

**National Oceanic and Atmospheric Administration (NOAA)  
National Environmental Satellite, Data, and Information Service (NESDIS)  
NOAA/NESDIS/NOAA National Data Centers (NNDC)  
006-48-01-13-01-3209-00-108-023  
Operational Analysis  
2006**

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**Executive Summary**

NOAA’s National Environmental Satellite, Data, and Information Service (NESDIS) is responsible for establishing and administering funding for the NOAA National Data Centers (NNDC). The NNDC consist of four data centers: the National Climatic Data Center (NCDC) located in Asheville, North Carolina; the National Geophysical Data Center (NGDC) located in Boulder, Colorado; the National Oceanographic Data Center (NODC) located in Silver Spring, Maryland, and the National Coastal Data Development Center (NCDDC) at Stennis Space Center, Mississippi, which NODC administers. The NNDC is an umbrella Exhibit 300 and includes three programs in addition to support of data center activities. The NOAA Virtual Data System (NVDS) is jointly supported by NCDC, NGDC, and NODC. The Climate Database Modernization Program (CDMP) is managed by NCDC and the NOAA Central Library is administered by NODC.

NOAA has statutory responsibility for the long-term archive and management of the nation's collection of environmental data, and it is through the NNDC that this responsibility is managed. Hence, there is no alternative in the public or private sector that can perform the functions of the NNDC. The economic contributions of the NNDC to the Nation are significant.

This operational analysis (OA) for the NNDC Exhibit 300 focuses on the operational state of the umbrella program as of December 31, 2006, and is based on the Department of Commerce (DOC) guidance "Operational Analysis," dated July 21, 2005. The associated link is located at [http://www.osec.doc.gov/cio/oipr/op\\_analysis\\_guidance.htm](http://www.osec.doc.gov/cio/oipr/op_analysis_guidance.htm). This OA is a review of the data centers' information technology infrastructure.

- Customer Results
- Strategic and Business Results
- Financial Performance
- Innovation

The NNDC supports e-Government initiatives by focusing on deployment of all the features provided through the use of Internet standards, which streamlines the finding, accessing, and the delivery of data and information from the nation's environmental archives. The current steady state program meets established cost, schedule, and performance parameters. The NNDC is not a typical program, but an umbrella initiative for planning and management of data center resources.

## 1.0 Customer Results

The NNDC impacts all economic sectors of the nation and is instrumental in the preserving of long-term data records of environmental conditions. Customers include insurance and energy companies, engineers, community planners, public safety providers, farmers, lawyers, and the general public. The nation is a stakeholder; other customers include federal agencies, National Aeronautics and Space Administration (NASA), state and local governments, and students from all levels of academia.

NNDC provides essential information to key decision makers in multiple industries (construction, agriculture, etc) contributing to an estimated cost savings of greater than \$6 billion annually. A breakout of these industries can be found in the Economic Value of the Nation. [http://www.ngdc.noaa.gov/noaa\\_pubs/economic.shtml](http://www.ngdc.noaa.gov/noaa_pubs/economic.shtml). A more recent document that describes the economic impact of the NNDC to the nation, Economic Statistics for NOAA, can be found at: [http://www.economics.noaa.gov/library/documents/economic\\_statistics\\_and\\_methodology/NOAAEconomicStatistics-May2005.pdf](http://www.economics.noaa.gov/library/documents/economic_statistics_and_methodology/NOAAEconomicStatistics-May2005.pdf).

## **1.1 Customer Requirements and Costs**

The NNDC program is meeting the customers' needs and the data centers are delivering the data, services, and products as outlined in the NOAA and NESDIS operational plans. The value of these centers has been well documented and mandates a continued need for this investment. The cost to the customer is as low as it could be for the results delivered. There are no alternative sources in the public or private sector that can perform the functions of the NNDC. The NNDC program continues to provide its customers with on-line data free of charge. The data centers also provide value added products for a nominal fee. These products can be ordered on-line or by phone. Phone support is made available to ensure that customers find the right product.

## **1.2 Performance Measures**

Below are examples of customer support throughout this past year.

NNDC supports many types of NOAA customers and products in addition to the core mission of ingest and archive of climate, geophysical, and oceanographic data. NNDC projects continue to exceed their goals and objectives in the number of products produced and data made available on-line. The economic contributions of the NNDC to the nation are significant.

Following 'lessons learned' from the aftermath of Hurricane Katrina, NCDDC embarked on an effort to provide near-real time coastal warning and weather information through a unique portal called Coastal Studies, Information & Data for the Ecosystem (C-SIDE). C-SIDE provides tailored information from over 200 different sources and is available over the web to both personal computers as well as low footprint devices such cell phones and PDA's. C-SIDE tailors observations, forecast weather, warning information to particular geographic areas such as coastal areas or designated evacuation routes. Feedback from the public and NOAA management has been overwhelmingly positive. A broadcast documentary on C-SIDE by Mississippi Public Broadcasting is planned before the hurricane season in 2007. In 2007, the technology behind this application of C-SIDE will also focus on ecosystem applications, particularly shellfish management and near-shore water quality monitoring.

As shown in Figure 1, NCDC had a substantial increase over projections for new products developed and placed on-line through 2006. This resulted in enhanced electronic access to data by the user community, directly facilitating improved research and better climatology forecasting.

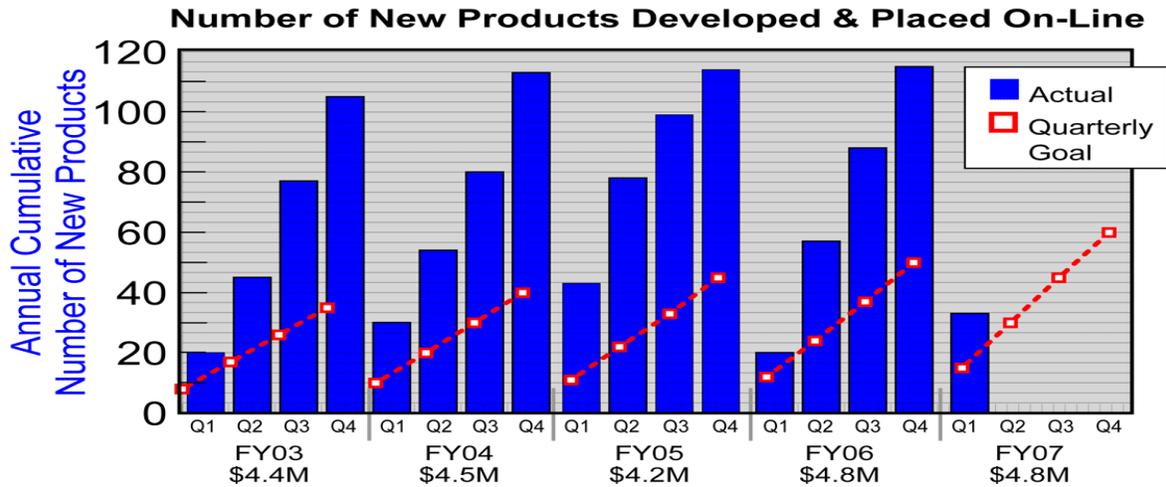


Figure 1. Number of new products developed during 2006

Figure 2 shows customer support at NODC by the increase in the number of hits and amount of data downloaded via the NODC on-line access system. In the last 12 years the number of hits has increased from 1,051,744 in 1995 to 46,634,870 in 2006, the number of monthly unique hosts increase from 94,013 in 1995 to 1,977,909 in 2006. The amount of data downloaded has increased from 27GB in 1995 to 10.7TB in 2006.

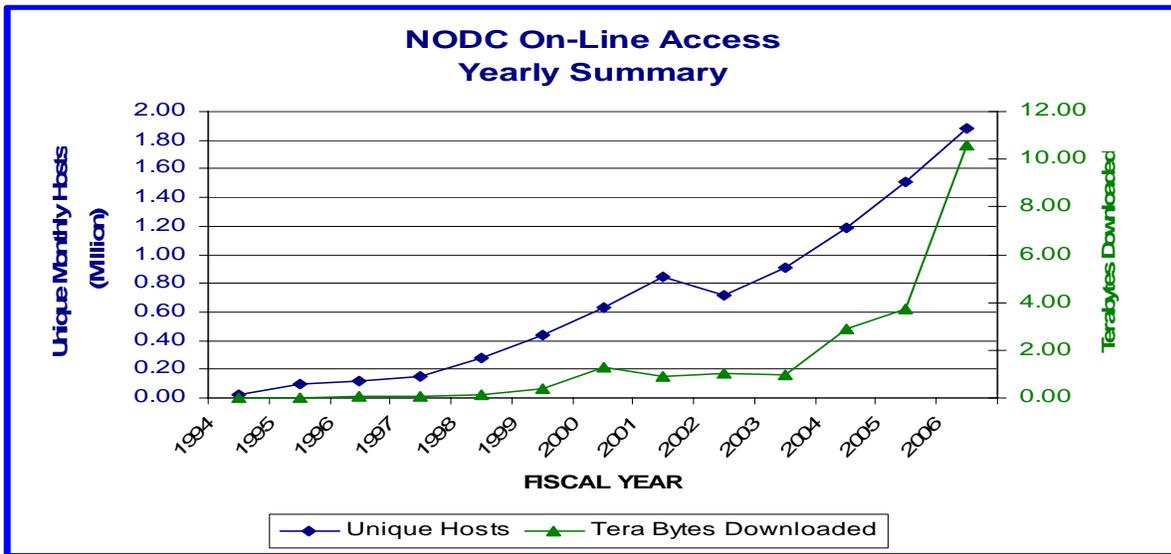


Figure 2. NODC access summary

Figure 3 shows data delivered on-line from the NGDC to customers via distinct hosts. During 2006, NGDC saw an increase of data accessed increase from 11,000 gigabytes to 15,800 gigabytes. This is an increase of over 25% of data downloaded by the customer during the year. Many individual users visited the NGDC exhibits at large scientific conferences including the American Geophysical Union and the American Meteorological Society annual meetings and the comments were typically, "You have a great web site; I use your data and information all the time."

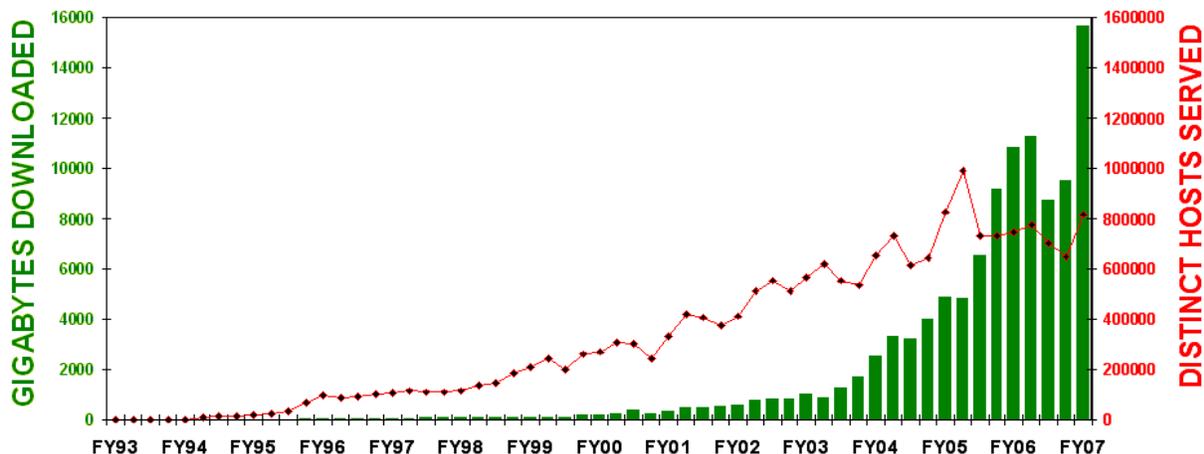


Figure 3. NGDC on-line data provided quarterly to customers

## 2.0 Strategic and Business Results

The NOAA National Data Centers Information Technology (IT) infrastructures are configured to accommodate the e-Government initiative by focusing on the storage, accessing, and delivery of data and information from the nation's environmental archives. These data are available to the global community by Internet access, phone calls and written request. Data and products are available in various forms to include CDROM, DVD, posters, publications, subscriptions and on-line access. All data interactions are now capable of being performed without human intervention using e-Commerce conventions. Development and improvement of end-to-end system resources and systems management is handled through oversight of contractor support.

### 2.1 Achieving NOAA Strategic Goals

The NNDC supports the four NOAA Mission Goals: Ecosystems, Climate, Weather and Water and Commerce and Transportation by providing data, information and products in support of understanding climate variability, weather and water information, and information for safe and environmentally sound transportation.

Below are samples of how the NNDC supports NOAA mission goals.

NCDDC is aligned with NOAA's Ecosystem mission goal. In 2006, NCDDC opened a Regional Ecosystem data portal which serves to provide both data discovery and access to required coastal data used to assess regional ecosystems. This effort is supported by a research program, the Ecosystem Data Assembly Center, which is envisioned by NOAA to become the cornerstone for the Integrated Ecosystem Assessment (IEA's) to commence in FY09.

NODC provides critical support for all NOAA's mission goals by operating the NOAA Central Library, which serves as the official archive for NOAA documents, and the NOAA Regional Libraries. NODC also supports the NOAA mission goals of Ecosystems and Climate by:

- Updating and managing the Coral Reef Information System (CoRIS) for the NOAA Coral Reef Conservation Program;
- Developing, maintaining, and updating large ocean observation data products, including the World Ocean Database, the World Ocean Atlas, the Argo float database, and the Global Temperature and Salinity Profile Project (GTSPP) database;
- Maintaining the international Long Term Stewardship and Reanalysis Facility (LTSRF) for the world's comprehensive collection of satellite-based sea surface temperatures (SST) collected under the Global Ocean Data Assimilation Experiment (GODAE) high-resolution sea surface temperature (GHRSSST) project; and
- Developing the distributing the Advanced Very High Resolution Radiometer (AVHRR) Pathfinder SST climate data record, the worlds longest and most accurate satellite based record of SST.

NGDC supports the Commerce and Transportation as well as the Weather and Water mission.

- NGDC added Geographical Information Systems (GIS) functionality to visualize NOAA observatories for the NOAA Observing Systems Architecture (NOSA) program by implementing access mechanisms via Google Earth.
- Increased online data delivered to customers this year from 31TB to 45TB
- NGDC is now providing near real time GPS (Global Positioning System) data feeds for weather models and ionospheric models.
- Continuously operating reference stations (CORS) GPS data archive at NGDC increased to 20TB in 2006.

NCDC focuses on two NOAA mission goals, Climate and Weather and Water. NCDC provides quality climate and weather data, information, and decision support products and services that:

- Improve business, government, and personal decisions related to planning, operations and assessments.
- Support research leading to improved weather and climate forecast and models.
- Provide information on the varying changing states of the national and global climate.

## **2.2 Business Results**

### **2.2.1 Program Management and Controls**

The NNDC program is guided by the Office of Management and Budget (OMB), DOC, and NOAA guidelines and policies. Oversight is provided by NESDIS, including the NESDIS Information Technology Architecture Team (ITAT) and the NESDIS Chief Information Officer (CIO).

A baseline of annual activity is contained in the matrix Annual Operating Plan (AOP) which is approved by the line office. Each center submits their AOP Performance Measures (PMs) and Milestones chart as part of their annual planning process. These plans contain mission goals and performance measures for the individual centers and the programs and systems within their

domain. The documents which are referred to as the Annual Management Contracts (AMCs) are made between the center directors and the NESDIS director. These AMCs are used to hold center directors responsible for specific milestones contained in this document.

The NNDC IT management process begins with out-year planning and a development of a spend plan broken out by month. Each data center is responsible for their individual spend plan. Once plans are approved and Operations, Research & Facilities (ORF) funds are made available, the systems-support and finance managers begin the acquisition for products and services. Recommendations must be compliant with Section 508, the DOC Enterprise Architecture and the Federal Enterprise initiatives. Prior to IT purchases, the ITAT reviews the purchase for best business practices. NOAA-wide contracts such as NOAA IT Electronic Store (NITES) and Blanket Purchase Orders are queried for product availability. If not found, other existing government contracts such as SMARTBUY are reviewed for product availability. Sole source purchases are made only when no other option is available. IT purchases follow the capital asset planning process and are incorporated into the NNDC Exhibit 300. NNDC IT support comes from integrated teams consisting of contractors and federal employees. Details of the support contracts can be found in the individual data center annual management contracts. All IT purchases over \$25K are reviewed by the NESDIS CIO to ensure the planning and budgeting process has been followed.

### **2.2.2 Monitoring Cost, Schedule and Performance**

**Cost.** The cost for NNDC programs is monitored in monthly reports submitted to the data centers' financial officers containing financial information such as estimated and actual costs versus projected cost. Monthly budget reviews are held with the program manager, Contracting Officer's Representatives (CORs), and contract managers to ensure contracts are within cost and on schedule. The NESDIS ITAT also reviews purchase orders for IT assets to ensure compliance with the "to be" architecture and that items purchased are using standard NOAA contracts.

**Schedule.** The data centers' annual management contracts are used to track key milestones. A plan is currently in effect to reflect the final appropriation and allotment decisions. NESDIS conducts monthly reviews.

**Performance.** Performance management is addressed at the individual data centers through their internal reviews and then briefed by the center directors to the NESDIS director and staff. Specific performance measures listed in the NNDC Exhibit 300 are reviewed and updated.

## **2.3 Reviews**

As part of the NOAA program structure, the NNDC program is reviewed continuously throughout the year. Each data center and program manager is responsible for monitoring their individual monthly spending and reporting to NESDIS Headquarters Financial Officer unacceptable deviations, along with explanations and a plan to correct.

## 2.4 Security

All NNDC systems have approved System Security Plans, Risk Assessments, and Contingency Plans in place. Operational and technical security controls are in place to ensure the confidentiality, integrity, and availability of information. All 4 data center systems completed security control and contingency plan testing this year.

NCDC and NGDC accomplished IT security Certification and Accreditation this year and received authority to operate. NGDC did operate under and Interim Authority to Operate for a month due to inclement weather in the Boulder area prohibiting scheduled testing. The official approval to operate was granted on 23 Jan 2007. However, all the preparation work had been completed in FY06.

Security of the NNDC systems are managed by Information System Security Officers (ISSOs) who meet once a month to discuss security issues. The ISSOs ensure that desktop and network security are implemented in accordance with DOC and NOAA guidelines. All NNDC system administrators have taken SANS (SysAdmin, Audit, Network, Security) Institute training.

NNDC facilities face all the traditional physical risk and security challenges that go with data operations. Providing on-line access to the public is a risk. NNDC system managers have implemented firewalls to protect its systems against intrusion. Physical building security has been improved and Virtual Private Networks (VPNs) installed. To further minimize risks, systems security, disaster preparedness, and continuity of operations plans are tested and updated yearly.

## 2.5 Performance Measures

Figure 4 demonstrates that the NNDC delivered online approximately 50 terabytes of data at the beginning of 2006. The number grew to over 170 terabytes of data delivered online to the customers by the end of the year.

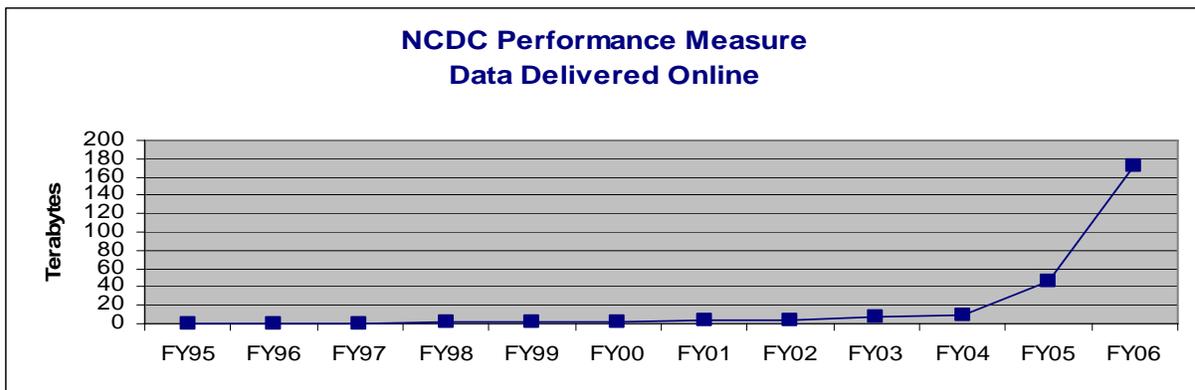


Figure 4. Data delivered online

Figure 5 shows projected images and records keyed based on input to the Presidential Budget for FY06 and FY07. Actual numbers for documents imaged and records keyed continue to exceed projections.

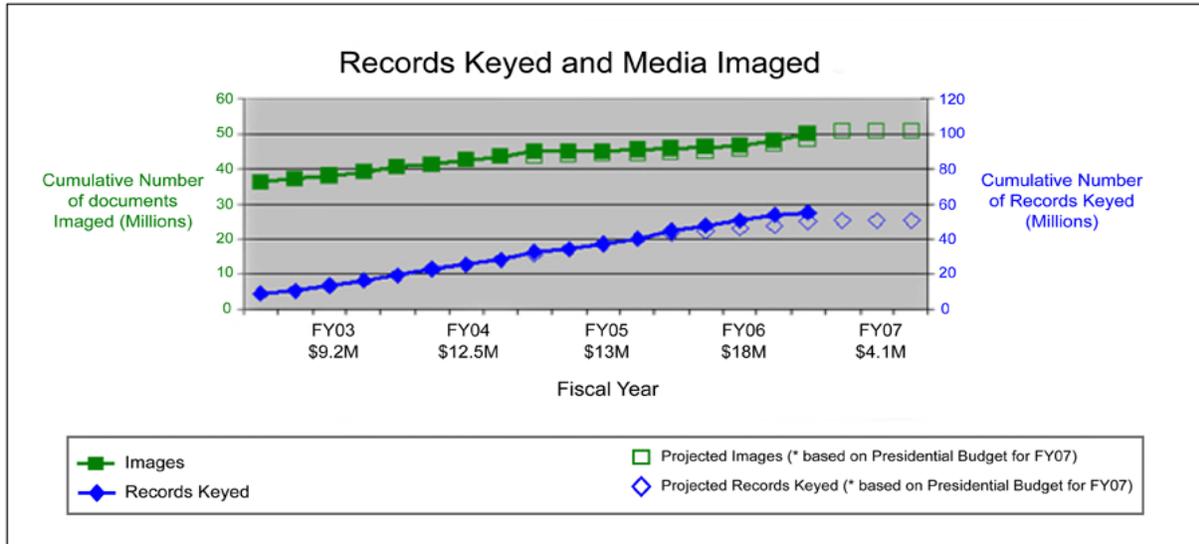


Figure 5. Increase of data available in digital format

Other Alternatives. There are no other organizations capable of doing this work better, more efficiently, or at lower cost. Details can be found in the NNDC OMB 300 Alternative Analysis section.

### 3.0 Financial Performance

#### 3.1 Current Performance vs. Baseline

The current NNDC financial performance is based on a pre-established cost baseline (e.g., annual spend plan). Program costs are steady state and consist of labor and benefits for full time permanent information technology staff dedicated to the data centers, telecommunication costs, supplies, and information technology equipment such as routers, desktops and data storage devices. Other planned project cost cover the support and services contracts at each data center. During 2006, the data centers consistently stayed within a three percent variance.

## **3.2 Financial Performance Review**

The NNDC funding requirements are listed in each data centers' AMC. All NNDC components produce a yearly Information Technology Financial Report. It is from the consolidation of these financial summaries that the NNDC Exhibit 300 budget line is developed. Detailed financial information for the NOAA Library is located in the NODC AMC. The NOAA Virtual Data System (NVDS) funding line items are located in the AMCs of NCDC, NGDC, and NODC. The Climate Database Modernization Program (CDMP) is also listed in the NCDC AMC

The NNDC annual spend plan reports and compares the actual cost of the program compared to a pre-established cost baseline. Program costs consist of labor and benefits for federal and contract employees and financial performance practices vary slightly from project and data center.

CDMP, which is a sizeable financial segment of the NNDC, used the General Services Administration's (GSA) Federal Supply Schedule Contract Blanket Purchase Agreements (BPAs). The BPA eliminates contracting and open market costs such as: the search for sources; the development of technical documents and solicitations; and the evaluation of bids and offers. The BPA further decreases costs, reduces paperwork and saves time by eliminating the need for repetitive, individual purchases from the schedule contract. This creates a purchasing mechanism that works better and costs less. The contractors issue monthly invoices for all products and services supplied under the contract. These are tracked and evaluated by the CDMP COR as well as each government task manager who is responsible for issuing the task order and monitoring the task for deliverables and for the quality assurance of these products and services. Progress meetings are conducted to review each task for its progress, quality, and costs. By using the BPA, purchases cannot exceed funds available thus always keeping the program within budget.

The NNDC is a steady state umbrella program that derives its budget from a combination of ORF support accounts for NCDC, NODC, NGDC, NCDDC, NVDS and CDMP. Each office has a financial staff that reports monthly to NESDIS Headquarters for variances of more than ten percent.

## **4.0 Innovations to Meet Customer Needs**

The following projects and efforts demonstrate how the NOAA data centers meet customer needs and make better use of technology to achieve existing and future requirements.

### **4.1 NOAA Virtual Data System (NVDS)**

Timely access to worldwide environmental data is critically important, in allowing decision makers, scientists, and business people from many professions to make informed decisions using the most up-to-date information. NVDS has transitioned customer access to over one petabyte (PB) of data and products to the World Wide Web and Geographic Information System (GIS)

services. Users now receive information in minutes or seconds as opposed to the days required in the past. In addition, the same E-Government systems used by customers are also used by National Climatic Data Center (NCDC) customer service staff to more efficiently process requests for those who do not have Internet access, or who require large volumes of data that they cannot retrieve on-line.

Following the NOAA Strategic Goal, Serve society's needs for weather and water information, NVDS provides user-friendly access to large holdings of environmental data. This includes in-situ climate data (e.g., data from a weather station) and weather radar data stored on a large tape robotics system, called the Hierarchical Data Storage System (HDSS). The customer base includes all users of NCDC's data holdings--businesses, universities, research institutes, consultants, lawyers, engineers, government agencies, etc. The URL's include: <http://cdo.ncdc.noaa.gov/> and <http://gis.ncdc.noaa.gov/>

The three main components of NVDS are:

1) Climate Data On-line and GIS Services. The Climate Data On-line (CDO) system is NCDC's data model and system for delivering in-situ data to customers. This includes multiple datasets stored on disk in a relational database. Data from over 50,000 unique worldwide weather/climate observing stations are available, such as daily maximum/minimum temperature and precipitation for small towns, or detailed hourly data from airport locations. GIS services provide fully Open Geospatial Consortium (OGC)-compatible data discovery and request capabilities. The main user interface allows initial selection through a GIS map service, or through a simple web interface by region, country, state, county, station/location name, or by data type. Also, the system includes various capabilities such as data summarization (e.g., mean monthly temperatures), data graphing, and specialized queries (e.g., greatest precipitation observed in a state, for each month of the year). Figure 6 is a sample query screen for the GIS user interface.

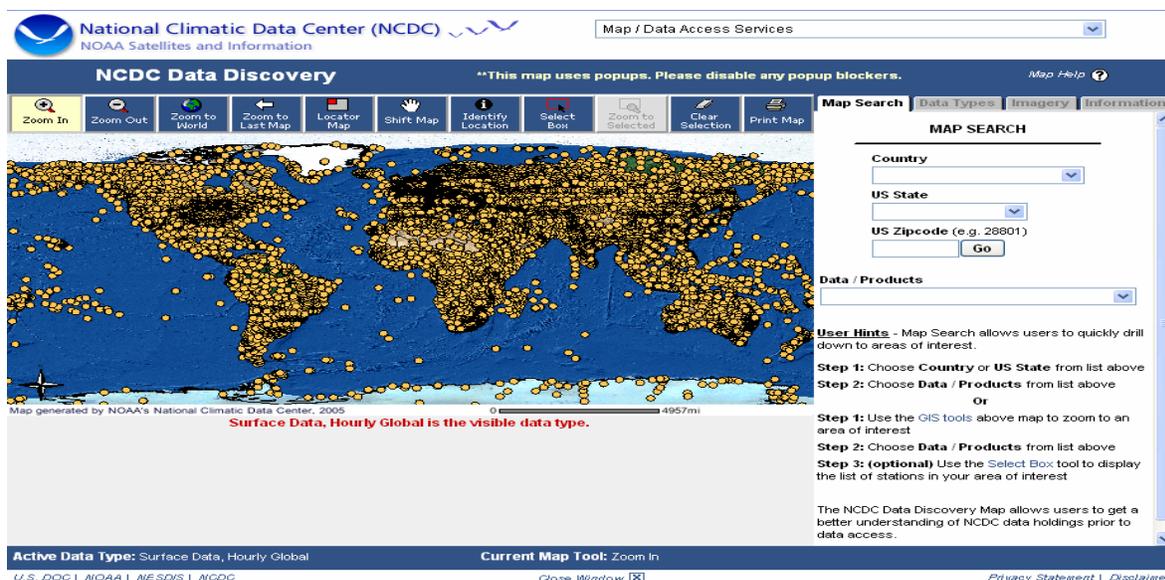


Figure 6. GIS map service

2) HDSS Access System (HAS). Prior to NCDC's development of HAS, data requests were filled using a manually-intensive process of identifying and mounting data tapes, then processing the data to provide the subset required by the customer. HAS now serves as a complement to CDO, by providing direct on-line access to the entire archive of radar data (stored on high-density tape), totaling one petabyte in volume, along with various other types of data. As with CDO, there are visualization capabilities, and the GIS services provide a map-based interface to the data. Figure 7 demonstrates the visualization capabilities by displaying a radar image of hurricane Charley.

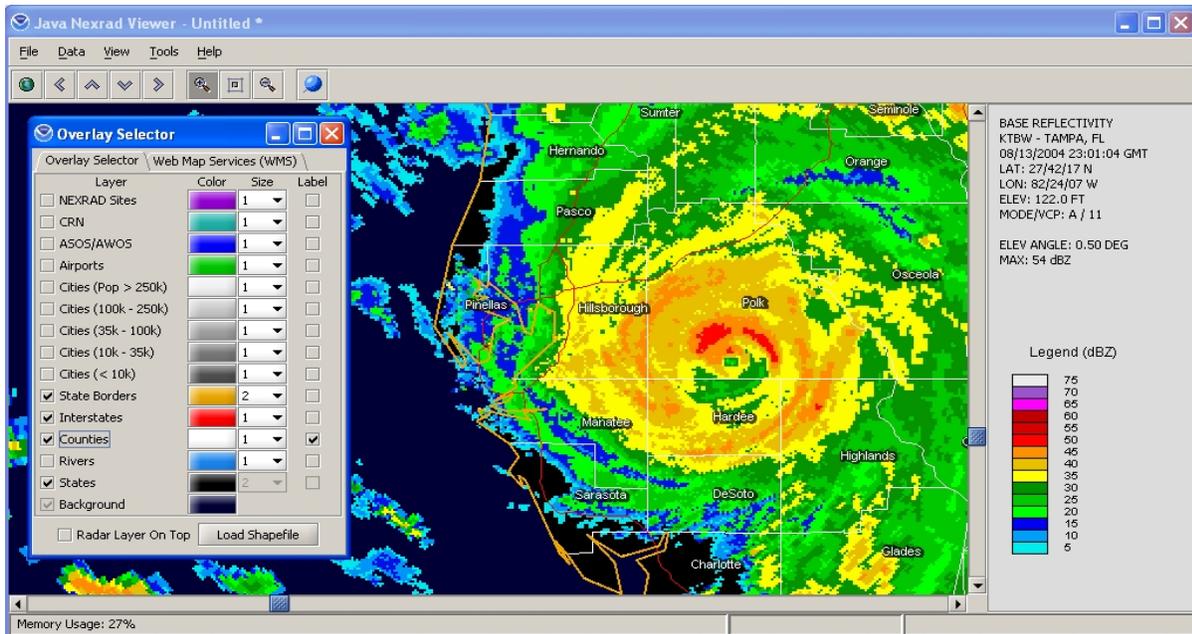


Figure 7. Radar image of hurricane Charley

3) NESDIS e-government System (NeS) and the On-line Store. NCDC developed and implemented the On-line Store to allow NOAA National Data Center customers to order various products on-line, which previously required a phone call or email to place the order. For example, NCDC has over 40 CDROM and DVD products available for purchase, providing a variety of observational data, data summaries, and images from various sources. Also, since many legal cases require weather data with certification for court use, customers can now order a certified copy of the data on-line. The order for the CDROM, DVD, or certified paper copy is then automatically generated, and quickly mailed to the customer.

Integrated Surface Database (ISD): In conjunction with NVDS, NCDC developed the Integrated Surface Database (ISD) to address a pressing need for an integrated, consistent global in-situ database. ISD consists of global surface observations compiled from numerous sources, into a single consistent format and common data model. It was developed as a joint activity within Asheville's Federal Climate Complex (NCDC, with U.S. Air Force and Navy partners), with the assistance of external funding from several sources. ISD integrates data from over 100 original data sources, including numerous data formats which were key-entered from paper forms prior to

the digital data era. The database comprises over 20,000 stations worldwide, with some having data as far back as 1901. Currently there are over 11,000 stations “active” and updated daily in the database. The URL:

<http://www.ncdc.noaa.gov/oa/climate/isd/index.php>

Federal Climate Complex - Synergy: NCDC is now working with the Air Force Combat Climatology Center (AFCCC), collocated with NCDC in the Federal Climate Complex, on joint/common relational databases for customer support. The concept of operations calls for NCDC, AFCCC, and the US Navy Detachment (also collocated with NCDC), to provide civilian and unclassified military customer support via a joint servicing system. The system will use the existing NOAA Virtual Data System (NVDS) as the initial operating capability, with features to be added as required. In-situ datasets (most used for military support) are the current focus of activity, with lightning data and upper-air data being the first two datasets to be included in the common database. Others will follow.

## **4.2 Climate Database Modernization Program (CDMP)**

The Climate Database Modernization Program (CDMP) supports NOAA’s mission to collect, integrate, assimilate and effectively manage Earth observations on a global scale, ranging from atmospheric, weather and climate observations to oceanic, coastal, and marine life observations. Many of these holdings, which are part of the U. S. National Archives, were originally recorded on paper, film, and other fragile media, and stored at various NOAA Centers. Prior to CDMP, not only were these valuable data source mostly unavailable to the scientific community, storage technology for the archives were not state-of-the-art. Without proper preservation of the media, the information they contained was in danger of being lost forever.

CDMP has greatly improved the preservation and access to NOAA’s holdings by migrating many of these resources to new digital media. Digital images of many of the holdings are now available online, and millions of historic data records have been keyed and integrated into digital databases, with more added continually. CDMP has over 60 separate NOAA data rescue projects that span the full spectrum of NOAA and supports all five line offices. CDMP also works with U.S. Regional Climate Centers, State Climatologists, the U.S. Air Force, the World Meteorological Organization, and foreign meteorological services in Europe, Africa, Asia, and the Americas. These efforts not only benefit NOAA, but researchers and data users throughout the Nation and world-wide. The increase in data accessibility and inclusion of these historical data sets into the integrated global databases needed by today’s climate and environmental data users validate the CDMP mission: to make major climate and environmental databases available via the World Wide Web.

## **4.3 National Coastal Data Development Center (NCDDC)**

The National Coastal Data Development Center continues to provide support to a broad range of customers through a variety of interfaces technologies. The evolution of the Service Orient Architecture (SOA) continues to focus on a few essential services that support multiple customer applications. The initial service developed at NCDDC is the "Information Broker" which provides publishing support for FGDC metadata for multiple applications including the NCDDC metadata

management tool MERMAid (Metadata Enterprise Resource Management Aid) and the West Coast Observation application used to automate the archive of observations to from five West Coast Sanctuaries to NODC. Additional work is being done on evaluating the need for an Enterprise Service Bus (ESB) and building requirements for an authentication service to be used within NCDDC. In addition, NCDDC also developed a new user-friendly GIS interface to the Southeast Phytoplankton Monitoring Network (SEPMN). SEPMN is a successful volunteer-based observational program to help identify and catalog harmful algal species as well as link the general public with NOAA and academic institutions. The interface combines photographs of individual plankton to assist the SEPMN volunteer as well as references, database and mapping functions. As a part of C-SIDE innovations discussed in section 1.2, NCDDC developers exploited the use of Really Simple Syndication (RSS) services to provide the backbone of data transport. The RSS data stream was enhanced by NCDDC to adhere to a geo-RSS format allowing those data streams to be easily mapped on simple interfaces such as Google Maps. The Google Map capability provided a familiar interface to NOAA data that is already in common use by the public.

#### **4.4 National Oceanographic Data Center (NODC)**

The NODC Ocean Climate laboratory continues making integrated products available to the data management and scientific communities. World Ocean Database 2005 (WOD05), which is the world's largest global collection of ocean vertical profile data, was distributed in June, 2006. World Ocean Atlas 2005 (WOA05), which are gridded fields of many of the variables in WOD05 at standard depth levels in the world ocean, was made available in September 2006. Products based on NODC databases are among the most cited works in all of the geosciences attesting to the importance of NODC's data management and analysis activities.

NODC achieved key innovations in the area of satellite-based measurements of the oceans. NODC's Pathfinder effort reprocessed the AVHRR data between 1985 and 2006 to create the climate data record for SST, which has been used by tens of thousands of customers over an enormous range of applications. NODC also designed and implemented the GHRSSST project's LTSRF, which is providing stewardship and access services to the international community for nearly every satellite capable of measuring SST. A chart (Figure 8) of the cumulative volumes in the LTSRF is shown below. As of December 2006, there were over 2 terabytes in the archive, and volume ingest rates indicate another 7 terabytes to be added in calendar year 2007.

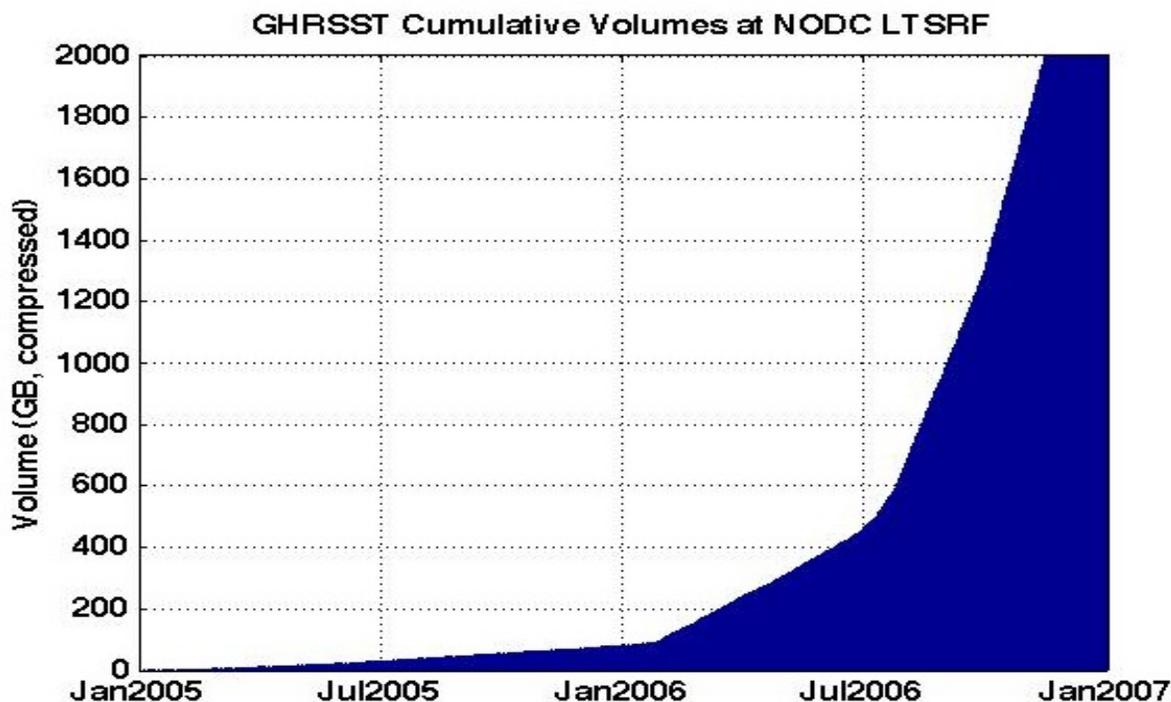


Figure 8. Volume of SST data available in the GHRSSST LTSRF

NODC continues to review and enhance the content quality of metadata available to the public through the online Ocean Archive System. New metadata include abstracts, titles, bounding information, and location plots for original data collections.

NODC re-established the quarterly publication of the Earth System Monitor (ESM) in 2006. The ESM, which is available at no charge online and in hard copy, provides information about data management activities at the NNDCs and is a widely-distributed forum for presenting new activities and projects undertaken by NNDC staff.

In 2006, NODC started serving data from the NOAA National Marine Sanctuary Program's West Coast Observation System and the International Oceanographic Data and Information Exchange's Global Ocean Surface Underway Data (GOSUD) project via the Open Source Project for a Network Data Access Protocol (OPeNDAP). OPeNDAP is a data transport protocol recommended by the Integrated Ocean Observing System (IOOS).

#### **4.5 National Geophysical Data Center (NGDC)**

NOAA's National Geophysical Data Center was the lead office on the compilation of two tsunami reports that are milestones within the NOAA Tsunami Program. The first report, U.S. States and Territories National Tsunami Hazard Assessment - Historical Record and Sources for Waves, by Dunbar and Weaver is currently under final review by the U.S. Geological

Survey, the NOAA Tsunami Program, and the National Tsunami Hazard Mitigation Program (NTHMP). This report is in response to a request from the President's Subcommittee on Disaster Reduction (SDR) to the NTHMP. NOAA and the USGS, partners in the NTHMP, had the primary responsibility for this first ever, complete hazard assessment. NGDC has also completed tsunami inundation grids for 6 U.S. coastal areas showing the potential areas of run-up and concern for flooding in case of a tsunami. A new web site for the NGDC Tsunami Inundation Gridding Project is available at <http://www.ngdc.noaa.gov/mgg/inundation/>

NGDC archives data from the U.S. Air Force Defense Meteorological Satellite Program (DMSP) including low light imaging observations made by the Operational Linescan System. NGDC has been developing nighttime lights products and applications for these data since 1994. A variety of applications have been developed for nighttime lights products from NGDC including global mapping of population, seasonal monitoring of fires and heavily lit fishing boats, gas flaring and independent estimates of economic activity. Recently NGDC combined nighttime lights with Department of Energy population grids to produce the first global maps of population numbers in poverty and constructed impervious surface area. Nighttime lights data were also used by the Global Learning and Observations to Benefit the Environment (GLOBE) project. This was a one-week (March 22-29 of 2006) effort to explore light pollution around the world by having kids report how the nighttime sky looked. The DMSP Nighttime lights dataset is the base layer for their online map service for the project. GLOBE web interface for this project is: <http://www.globe.gov/globeatnight>.

NGDC released Earth TOPOgraphy (ETOPO2v2), a new-and-improved 2-minute database of world elevations (bathymetry and topography). This new release contains data from higher-resolution sources for coastal US waters, and new data for the US Great Lakes, and the Caspian Sea. It has a cell-centered grid alignment to give greater internal consistency than in the previous ETOPO2 (2001) 2-minute data grid. The new database is available in a variety of standard formats. New suites of planar and global relief images are online. <http://www.ngdc.noaa.gov/mgg/fliers/06mgg01.html>. Two new shaded color relief globe posters and an updated color relief slide set derived from the spectral-color images are also available. Digital elevation data support a broad range of research and educational activities; the image sets are especially appropriate for educational and outreach activities.

NGDC released the Significant Volcanic Eruptions Database as part of its ongoing effort to develop an integrated natural hazards database. The integrated database links earthquakes, tsunamis and volcanic eruptions providing death and damage information. These data are accessible via NGDC's Natural Hazards page: <http://www.ngdc.noaa.gov/seg/hazard/hazards.shtml>. Volcanic eruptions can cause considerable damage, loss of life and devastating tsunamis. The NOAA/NGDC and co-located World Data Center long-term integrated hazards archive provides data essential for hazard assessment, improved data for research and assured access to data related to past hazardous events, such as the catastrophic 2004 Indian Ocean Tsunami.

NGDC is ingesting level-0 GOES-13 Solar X-ray Imager (SXI) data in real time. The browse imagery are being made available to the public as they come in. The quality of the image product that is being delivered by GOES-13 SXI continues to receive universal acclaim. The browse data

are available at the NGDC website: <http://sxi.ngdc.noaa.gov>. This is in support of NOAA's work in managing environmental data and information and supports the NOAA Space Weather Program.

## **4.6 Telecommunications/Technology**

As the volumes of NOAA satellite and radar data increase exponentially, telecommunications networks will experience major change. The demands for high bandwidth will require centers to utilize some of the networks designed for research, education and technology development. These networks are consortiums comprised of research and development labs, universities, equipment vendors, and telecommunication network carriers. These include the networks for Internet2/Abeline and National Lambda Rail (NLR).

Additionally, new technologies will be incorporated to distribute critical weather data and products to users throughout academia, research and military environments, as well as businesses and the public. Some of these technologies will include Multi-Protocol Label Switching (MPLS)-based Internet Protocol (IP), Virtual Private Networks (VPNs), multicasting, grid computing, and shared processing. Multiple data centers and processing centers will be used for processing and archiving data for near-real time access.

Network designs will continue to focus on innovative security arrangements, hardening of the network for Continuity of Operations (COOP) activities, and Critical Infrastructure Protection. Access to the high bandwidth networks will remain a challenge because of on-going cost and bandwidth availability issues. The success of the NNDC will depend on the collaborative implementation of new telecommunications and storage solutions.

## **5.0 NNDC Summary**

This annual review of the NNDC program has demonstrated that the NNDC have exceeded their performance measures for 2006, surpassed projections for new products, and continued to ingest, archive and make accessible data and products that are timely for the customer(s) within their planned 2006 budgets.