP, and integrate format-neutral and standards-based capabilities into CLASS. Under the CLASS umbrella, NOMADS model data services will be scaled toward a true, service-oriented architecture.

National and International Collaboration

NOAA works directly, and coordinates with, other federal organizations such as the U.S. Geological Survey's Earth Resources Observation and Science Data Center; NASA's Distributed Active Archive Center system; and the Department of Energy's Carbon Dioxide Information Analysis Center. These activities occur under the federal National Archives and Records Administration (NARA) umbrella for data preservation.

A NOAA–NASA Memorandum of Understanding addresses responsibilities for long-term preservation of atmospheric and

U.S. global maritime trade is projected to more than double before 2020. Currently, more than two billion metric tons of domestic and international waterborne cargo move on U.S. waterways each year.

National and International Data and Systems Initiatives

- August 2003. The Interagency Working Group on Earth Observations (IWGEO), established under the National Science and Technology Council (NSTC) Committee on Environment and Natural Resources, develops the U.S. 10-year plan and coordinates U.S. input into the GEO.
- April 2004. The Earth Observation Summit II adopts the GEO Framework identifying nine areas of societal benefits.
- February 2005. The Earth Observation Summit III adopts the GEO 10-Year Implementation Plan.
- March 2005. NSTC adopts USGEO as a subcommittee of the Committee on Environmental and Natural Resources, formalizing and replacing the IWGEO.
- March 2005. The Integrated Ocean Observing System adopts a Data Management and Communications Plan for Research and Operational Integrated Ocean Observing Systems.

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oceanic data. NOAA and NASA also participate in the Interagency Working Group on Data Management for Global Change whereby agencies have agreed to build interoperability among their data and information systems. In addition, NOAA and NASA collaborate in the development of the Joint Center of Satellite Data Assimilation, which accelerates the research-to-operations timeline of integrating new satellite observations into operational numerical weather prediction.

NOAA's National Data Centers (NNDCs) have formal federal responsibility for archive, management, and distribution of climate, oceanographic, and geophysical data and information. Stewardship of these data conforms to the rules, regulations, and procedures of NARA. Significant amounts of environmental data are also held temporarily by NOAA Centers of Data. The Centers of Data bring specific scientific expertise to the initial assimilation and management of observational data. While not held to NARA standards, Centers of Data are held to high expectations of data management before transferring data to the appropriate Data Center.

The Climate Change Science Program Office provides a mechanism for federal coordination of climate data preservation, recognizing NCDC as the formal climate data center for federal climate programs. The Oceans.US coordinating umbrella provides a similar federal coordination mechanism for oceanographic data, recognizing NODC as the data center for oceanographic data.

The NNDCs are national and world repositories of climate, oceanographic, and geophysical data, operating seven of the 15 World Data Centers (WDC) in the U.S. The WDC system, operated under the auspices of the International Council on Science, now comprises 52 Centers in 12 countries, archiving and distributing international observational data including a wide range of solar, geophysical, environmental, and human dimensions data covering time scales ranging from seconds to millennia. These data provide baseline information for research in many disciplines.

In addition to the WDC system, NOAA closely supports several other intergovernmental and international organizations. NOAA's National Data Centers cooperate with international organizations to develop, archive, and distribute global baseline data sets. These include the World Meteorological Organization (WMO) for climate and sea ice global change monitoring; the Intergovernmental Oceanographic Commission (IOC), which maintains the International

By 2007, NOAA will expand its Deep-ocean Assessment and Reporting of Tsunamis network to 39 stations to cover the Pacific Ocean, Caribbean Sea, and East coast of the United States, supporting GEO Task DI-0601.

Tsunami Information Centre, hosted by NOAA; and the International Hydrographic Organization (IHO), an intergovernmental consultative and technical organization established to support safety in navigation and the protection of the marine environment.

NOAA has a commitment to the WMO's World Weather Watch Program, operating the World Meteorological Center–Washington at the National Centers for Environmental Prediction. NOAA's National Data Centers share this responsibility through their archive and distribution duty. In addition, NOAA's NGDC is responsible for the IHO Data Center for Digital Bathymetry and regional mapping projects.

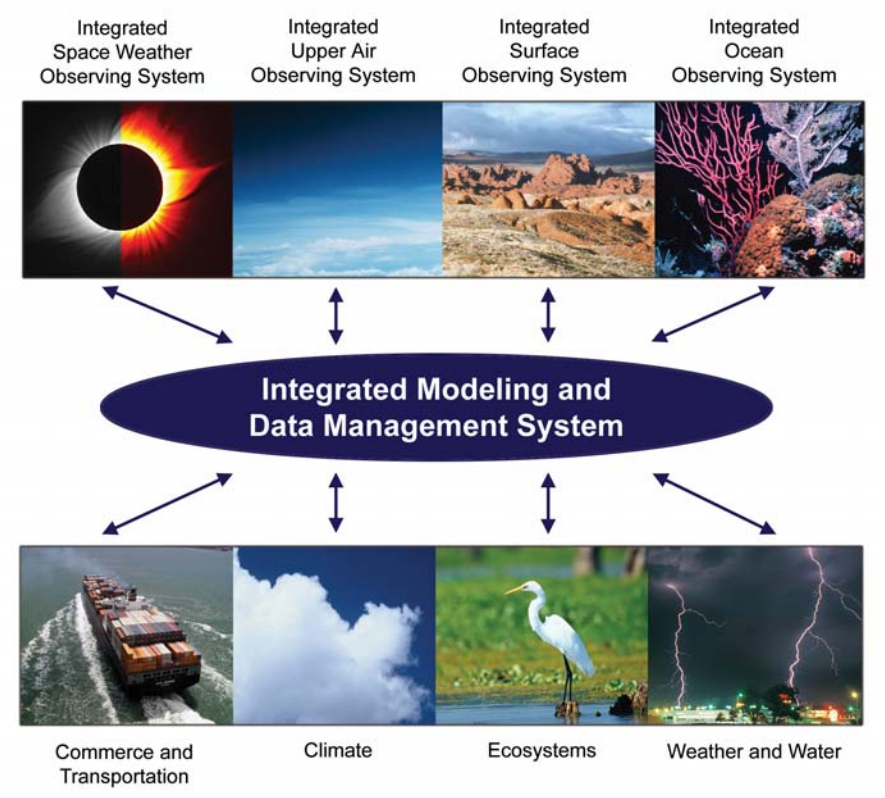
NCDC serves as a GCOS Lead Data Center. GCOS is the formal climate component of the GEO and, as such, coordinates a range of data management, data archive, and monitoring activities with data centers in many countries including Australia, Germany, Japan, and the United Kingdom. NOAA's participation in the USGEO, along with other federal agencies, will result in increased data and information exchange and migration toward adoption of common tools and processes, benefiting both the IEOS and GEOSS.

Through participation and leadership in national observing efforts, including IOOS, which is the U.S. contribution to GOOS, ISOS, and IUOS, NOAA can further integrate its observing systems, data, and quality control with efforts of other nations to guarantee the best quality and coverage of Earth observing data.

We will continue to work with local, national, and international partners to develop an integrated global-to-local environmental and ecological observation and data management system that will continually monitor the complex, symbiotic systems of the ocean, atmosphere, and land.

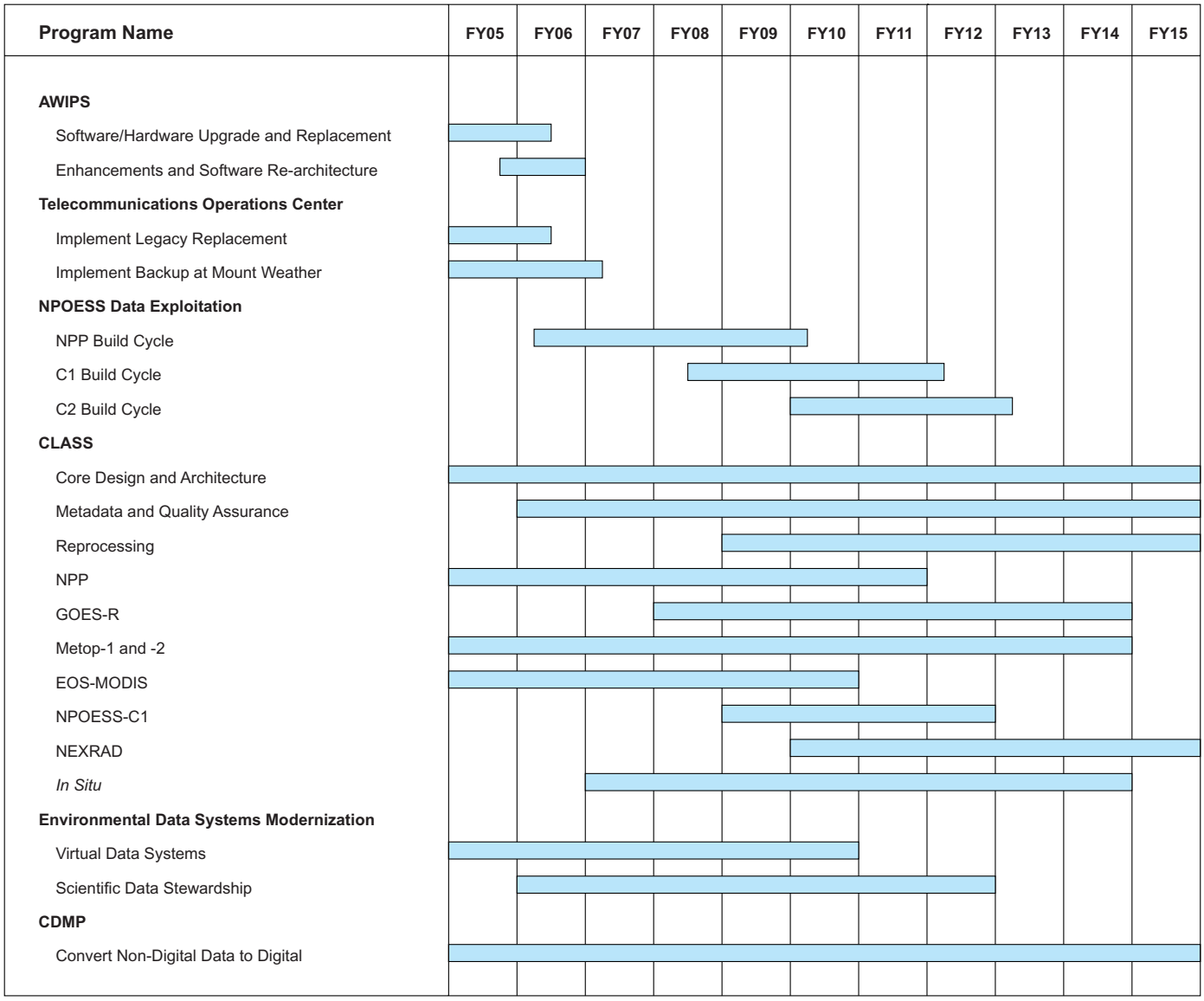
Implementation Schedule

NOAA relies on advanced observing systems, assimilation capabilities, and numerical models to accomplish its mission. All of these efforts require, and therefore include, data management as an integral part of their operations. For example, orbiting satellites include advanced data acquisition, transmission, and reception at ground stations, followed by data processing, product generation (often based on models), and



Operational view of NOAA's target architecture. National observing systems will benefit from NOAA's integrated modeling and data management system, and enhance NOAA's four Mission Goals. The reverse is also true. NOAA's four Mission Goals are critical components of systems such as IOOS, ISOS, and IUOS, which depend on improved integration of NOAA data and observations.

The NOSC and DMC will ensure that NOAA's efforts are consistent with, and supporting of, emerging national and international frameworks such as GEOSS, IEOS, and the Federal Enterprise Architecture.



Implementation schedule for NOAA data and information modernization projects.

dissemination of data products to customers.

NOAA identified several projects to modernize data management. The projects address real-time acquisition, processing, and distribution; modeling, reprocessing, and rescue; and, description, archive, and access. These modernization projects are a critical part of the total NOAA data management effort. Major milestones and implementation dates for these modernization projects are shown in the implementation schedule chart.

Some of these data management modernization activities are ongoing. These include improved data acquisition and delivery (e.g., AWIPS and TOC), data rescue (e.g., CDMP), data archive (e.g., CLASS and EOS), and data system interoperability and metadata (e.g., Environmental Data Systems Modernization). These various modernization efforts are in differing stages of maturity, but all of these capabilities support NOAA's development of a comprehensive, coordinated, and sustained Earth observation system to collect, process, disseminate, and archive improved data, information, and models.

The positive impacts of NOAA's modernization efforts are evident in the results of the internal assessment. For example, the Collect and Rescue effort in the Climate Goal is green, indicating adequate resource to support this effort. This is due in large part to the impact of CDMP, which focused on the rescue of climate records. The other three NOAA Goals show yellow or red, indicating the need for additional resources to support their data rescue needs. Similarly, the Access/Disseminate activity is green for Weather and Water, due in part to the success of the TOC and AWIPS modernization effort, while the other Goals show additional resource requirements.

The assessment in Part 1 contains more details on other examples of data management modernization in the last few years.

The first step in improving data management is rapid, reliable acquisition, processing, and distribution of real-time data and products. The ongoing improvements to NOAA's TOC and AWIPS help to address these challenges. The TOC is NOAA's 24x7 nerve center for real-time environmental data dissemination, monitoring the Global Telecommunication System, AWIPS, Wide Area Forecast System, NOAA Weather Wire Service, and NWR status. In addition to these national and international circuits, the TOC also maintains connectivity with the Department of Defense, Federal Aviation Administration, and Department of Homeland Security. During FY 2006–2007, the TOC will complete the upgrade to message switch capabilities and implement a backup facility at Mount Weather, Virginia, to ensure uninterrupted operations and manage the increased flow of data. The TOC replacement is designed to meet future data volume requirements, with expansion capacity to 500 percent of the current average traffic volume.

AWIPS processes and overlays multiple data sources to allow local Weather Forecast Offices and River Forecast Centers to generate weather and water forecasts and warnings. It continually evolves to accommodate new science and technology to meet strategic goals. The ongoing AWIPS modernization efforts include increasing system performance, functionality, and improving forecasts and warning timeliness. The TOC and AWIPS modernization efforts will help ensure continuous acquisition and dissemination of NOAA and other domestic and foreign data and products.

The NPOESS Data Exploitation (NDE) and CLASS projects will improve the efficiency of NOAA's environmental satellite data processing, product dissemination, archive, and access capabilities. NDE is implementing a new ground system that permits sharing of databases, tools, and science across various scientific disciplines. Once established, the project's approach to data processing and dissemination will set the stage for other observing missions to share vast volumes of data across their platforms. NDE organized build cycles into phases for Customer Coordination, Design, Construction, Test, and Systems Integration. Each phase has checkpoints for review and approval of the set of deliverables for that phase.

NDE will also improve metadata generation to help meet the requirement that all NPOESS metadata abide by approved standards, establish sound quality control

Selected modernization achievements over the last two years:

- CLASS architecture design, including System Documentation, was completed.
- NOAA delivered CLASS baseline systems to Suitland and Asheville with dual-site configuration. Operational, test, and development environments were established in Suitland.
- CLASS became operational with POES, DMSP, and GOES datasets, plus RadarSat (Synthetic Aperture Radar) and SeaWiFS (Ocean Color Product).
- The TOC upgraded message switch capabilities to better serve federal and private sector real-time environmental data needs.
- MADIS is now collecting, formatting, analyzing, assessing quality, and redistributing real-time data from more than 13,000 non-NOAA surface Mesonet stations.

measures of the ingest data, and to facilitate retrospective data processing for scientific research and analysis. Tools developed through NDE will support the access and archive through CLASS.

When operational, CLASS will manage the archive; maintain the metadata; and, support access to retrospective environmental data assets and products, including EOS. CLASS will achieve this through a common data access look and feel, and an efficient architecture for archive and distribution. CLASS will foster the use of advanced visualization and geospatial information systems data discovery techniques, and provide access to its own archives as well as to other data collections described in the metadata repository. Performance tasks include automated quality assurance processes on ingested data to ensure readability, detecting transmission errors, ensuring compliance with data set format agreements, and assessing record quality indicators. CLASS supports the efforts under development in the Environmental Data Systems Modernization project.

The Environmental Data Systems Modernization project planned for FY 2006–2015 focuses on developing an integrated, virtual NOAA data system and improving the scientific stewardship of NOAA data. The Scientific Data Stewardship Program, a new NOAA initiative in FY 2006, will provide high-quality climatologies of the atmosphere, oceans, and Sun-Earth geophysical environment. Tasks include monitoring observing systems, generating near real-time climate records, reprocessing, and generating new products—made possible by extending the data record through reprocessed or rescued data.

CDMP focuses mainly on converting non-digital data and records (e.g., paper, microform, publications) to digital formats for online access and digital archiving, extending the data record. During FY 2006–2015, CDMP's major function is to acquire relevant data and metadata, converting around 80–110 million records per year, and making these data easily accessible via the Internet.

Over the coming years, the results of the data management assessment, along with the other tools mentioned in this report, will be used by NOAA to develop implementation plans to address significant data management gaps. Some of these areas can be addressed by evolving existing efforts; others will require new modernization efforts. The combination of requirements-based programming, implementation of an overarching IT architecture, and careful assessments of data management needs by NOAA Program will lead to effective use of existing resources and identification of future needs.

Conclusion

NOAA's first assessment of data management capabilities by Mission Goal provided valuable insight into the progress and challenges facing NOAA Programs today. NOAA has made strides in the improved planning, acquisition, archive, and dissemination of Earth environmental data. Based on the data management assessment by NOAA Program, NOAA is better prepared now to ensure the reliable and efficient flow of quality data from observation source to real-time products to secure long-term archive and research efforts. Despite significant improvements, NOAA still faces challenges in:

- managing growing data diversity and volume;
- collecting and rescuing data at risk;
- improving accessibility;
- improving data descriptions (metadata); and,
- enabling integration across platforms and disciplines.

NOAA is in the process of designing and implementing an integrated observation and data management system of systems. The backbone of this system is a robust, secure IT infrastructure. NOAA has developed an IT Enterprise Architecture and is now developing a NOAA-wide data management plan to enable standards-based integrated access to data and information. NOAA is in the process of documenting operational requirements, addressing the functionality of our legacy observing and data management systems, and determining enterprise practices, policies, standards, and protocols.

NOAA has a strategic plan in place and is currently developing an integrated data management plan addressing the key next steps of:

- identifying and addressing integration gaps;
- creating interoperability across NOAA;
- developing and adopting standards for formats and terminology;
- integrating measurements, data and products; and,
- examining future requirements.

NOAA is committed to collecting and providing the highest quality environmental data delivered in a secure and efficient manner and maintained in a stable, long-term archive for future generations. Investments must focus on people, tools, and technology, and also an integrated approach to observation and data management. This approach will ultimately serve a diverse set of users, thereby realizing a wide range of benefits for our people, our economy, and the planet on which we live.

Appendix A. Legislative Mandates

P.L. 102-567, SEC. 106: Data and Information Systems

(c) NEEDS ASSESSMENT FOR DATA MANAGEMENT, ARCHIVAL, AND DISTRIBUTION
(1) Not later than 12 months after the date of enactment of this Act and at least biennially thereafter, the Secretary of Commerce shall complete an assessment of the adequacy of the environmental data and information systems of the National Oceanic and Atmospheric Administration. In conducting such an assessment, the Secretary shall take into consideration the need to:

(A) provide adequate capacity to manage, archive, and disseminate environmental data and information collected and processed, or expected to be collected and processed, by the National Oceanic and Atmospheric Administration and other appropriate departments and agencies;

(B) establish, develop, and maintain information bases, including necessary management systems, which will promote consistent, efficient, and compatible transfer and use of data;

(C) develop effective interfaces among the environmental data and information systems of the National Oceanic and Atmospheric Administration and other appropriate departments and agencies;

(D) develop and use nationally-accepted formats and standards for data collected by various national and international sources; and,

(E) integrate and interpret data from different sources to produce information that can be used by decision makers in developing policies that effectively respond to national and global environmental concerns.

(2) Not later than 12 months after the date of enactment of this Act and biennially thereafter, the Secretary of Commerce shall develop and submit to the Committee on Commerce, Science, and Transportation of the Senate and the Committee on Science, Space, and Technology of the House of Representatives a comprehensive plan, based on the assessment under paragraph (1), to modernize and improve the environmental data and information systems of the National Oceanic and Atmospheric Administration. The report shall:

(A) set forth modernization and improvement objectives for the 10-year period beginning with the year in which the plan is submitted, including facility requirements and critical new technological components that would be necessary to meet the objectives set forth;

(B) propose specific agency programs and activities for implementing the plan;

(C) identify the data and information management, archival, and distribution responsibilities of the National Oceanic and Atmospheric Administration with respect to other Federal departments and agencies and international organizations, including the role of the National Oceanic and Atmospheric Administration with respect to large data systems like the Earth Observing System Data and Information System; and,

(D) provide an implementation schedule and estimate funding levels necessary to achieve modernization and improvement objectives.

NAO 212-15: Management of Environmental and Geospatial Data and Information

SECTION 1. PURPOSE.

This Order establishes a National Oceanic and Atmospheric Administration (NOAA) policy for acquiring, integrating, managing, disseminating, and archiving environmental and geospatial data and information obtained from worldwide sources to support NOAA's mission.

SECTION 2. SCOPE.

This Order applies to all NOAA environmental and geospatial data and to the personnel and organizations that manage these data, including Line Offices, Program Managers, NOAA National Data Centers, and Centers of Data.

SECTION 3. POLICY.

.01 NOAA environmental and geospatial data will be maintained in accordance with applicable Office of Management and Budget (OMB) regulations, including OMB Circulars A-16 and A-130; Federal Geographic Data Committee (FGDC) approved data standards; Federal law related to records management within Federal agencies - Sections 3101-3107 of Title 44 of the United States Code (44 U.S.C. 3101-3107); the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.); and National Archives and Records Administration (NARA) Records Management Regulations - Parts 1220-1238 of Title 36 of the Code of Federal Regulations (36 CFR 1220-1238).

.02 NOAA data management planning will include end-to-end data stewardship.

.03 For major systems acquisitions, any exception to including validated data requirements shall be outlined in a decision memorandum to the Under Secretary of Commerce for Oceans and Atmosphere before funding is sought.

SECTION 4. RESPONSIBILITIES.

.01 The NOAA Chief Information Officer (CIO) shall be responsible for implementing and managing this Order in consultation with the CIO Council.

.02 Each NOAA Program Manager shall:

a. support NOAA's mission for stewardship of the Nation's environmental and geospatial data and information throughout the process of acquiring, archiving, integrating, and disseminating such data and information;

b. develop a data management plan in coordination with the appropriate data center, specifying the data life cycle and disposition of data and information for each Program;

c. ensure that during the initial planning of new Programs, NOAA Line and Staff Office requirements for new data are identified;

d. take appropriate steps to ensure acceptable accuracy, precision, representativeness, documentation, and long-term continuity of NOAA's quality datasets for the user community;

e. be alert to and mitigate the risks caused by changes of instruments, platforms, locations, and methods for observing or processing data;

f. comply with Section 515 of Public Law 106-554 to ensure and maximize the quality of information disseminated by NOAA - scientific procedures shall be followed to ensure quality control and calibration of the data; and,

g. cooperate with other agencies to ensure compatibility between the recorded observations of each agency to the maximum extent practicable.

.03 Each Line Office shall determine, in accordance with applicable law, regulations, and policy; where, when, and/or how its environmental and geospatial data and information are archived and how they are made available. Data are considered, and are to be treated as, corporate assets.

.04 NOAA National Data Centers and Centers of Data shall:

a. maintain an environmental data and information metadata catalog;

b. protect and preserve their environmental data and information holdings; and,

c. make their holdings accessible to users under uniform guidelines.

SECTION 5. DEFINITIONS.

.01 Environmental Data - recorded observations and measurements of the physical, chemical, biological, geological, or geophysical properties or conditions of the oceans, atmosphere, space environment, sun, and solid earth, as well as correlative data and related documentation or metadata. Media, including voice recordings and photographs, may be included.

.02 Geospatial Data - information that identifies the geographic location and characteristics of natural or constructed features and boundaries on Earth. This information may be derived from, among other things, remote sensing, mapping, and surveying technologies. Statistical data may be included in this definition at the discretion of the collecting agency.

.03 Information Quality - a term prescribing requirements for objectivity (accuracy and absence of bias), utility (usefulness), and integrity (protection from unauthorized disclosure or changes) associated with data disseminated by Federal agencies.

.04 NOAA National Data Centers are major archives that maintain, process, and distribute retrospective environmental and geospatial data. The Centers provide long-term stewardship for most of NOAA's environmental and geospatial data and a broad range of user services. The Centers serve as Agency Record Centers subject to NARA-accepted archive standards. NOAA National Data Centers may be composed of two or more archive facilities linked together through a computerized wide area network.

.05 Centers of Data are facilities where extensive collections of a given environmental parameter(s) are maintained because of individual or institutional research or operational requirements (e.g., the National Ice Center). The Centers of Data, which are not held to all the NARA archive standards, must still adhere to basic good stewardship practices including off-site data backup and maintenance of adequate environmental control and security for their holdings. Centers of Data transfer their data holdings to the NOAA National Data Centers for permanent archiving when continued storage at the Center of Data is no longer appropriate.

.06 Program Managers, for purposes of this Order, are those individuals who have overall responsibility for the collection or acquisition of data or information. This responsibility extends from the Assistant Administrator level down to the individual manager who is most directly involved in the conduct and outcome of a particular Program (e.g., a specific field Program).

.07 Data management is the control of data handling operations such as planning, data acquisition, quality control and validation, reprocessing, storage, retrieval, and dissemination of data. Data management services include maintaining active data bases, documenting algorithm development, providing interactive access to both Program data and data from other sources, data handling, and assisting secondary users with access to collected data.

SECTION 6. REFERENCES.

The Office of the Chief Information Office (OCIO) will maintain a list of applicable reference materials and will provide access to their electronic editions on the OCIO Web site at http://www.cio.noaa.gov. The following items are some of the primary reference materials related to this Order.

.01 "Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility, and Integrity of Information Disseminated by Federal Agencies" - OMB issuance that implements Section

515 of Public Law 106-554; intended to "provide policy and procedural guidance to Federal agencies for ensuring and maximizing the quality, objectivity, utility, and integrity of information (including statistical information) disseminated by Federal agencies.''

.02 NOAA Information Quality Guidelines - NOAA's policy and procedures document implementing Section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001 (Public Law 106-554).

.03 NOAA Information Technology Architecture - contains the Archive and Access segment; NOTE: restricted access - those seeking access to the document must obtain a user identification and password from the OCIO.

.04 NOAA Records Disposition Handbook - documents NOAA's records disposition schedules.

.05 Federal law related to records management within Federal agencies (44 U.S.C. 3101-3107) and the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.).

.06 National Archives and Records Administration (NARA) records management regulations (36 CFR 1220-1238).

.07 OMB Circular A-l6, Coordination of Geographic Information and Related Spatial Data Activities.

.08 OMB Circular A-130, Management of Federal Information Resources.

.09 The E-Government Act of 2002 (44 U.S.C. 3602 et seq.) - promotes enhanced access to Federal Government information and services in a manner consistent with laws and regulations.

SECTION 7. EFFECT ON OTHER ISSUANCES: None.

(signed)
Under Secretary of Commerce for Oceans and Atmosphere

Office of Primary Interest: NOAA Office of the Chief Information Officer (OCIO)

P.L. 106-554: FY 2001 Consolidated Appropriations Act

Sec. 515. (a) In General. – The Director of the Office of Management and Budget shall, by not later than September 30, 2001, and with public and Federal agency involvement, issue guidelines under sections 3504(d)(1) and 3516 of title 44, United States Code, that provide policy and procedural guidance to Federal agencies for ensuring and maximizing the quality, objectivity, utility, and integrity of information (including statistical information) disseminated by Federal agencies in fulfillment of the purposes and provisions of chapter 35 of title 44, United States Code, commonly referred to as the Paperwork Reduction Act.
(b) Content of Guidelines. – The guidelines under subsection (a) shall –
(1) apply to the sharing by Federal agencies of, and access to, information disseminated by Federal agencies; and,

(2) require that each Federal agency to which the guidelines apply –

(A) issue guidelines ensuring and maximizing the quality, objectivity, utility, and integrity of information (including statistical information) disseminated by the agency, by not later than 1 year after the date of issuance of the guidelines under subsection (a);

(B) establish administrative mechanisms allowing affected persons to seek and obtain correction of information maintained and disseminated by the agency that does not comply with the guidelines issued under subsection (a); and

(C) report periodically to the Director –

(i) the number and nature of complaints received by the agency regarding the accuracy of information disseminated by the agency; and

(ii) how such complaints were handled by the agency.

Paperwork Reduction Act References in the Data Quality Law

As quoted above, section 515 of the new Data Quality law notes that its provisions are in furtherance of certain key provisions of the Paperwork Reduction Act (PRA) (44 U.S.C. Chapter 35). The following are the PRA referenced in the Data Quality law.

§ 3501. Purposes
"The purposes of this chapter are to –. . .
(2) ensure the greatest possible public benefit from and maximize the utility of information ... disseminated by or for the Federal Government;. . .
(4) improve the quality and use of Federal information to strengthen decision making, accountability, and openness in Government and society;. . .
(7) provide for the dissemination of public information on a timely basis, on equitable terms, and in a manner that promotes the utility of the information to the public and makes effective use of information technology;. . .
(9) ensure the integrity, quality, and utility of the Federal statistical system;. . .
(11) improve the responsibility and accountability of the Office of Management and Budget and all other Federal agencies to Congress and to the public for implementing the ... policies and guidelines established under this chapter."

§ 3504. Authority and functions of the Director. . .
"(d) With respect to information dissemination, the Director shall develop and oversee the implementation of policies, principles, standards, and guidelines to –
(1) apply to Federal agency dissemination of public information, regardless of the form or format in which such information is disseminated; ...."

§ 3516. Rules and regulations
"The Director shall promulgate rules, regulations, or procedures necessary to exercise the authority provided by this chapter."

Appendix B. Template for Assessing Data Management, Archival, and Distribution

Environmental Data Management Report to Congress

Under Public Law (P.L.) 102-567 Section 106 (c) and (2), NOAA must complete and report to Congress an assessment of the adequacy of our environmental data and information systems. Many efforts are currently underway within NOAA to assess requirements within our Programs, including the Program Baseline Assessments (PBA), NOAA Observing System Architecture (NOSA), and NOAA's Coordinated Observation Requirements List (CORL). To reduce the impact of these numerous data calls and to ensure a consistent message, we are asking Program Managers for help in preparing the report to Congress. The attached questionnaire and worksheets, based on NOAA's response to P.L. 106-554 Section 515 (Information Quality Act) and P.L. 102-567 reporting requirements, will be used to evaluate the current and near-future environmental data management requirements of each Program and develop an over-arching understanding of both the current status and future needs for end-to-end data management in NOAA. Your prompt attention and cooperation is essential to the success and quality of this report to Congress and will provide input to several related efforts in data management in NOAA. *Thank you for your help.*

Background

P.L. 102-567 Requirement: Every two years NOAA will assess whether there is adequate capacity to:

- manage, archive, and disseminate environmental data and information collected and processed, or expected to be collected and processed, by the NOAA and other appropriate departments and agencies;
- establish, develop, and maintain information bases, including necessary management systems that will promote consistent, efficient, and compatible transfer and use of data;
- develop effective interfaces among the environmental data and information systems of NOAA and other appropriate departments and agencies;
- develop and use nationally accepted formats and standards for data collected by various national and international sources; and,
- integrate and interpret data from different sources to produce information that can be used by decision makers in developing policies that effectively respond to national and global environmental concerns.

For the purpose of this report, we are assessing the capacity at the Program level and summarizing the Programs by NOAA Goal. At the Program level, we are assessing our capability to: (1) acquire and transmit observations needed by the Program (NOAA and non-NOAA source); (2) validate and describe the observations, scientific data, and products; and, (3) archive and provide discovery and access to these data and products in such a way as to enable integration across platforms and disciplines.

NOAA data streams are broken into the following six categories modified from P.L. 106-554 Section 515 (The Information Quality Act):

1. *Original Data* are data in their most basic, useful form. These are data from individual times and locations that have not been summarized or processed to higher levels of analysis. While these data are often derived from other direct measurements (e.g., spectral signatures from a chemical analyzer, electronic signals from current meters, and raw radar level II data), they represent properties of the environment. These data can be disseminated in both real time and retrospectively. Examples of original data include buoy data, survey data (e.g. living marine resource and hydrographic or aeromagnetic surveys), biological and chemical properties, weather observations, and satellite data (e.g., solar x-ray imager).

2. Synthesized Products are those that have been developed through analysis of original data. This includes analysis through statistical methods; model interpolations, extrapolations, and simulations; and combinations of multiple sets of original data. While some scientific evaluation and judgment is needed, the methods of analysis are well documented and relatively routine. Examples of synthesized products include summaries of fisheries landings statistics, weather statistics, model outputs, data display through geographic information system techniques, precipitation estimates from radar data, and satellite-derived maps.

3. Interpreted Products are those that have been developed through interpretation of original data and synthesized products. In many cases, this information incorporates additional contextual and/or normative data, standards, or information that puts original data and synthesized products into larger spatial, temporal, or issue contexts. This information is subject to scientific interpretation, evaluation, and judgment. Examples of interpreted products include journal articles, scientific papers, technical reports, and production of, and contributions to, integrated assessments.

4. Warnings, Forecasts, and Advisories are time-critical interpretations of original data and synthesized products, prepared

under tight time constraints and covering relatively short, discrete time periods. As such, these warnings, forecasts, and advisories represent the best possible information in given circumstances. They are subject to scientific interpretation, evaluation, and judgment. Some products in this category, such as weather forecasts, are routinely prepared. Other products, such as tornado warnings, hazardous chemical spill trajectories, and solar flare alerts, are of an urgent nature and are prepared for unique circumstances.

5. Natural Resource Plans are information products that are prescribed by law and/or regulation and have content, structure, and public review processes (where applicable) that are based upon published standards (e.g., statutory or regulatory guidelines). These plans are a composite of several types of information (e.g., scientific, management, stakeholder input, policy) from a variety of internal and external sources. Examples of Natural Resource Plans include fishery, protected resource, bio-environment, and sanctuary management plans and regulations, and natural resource restoration plans.

6. Experimental products are products that are experimental (in the sense that their quality has not yet been fully determined) in nature, or are products that are based in part on experimental capabilities or algorithms. Experimental products fall into two classes, either (1) disseminated for experimental use, evaluation, or feedback, or (2) used by qualified scientists in current situations where the timely flow of vital information is crucial to human health, safety, or the environment or the danger to human health, safety, or the environment will be lessened if every tool available is used. Examples of experimental products include imagery or data from non-NOAA sources, algorithms currently being tested and evaluated, experimental climate forecasts, and satellite imagery processed with developmental algorithms for urgent needs (e.g., wildfire detection).

Major NOAA data streams are typically housed with NOAA Data Centers or NOAA Centers of Data.

NOAA Data Centers: NOAA National Data Centers are major archives that maintain, process, and distribute retrospective environmental and geospatial data. The Centers provide long-term stewardship for most of NOAA's environmental and geospatial data and a broad range of user services. The Centers serve as Agency Record Centers subject to National Archives and Records Administration (NARA) accepted archive standards. NOAA National Data Centers may be composed of two or more archive facilities linked together through a computerized wide area network. NOAA Data Centers strive to meet the requirements of an Open Archival Information System, including:

- Negotiate for, and accept appropriate information.
- Obtain sufficient control of the information provided to ensure Long-Term Preservation.
- Determine, either by itself or in conjunction with other parties, which communities should become the Designated Community and, therefore, should be able to understand the information provided.
- Ensure that the information to be preserved is independently understandable to the Designated Community.
- Follow documented policies and procedures, so that information is preserved against all reasonable contingencies, and enables the information to be disseminated as authenticated copies of the original, or as traceable to the original (i.e., on-site and off-site storage of data, regular refreshment and replication of data media.).
- Make the preserved information available to the Designated Community.

NOAA Centers of Data: NOAA Centers of Data are facilities where extensive collections of a given environmental parameter(s) are maintained because of individual or institutional research or operational requirements (e.g., the National Ice Center). The Centers of Data, which are not held to all the NARA archive standards, must still adhere to basic good stewardship practices including off-site data backup and maintenance of adequate environmental control and security for their holdings. Centers of Data transfer their data holdings to the NOAA National Data Centers for permanent archiving when continued storage at the Center of Data is no longer appropriate. The National Data Buoy Center, Climate Research Data Center, Continuously Operating Reference Stations, and Atlantic Oceanographic and Meteorological Laboratory Global Ocean Observing System Center are examples of NOAA Centers of Data.

Introduction

As Programs assess the adequacy of their environmental data and information systems, it is important to encompass all the data each Program requires to accomplish its objectives, as well as any products generated by the Program. Business contingency planning is an integral element of any comprehensive assessment of data management capability. Data management practices for Program-essential activities need to assess contingency planning for all sources of mission-critical data, whether such data is obtained from NOAA or non-NOAA sources. Where critical data (or information systems) are obtained from non-NOAA sources, the Program Manager should consider the contingency planning in place at the organization or agency providing the data or information service critical to the essential NOAA mission. Similarly, the Program Manager must consider the entire business process for reconstitution of the function at the Program level (i.e., if data are archived off-site, do applications used to access information in the archive require extensive periods to configure and reach operational status? Do personnel at the

archive site have access to the necessary systems?).

Materials Provided

To assist in the data management assessment, a questionnaire, answer sheet, data worksheet, and Program Worksheet are provided. The questions in the questionnaire must be answered once for each of the six data and product categories applicable to the Program (defined above: Original Data, Synthesized Products, Interpreted Products, Warnings/Forecasts/Advisories, Natural Resource Plans, and Experimental Products). Programs may fill in either the Answer document, the Data Worksheet (Excel), or both for each of the applicable of the six categories. Each Program must also provide at least one completed Program Worksheet (Excel). Please return the completed Program Worksheet and any Answer sheets or Data Worksheets to your Writing Team contact. Members of the Writing Team are available to work with you at any and all phases of preparing the Program response.

Questions for NOAA Program Managers

Please answer all of the questions below, using the accompanying answer sheet, once for each of the six data and information categories (see background, above) relevant to the Program. Please save your responses with unique file names. All of the questions below cover the current and near-future. The questions are organized around four broad themes of data and information management: observation acquisition and transmission, scientific data management, archive and access, and contingency planning.

Responses to Five-Year Plan Questions:

F. Plan completed and in place
P. Plan partially completed
N. No plan

Responses to Other Questions:

A. Excellent shape or doing with existing resources
B. Partially accomplished or need incremental additional resources
C. Not accomplished or need substantial increase in resources to accomplish

If the appropriate response is (C), please describe the particular needs not being met in the comments section below the question. Also please comment on the Programs accomplishments and special needs at the end of the questionnaire.

Observation Acquisition and Transmission

Five-Year Plan

1. Does the Program have plan in place (i.e., NOSA, CORL, PBA) for the next five years of observational needs identifying and documenting at least of the following: observational requirements, adequate observing systems hardware and software, bandwidth for transmission of data?

Maintain and Monitor

2. Are all of the Program's observations currently being collected in a manner sufficient to meet Program needs (i.e., are there adequate backup systems and appropriate automated monitoring to ensure accurate, complete, and secure data collections, and are appropriate automated monitoring systems in place to monitor system drifts, evaluate observational biases, or detect other changes in system status)?

Collect and Rescue

3. Have historical observations (e.g., digital aging media, non-digital, and physical samples) relevant to the Program been identified and/or inventoried and rescued?

Scientific Data Management

Five-Year Plan

4. Does the Program have a plan in place (i.e. NOSA, CORL, PBA) for the next five years of observation management needs identifying and documenting at least the following: automated methods of monitoring observing systems and automated methods for processing data, including calibration and validation of data quality and recording processing in appropriate metadata, and resources for transmitting data to a Data Center or Center of Data?

Calibrate and Validate

5. Are Program observations calibrated and validated and the related products reviewed for quality using accepted research or statistical methods?

Appropriate Formats

6. The broad range of environmental data requires the use of different native formats. Data formats, standards, and protocols must be of sufficient diversity and quality to guarantee interoperability—supporting integration across disciplines, organizations, scales, and geographic locations. Are Program data and products currently available in formats that can be easily integrated, supporting interoperability?

Complete Metadata

7. Is there current, complete, and authoritative metadata, in appropriate formats, describing Program data and products—including information on the collection, calibration, quality, and processing—such that the data and products are independently understandable by users?

Archive and Access

Five-Year Plan

8. Does the Program have a plan in place (i.e. NOSA, CORL, PBA) for the next five years of observational archive and dissemination needs identifying and documenting at least the following: adequate bandwidth for transmission of data and products to Data Center or Center of Data; automated methods of monitoring and verifying transmission; and, adequate resources for archive and dissemination through a Data Center or Center of Data?

Long-term Preservation

9. Are all observations, calibrated and validated data, related products, and metadata preserved for long-term use (i.e. routinely sent—in appropriate formats — to a NOAA Data Center or Center of Data; secure on- and off-site archives exist for the observations, related products, and metadata; the archive is regularly exercised, the media refreshed, and data formats kept current)?

Data Discovery

10. Are Program archives and metadata described in appropriate online catalogs or clearing houses and at the appropriate granularity to improve discovery of data and products?

Access/Disseminate

11. Are the observations and related products available online based on open, standard technology to enable data integration?

Contingency Planning

12. What is the status of contingency planning for access to the observations, related products, and archives?

Where Programs either execute or are on the critical path for national or NOAA essential functions, consider:

- Is the reporting Program identified as an essential function in Line/Staff Office or NOAA contingency and continuity plans?
- Are systems critical to the reporting Program identified as NOAA IT Security Systems? (Note: Program Managers should refer to contingency planning sections of Certification and Accreditation documentation for NOAA IT Security Systems.)
- Has a Minimum Acceptable Down Time been defined for the products/ services provided by the Program? (This may require coordination with supported activities.)
- Are alternate communication infrastructures (e.g., high frequency radio) in place and exercised allowing transmission of mission-critical products/serves for conditions where the primary method of transmission is non-operational? Are vital products/services accessible from predefined alternate operating sites?
- For a response of (A—"green"), the contingency plan must have been exercised in the last 6 months.

If products/services critical to the Program are supplied by program-external sources (NOAA or non-NOAA) also consider:

- Does the agreement defining their relationship (e.g., memorandum of understanding) identify emergency contact information and alternate sources?
- Are the sources providing the inputs critical to reporting programs identified as national or NOAA essential functions in *their* contingency/continuity plans?

10-Year Objectives

(Respond once per Program)

Set forth modernization and improvement objectives for the next 10 years, including changes to improve interoperability of data and products, facility requirements, and critical new technological components that would be necessary to meet the objectives. (Mandatory.)

Additional Comments

(Free-form reply)

What are the Program's greatest successes and areas of greatest need for data and data management? What, if any, are the greatest vulnerabilities for data acquisition? What, if any, are the greatest vulnerabilities for data archival? What if any, are the greatest challenges for data access? What, if any, are the greatest obstacles for integration with other data sources? Consider unstable or unreliable data sources, lack of secure and accessible archive, incompatible formats, incomplete metadata, etc., when replying.

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Appendix D. Acronyms

AIS
Automated Identification System

AOC
Aircraft Operations Center

AWIPS
Advanced Weather Interactive Processing System

CDMP
Climate Database Modernization Program

CLASS
Comprehensive Large Array-data Stewardship System

COOP
Continuity of Operations Plan

CORL
Coordinated Observation Requirements List

DHS
Department of Homeland Security

DMAC
Data Management and Communications

DMC
Data Management Committee

DMIT
Data Management Integration Team

DMSP
Defense Meteorological Satellite Program

DVB-S
Digital Video Broadcast-Satellite

ENC
Electronic Navigational Chart

EOS
Earth Observing System

FEA
Federal Enterprise Architecture

FEMA
Federal Emergency Management Agency

FGDC
Federal Geographic Data Committee

FY
Fiscal Year

GCOS
Global Climate Observing System

GEO
Group on Earth Observations

GEOSS
Gobal Earth Observing System of Systems

GIS
Geographic Information Systems

GOES
Geostationary Operational Environmental Satellite

GOOS
Global Ocean Observing System

HADS
Hydro-meteorological Automated Data System

HSOC
Homeland Security Operations Center

HSPO
Homeland Security Program Office

IHO
International Hydrographic Organization

IOC
Intergovernmental Oceanographic Commission

IEOS
Integrated Earth Observation System

IMAAC
Interagency Modeling and Atmospheric Assessment Center

IOOS
Integrated Ocean Observing System

ISOS
Integrated Surface Observing System

IT
Information Technology

IUOS
Integrated Upper-Air Observing System

IWGEO
Interagency Working Group on Earth Observations

LIDAR
Light Detection and Ranging

MADIS
Meteorological Assimilation Data Ingest System

MDA
Maritime Domain Awareness

METOP
Meteorological Operational Weather Satellite

NARA
National Archives and Records Administration

NCDC
National Climatic Data Center

NCDDC
National Coastal Data Development Center

NCEP
National Centers for Environmental Prediction

NDBC
National Data Buoy Center

NDE
NPOESS Data Exploitation

NDFD
National Digital Forecast Database

NEXRAD
Next Generation Weather Radar

NGDC
National Geophysical Data Center

NNDC
NOAA National Data Centers

NOAA
National Oceanic and Atmospheric Administration

NODC
National Oceanographic Data Center

NOMADS
NOAA Operational Model Archive and Distribution System

NOSA
NOAA Observing System Architecture

NOSC
NOAA Observing System Council

NPOESS
National Polar-orbiting Operational Environmental Satellite System

NPP
NPOESS Preparatory Project

NRT
Navigation Response Team

NS&T
National Status and Trends

NSTC
National Science and Technology Council

NWR
NOAA Weather Radio

NWS
National Weather Service

OCIO
Office of the Chief Information Office

OE
(Office of) Ocean Exploration

OLE
Office for Law Enforcement

PaCOOS
Pacific Coast Ocean Observing System

PBA
Program Baseline Assessments

POES
Polar-orbiting Operational Environmental Satellite

PORTS
Physical Oceanographic Real-Time System

SBN
Satellite Broadcast Network

SEC
Space Environment Center

TAO
Tropical Atmosphere Ocean

TB
Terabytes

TOC
Telecommunications Operations Center

USCRN
U.S. Climate Reference Network

USDA
U.S. Department of Agriculture

USGEO
U.S. Group on Earth Observations

VDatum
Vertical Datum

VMS
Vessel Monitoring System

VTEC
Valid Time Event Code

WDC
World Data Center

WMO
World Meteorological Organization

WRF
Weather and Research Forecast

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