

NOAA OFFICE OF OCEAN EXPLORATION  
DATA MANAGEMENT



NESDIS INTEGRATED PRODUCT TEAM  
2006 ANNUAL REPORT

EXPLORE  RE

*“...ensure that knowledge gathered during ocean exploration is effectively made available for informed decision making by... establishing a broad-based task force to design and implement an integrated, workable, and comprehensive data management information processing system for all information including unique and significant features...”*

Discovering Earth's Final Frontier: A U.S. Strategy for Ocean Exploration  
October 2000, the President's Panel for Ocean Exploration

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Prepared by NOAA's National Coastal Data Development Center

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## Executive Summary

This annual report of the 2006 activities of the NOAA NESDIS Integrated Product Team (IPT), a partnership with the Office of Ocean Exploration (OE) and other NOAA and non-NOAA entities, has been prepared by the National Coastal Data Development Center (NCDDC) as a report to our stakeholders and partners within NOAA and our customers throughout government and academia. It represents our commitment to share our accomplishments during the past year and to report how well our stakeholder's expectations and needs were met. In addition, it allows us an opportunity to review the commitments to new initiatives that we made in the last year and to establish a look-ahead for the upcoming year.

In October 2000, the President's Panel for Ocean Exploration released "Discovering Earth's Final Frontier: A U.S. Strategy for Ocean Exploration" (Frontier Report). This report set the stage for NOAA's Office of Ocean Exploration to lead NOAA's ocean discovery efforts using interdisciplinary exploration and to advance and disseminate knowledge of the ocean environment and resources. In the Frontier Report, Data Management and Dissemination was listed as one of five exploration priorities.

The Frontier Report's requirements, coupled with the existing need to organize the many types of emerging ocean exploration data and information, led to the need to quickly develop a cooperative OE data management system. Formed in 2002, the IPT has completed an analysis of initial requirements and initial development projects and is now assessing operational products. The IPT has consistently achieved a high level of cooperation while developing an extensible, standardized, and interoperable end-to-end data management system.

Highlights for 2006 include: managing record numbers of OE data, data products, and information; publishing three new Digital Atlas geospatial regions; completing Phase I development of the Cruise Information Management System (CIMS), culminating in an at-sea operational test during the *Operation Laser Line Scan* cruise in November 2006; publishing data management Standard Operating Procedures; and expanding IPT capabilities through embracing new opportunities and partnerships.

The IPT leadership, working with OE and other NOAA and non-NOAA entities, is committed to continually improving delivery of products and services, both in terms of quality and cost effectiveness. Our focus and emphasis will evolve as our stakeholders and customers identify new or emerging requirements. With this in mind, we invite the reader to study this annual report. We also encourage feedback, not only about this report, but throughout the year. As partners with our stakeholders and customers, we seek to continue our efforts to meet new data management challenges in support of NOAA's vision of 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.

# DATA MANAGEMENT

The Frontier Report challenged NOAA to advance and disseminate knowledge of the ocean environment and resources collected during ocean exploration. The diversity of data collected during each OE expedition, the multiplicity of data sources, user access requirements, and data access restrictions combine with the array of standards for discovery and interoperability to form a complex matrix that is the OE data management challenge. The creation of standardized metadata records is of key importance in meeting this data management challenge, because these records facilitate data discovery, description, interoperability, and access.

From inception, the Integrated Product Team (IPT) sought to simplify metadata record creation. To accomplish this task, content is collected from routine OE activities, such as proposal review and cruise planning, and 'mapped' or compiled into the Federal Geographic Data Committee (FGDC) Content Standard for Digital Geospatial Metadata (CSDGM) in accordance with Executive Order 12906. Another important standard is the MARC (MACHine-Readable

Cataloguing) format, the Library of Congress standard for the storage and exchange of bibliographic records and related information. The NOAA Central Library (NCL) uses this standard for OE documents and has adapted this format for OE video records.

During 2006, a close alignment was achieved between OE metadata creation and the Metadata Enterprise Resource Management Aid (MERMAid), a secure internet-based software tool developed at NCDDC to create, validate, and manage FGDC metadata records. Content collected from OE processes is now validated directly in MERMAid. Validated FGDC records may be published for public access and are coupled with scientific data records for archival at the National Oceanographic Data Center (NODC) and the National Geophysical Data Center (NGDC). During 2006 NCDDC customized the MERMAid software to automatically transform FGDC records to the MARC format. MARC records are now generated directly from validated FGDC records and are coupled with OE documents and recorded video to facilitate access and archival at the NCL.

## ACCOMPLISHMENTS

- Automated creation of FGDC-compliant metadata from OE content using MERMAid
- Automated transformation of OE FGDC records to MARC standard
- Codified end-to-end Data Management Standard Operating Procedures for OE Signature Expeditions
- Ground-truthed the SOP on 2006 Submarine Ring of Fire Expedition
- Applied elements of the SOP to selected 2003-2006 cruises
  - Created 1565 FGDC metadata records
  - Created 166 Marc XML records
  - Integrated NGDC archive into process for the first time since IPT inception
  - Archived 3.3 gigabytes of compressed geophysical data to NGDC
  - Archived 154 videos at NCL
  - Archived 123 metadata records and 500 megabytes of data at NODC

A significant achievement in 2006 was the adoption of OE Data Management Standard Operating Procedures (SOP) by the NOAA Data Centers and OE leadership. Developed and documented by NCDDC, the SOP specifies the steps required to manage scientific data, data products and information associated with OE Signature Expeditions from “end-to-end”; that is, from proposal through archive. Roles and responsibilities for SOP processes were also defined. During September 2006, NCDDC presented the draft SOP to the NOAA Data Centers and IPT members at a workshop held in Silver Spring, Maryland. During the workshop, the SOP was refined, accepted, and adopted by the IPT.

The SOP follows the flow of OE cruise activities, leveraging information collected during the pre-cruise and at-sea phases to generate post-cruise products including metadata records. Pre-cruise steps are designed to prepare the OE data manager for at-sea tasking and include software initialization and file system organization. At-sea steps include the execution of daily tasks such as data collection and report generation. Post-cruise steps include product generation such as completion of metadata records, creation of geospatial data, product publishing, and archive submission.

The SOP was tested during the 2006 *Submarine Ring of Fire* Signature Expedition. The end-to-end process generated 271 metadata records that were appropriately distributed to the archive centers with the corresponding data as follows: 504 gigabytes of video data to NCL; 5 gigabytes of geophysical data to NGDC; and 500 megabytes of oceanographic observation and vessel navigation data to NODC. As a result of these promising statistics, the SOP has been initiated for other OE Signature Expeditions dating from 2003-2006.

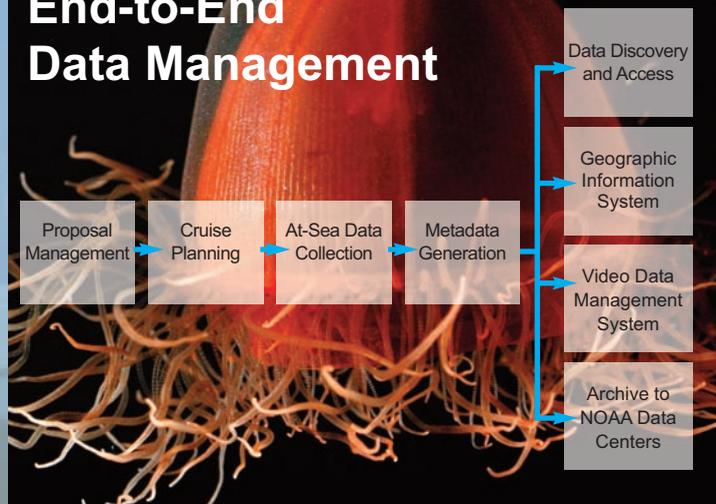
During the 2007 field season, the Cruise Information Management System (CIMS) will replace the original Expedition Information System (EIS) for OE Signature Expeditions. The improvements to at-sea data collection offered by the CIMS will further streamline the data management process. A key improvement will be the direct transfer of information from CIMS to MERMAid, preparing metadata records for secure review, and publishing as appropriate. As CIMS is deployed the SOP will be modified to reflect the more automated processes. (Note: CIMS discussed on page 8.)

By employing data management best practices to generate standard interoperable products, the IPT ensures timely end-user access to scientific data, data products, and information that contribute to NOAA’s evolving environmental and economic missions.

## LOOKING AHEAD

- Integrate CIMS into the OE end-to-end Data Management Standard Operating Procedures
- Implement the enhanced SOP for the OE 2007 field season
- Develop the SOP for non-signature expeditions
- Complete 2006 field season processing
- Evaluate data management requirements for remaining 2002-2005 cruises

## End-to-End Data Management



# PRODUCTS

One goal of the OE end-to-end data management process is the development of data products from data and information acquired during OE-sponsored expeditions. Products must meet the following requirements: conform to national standards for interoperability to fully serve a wide variety of end-users; provide access to information necessary to assess, measure, and report OE accomplishments; support planning future OE activities; and contribute to NOAA's evolving environmental and economic missions. During 2006, initial products created by the IPT were enhanced to include a wider variety of data products created as a result of the end-to-end data management process.

## The Digital Atlas

The OE Digital Atlas is a Geographic Information System (GIS) available to end-users through Internet map services. Initially developed as a prototype for the South Atlantic Bight, three new map regions were published during 2006 including the North Atlantic, the Arctic, and the Gulf of Mexico. Within each region, cruises may be sorted by year or theme. A total of 43 OE expeditions from field seasons 2002-2006 are represented within the Digital Atlas regions.

OE data is stored at NCDDC in a spatial database for display in the Digital Atlas. The amount and types of data available for viewing vary from one cruise to another, depending on the proprietary nature of certain data sets as determined by date collected and other variables. Typical data sets may include survey area, ship navigation tracks, submersible navigation tracks, dive

target sites and summaries, and non-dive scientific activity sites and summaries. Standardized reports, video highlights, and other products are linked to each cruise as available. All data and data products are coupled with FGDC metadata descriptions.

Within the Digital Atlas, data sets may be viewed in different combinations at different map scales. OE data are integrated with non-OE data such as National Data Buoy Center (NDBC) buoys, NGDC multibeam swaths and sediments, Naval Oceanographic Office bathymetry, as well as coastline, landmass, administrative boundaries and various other data sets which provide a common geospatial understanding.

## ACCOMPLISHMENTS

- **Four Digital Atlas regions are now available:**
  - South Atlantic Bight
  - North Atlantic
  - Arctic
  - Gulf of Mexico
- **Science Binder for OE library designed and implemented**
  - Generated five, archived one



NOAA Central Library Staff

Additional Digital Atlas regions will be developed during 2007. Advances in geospatial technology will be evaluated for incorporation into the Digital Atlas.

**The Video Data Management System**

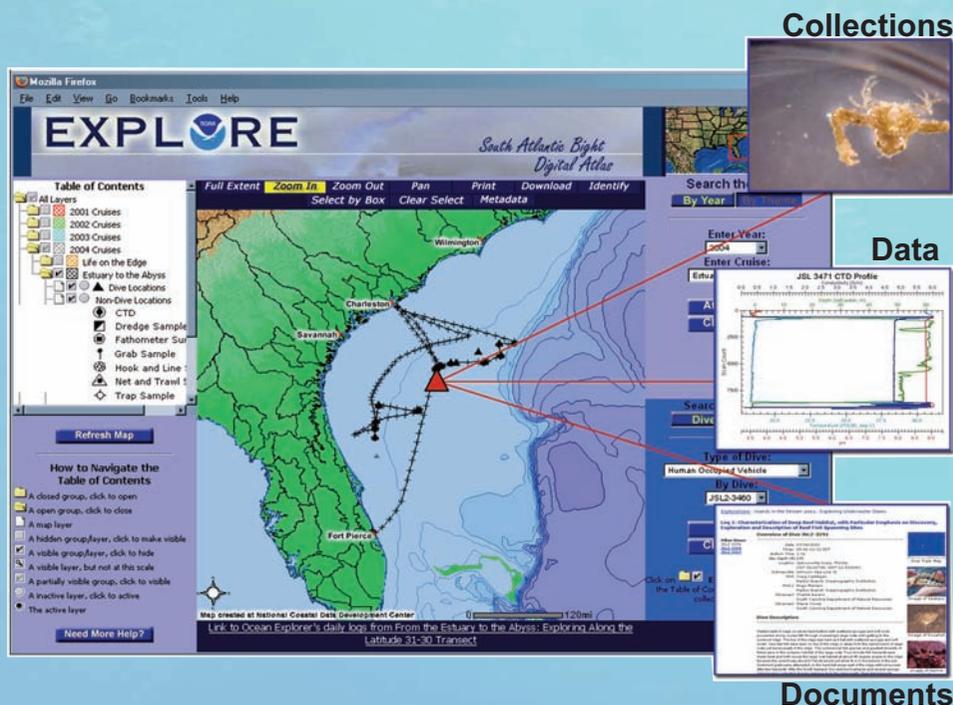
The NCL staff was integral to the formation of the Video Data Management System (VDMS), which addresses both digital video and digital image formats. In support of the OE requirements to document, store, and provide access to video and image information, the NCL presently provides online access to more than 2000 MiniDV's, 500 DVCAM tapes, over 1000 DVDs, and access to more than 100 digital video highlights clips. Metadata guidelines (DV12 and DI12) were developed to aid data managers and librarians in the creation of MARC21 standard metadata records. Plans for 2007 include expansion of NCL video editing capability and expansion of the VDMS to encompass the needs of other NOAA video and imagery collections.

**Data Discovery**

The OE end-to-end data management process results, in part, in the creation of standard metadata records. The process of validating and publishing FGDC metadata records enables data discovery from multiple sources including the NCDDC portal, the FGDC Clearinghouse System, and the Geospatial One-Stop (GOS), one of the electronic government (e-Gov) initiatives defined by the Office of Management and Budget (OMB). Digital Atlas components are also published to GOS.

The VDMS is available through the NOAA Online Library Catalog (NOAALINC). Also accessible online or in the NCL archives are OE cruise reports, lesson plans, and related documents such as the OE Cruise Binder which contains the proposal, cruise plan, reports, spreadsheets, paper logs, all DVDs and CDs, and other products. Copies of all pertinent reports, products, and data are used to generate the new OE Science Binders which will be housed within the OE office space.

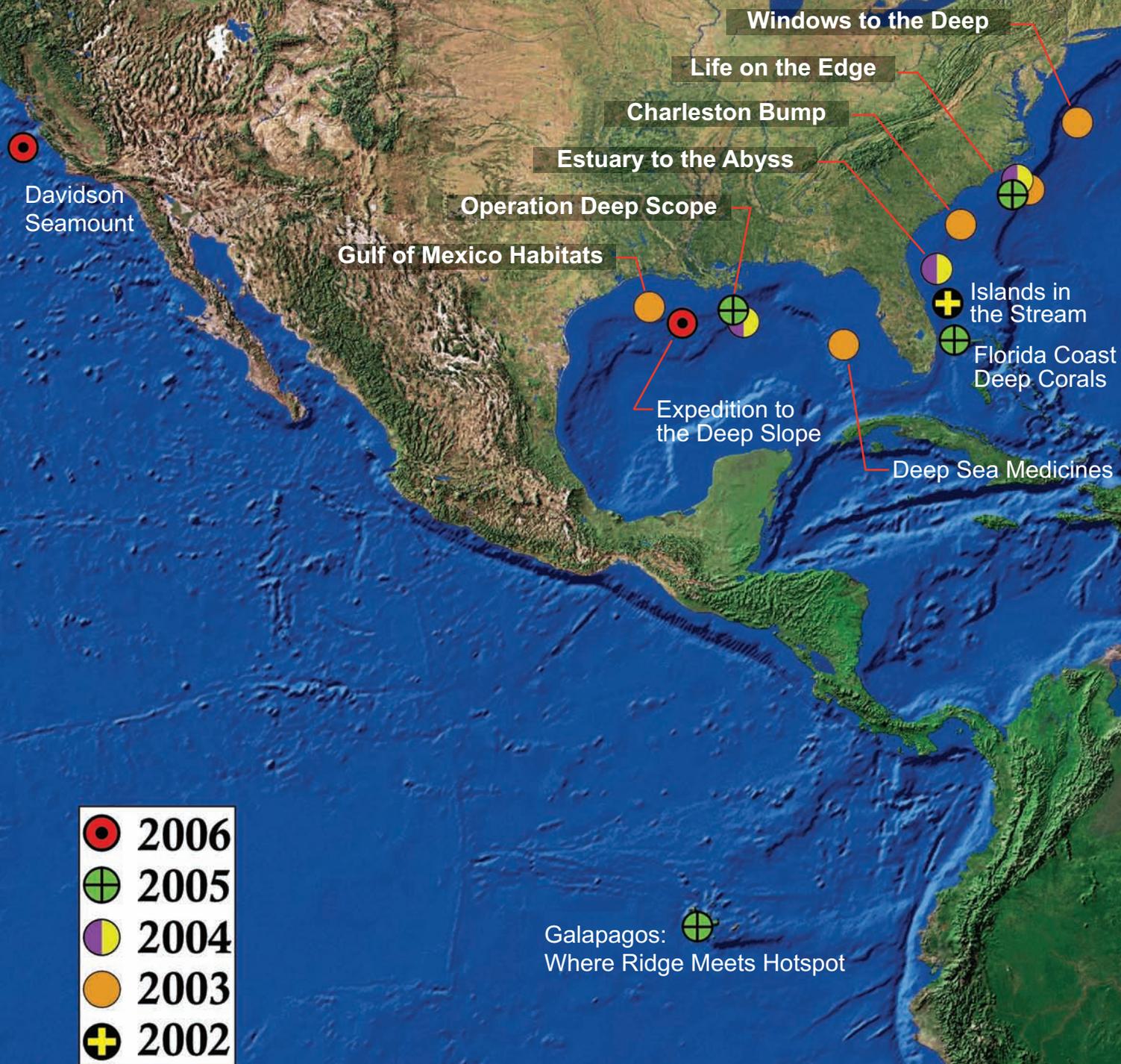
NCDDC maintains a website with public access to these products and secure access to a collaborative site for IPT members. Plans for 2007 include website modernization and further integration of these products with other OE products and access points.



## LOOKING AHEAD

- Examine new technologies to enhance Digital Atlas capabilities
- Optimize Digital Atlas for different end-user communities
- Integrate IPT products to main stream OE activities (marketing plan)
- Enhance OE lesson plans with geospatial components
- Expand the VDMS to incorporate the needs of other NOAA offices

# Expeditions in Data Management



# Americas

Titanic   
Mountains in the Sea 

Deep Atlantic Stepping Stones 

The Lost City 

# Mediterranean

Project Phaedra 

# Oceania

Submarine Ring of Fire 

Submarine Ring of Fire 

# Hawaii

Operation Laser Line Scan 

# Arctic

Hidden Ocean 

Russian-U.S. Arctic Census 

Gulf of Alaska 

# CRUISE INFORMATION MANAGEMENT SYSTEM (CIMS)

As part of the OE end-to-end data management process, NCDDC is developing the Cruise Information Management System (CIMS). In planning CIMS, the IPT considered the day-to-day workflow of OE activities while preparing and executing Signature Expeditions. Other considerations included the software and other tools currently in use within OE to address these tasks, the far-reaching network of OE staff and partners collaborating in expeditions, the complexity of the overall data management initiative, and the desired outcomes. A web-based application was proposed as the best solution to securely manage information and automate the generation of standard data products.



The CIMS high-level design addresses the need for proposal management, cruise planning, at-sea data collection, secure post-cruise access, and production activities. Phase I of the CIMS

## ACCOMPLISHMENTS

- Completion of CIMS Phase I development
- Successful Cruise Server testing during Operation Laser Line Scan Signature Expedition
- Controlled testing of Cruise Server by CIMS working group
- Automated generation of FGDC records and standard reports

design, the Cruise Server component for at-sea data collection and automated product generation, was successfully deployed in 2006. The Cruise Server currently contains all capabilities provided by the legacy Expedition Information System (EIS), with significant improvements and enhanced functionality throughout.

The Cruise Server integrates existing OE processes into a standardized work flow that streamlines and guides data collection activities, provides automated support for products, and enhances OE analysis capabilities. Experienced OE data managers collaborated with NCDDC software developers in designing the data entry interfaces. Logical screen layouts, aesthetics, and organized presentation of complex relationships were high priorities.

The Cruise Server provides the OE data manager with a unique data management tool, customized for each cruise based on the information defined in the proposal and cruise plan. Each cruise is customized with a unique cruise vocabulary, which maintains items in drop-down lists used throughout the user interface. Examples of vocabulary items are time zones, ocean basins and sub-basins, submersibles, and scientific instruments. Use of a customized vocabulary minimizes the workload for the data manager and reduces data entry errors. Methods of easily extending this vocabulary are provided, allowing user flexibility to adapt to the unexpected while preventing duplicate entries.

The Cruise Server features data entry assistance to reduce user keystrokes. Based upon the unique vocabularies, forms are pre-filled with default values and drop-down selection lists are focused where possible, allowing the data manager to override defaults as needed. Ease of use is supported through the CIMS tutorial, and a user suggestion mechanism is accessible from within the application. The Cruise Server strives to simplify data manager duties while ensuring data integrity.

The OE pre-cruise planning process produces a detailed itinerary for each day at sea. The Cruise Server incorporates this itinerary into a 'Daily Planner' conceptualized to provide the data manager with a snapshot of the day's scheduled tasks and guidance for task completion. Dynamic shipboard operations such as collection of raw data, physical samples or artifacts, or multimedia creation can be added to the Cruise Server as they occur. Another user interface presents the data manager's "To Do" list which tracks and presents outstanding tasks at a glance.

The CIMS Cruise Server workflow provides a logical process for entering cruise information and generating standard products and reports. FGDC compliant metadata records are produced programmatically from information entered throughout the process. Similarly, the report generation feature routinely provides standard reports such as daily "Situation Reports," dive summaries, video annotation logs, science activity logs, and dive operation logs.

The IPT CIMS working group and their willing colleagues conducted an external evaluation of the CIMS Cruise Server in July 2006. The software was exercised online in controlled tests which provided guidance and feedback. Issues were resolved and suggestions were implemented. In November 2006, NCDDC software developers took the Cruise Server on a sea trial during the *Operation Laser Line Scan Signature Expedition*. The developers evaluated the CIMS software performance in a real-life situation and completed further testing and development while at-sea.

The CIMS Cruise Server will support OE data managers during Signature Expeditions during the 2007 OE field season. An online tutorial and a quick start guide will deploy with the software, and a detailed design document is available upon request.

### LOOKING AHEAD

- **Design and develop a Cruise Portal to provide access to multiple Cruise Server instances from a single location**
- **Design and develop a Cruise Planning interface to initialize the CIMS Cruise Server with cruise plans**
- **Design and develop a Proposal Management interface to initialize the CIMS Cruise Server with proposal information**

# OKEANOS EXPLORER DATA STRATEGY

In the spring of 2008, NOAA expects to commission a dedicated ship of exploration, the Okeanos Explorer. This ship is designed to carry out a systematic, global program of explorations in the ocean. The recorded data will be linked to user communities in real time through satellite and Internet telepresence technology. These exciting new technical capabilities also create a new paradigm for data management and will require a unique data management plan.

In 2006, the IPT formed the Okeanos Explorer Working Group to begin formulation of recommendations for data management that will work in concordance with the new operational paradigm. Working group members represent a cross section of staff from NOAA and partner agencies including the NOAA Marine and Aviation Operations (NMAO), National Undersea Research Program (NURP), NCDDC, OE, and the Institute for Exploration (IFE.)



Photo by U.S. Navy

**Former Navy ship USNS Capable before beginning conversion to NOAA's Okeanos Explorer.**

## ACCOMPLISHMENTS

To date, the key focus for the Okeanos Explorer Working Group has been to plan the incorporation of CIMS into the NOAA Shipboard Computing System as an integrated software application. The goal of this integration is to provide an automated capability to generate metadata records for raw data collections and video generated during ship operations.

## LOOKING AHEAD

The Okeanos Explorer Working Group will expand to evaluate product and archive requirements for streamed data, and to plan methods to meet these new requirements.

# DATA POLICY

In 2006, the Data Policy Working Group was formed to research, examine, adopt, and author policies that would affect and protect the issues surrounding the end-to-end management of data from OE-sponsored expeditions. The group's mission is defined as follows:

*“Under the direction of legal counsel, develop policy in support of the other IPT working groups to address issues regarding proprietary rights to data, samples, and products that are the direct result of research and technology efforts funded by OE.”*

A working group lead was selected from the OE staff. Representatives from OE, the NOAA National Data Centers, the National Marine Sanctuaries Program, and the National Undersea Research Program participated in the group's activities. Policies developed by this group will be implemented within the OE Announcement of Opportunity, Data Management Submission Agreements, and within the automated data management systems.

## ACCOMPLISHMENTS

- **Drafted OE data policy questions**
- **Began research into Federal and other applicable policies**
- **Drafted timelines for geospatial data and information publishing for review by the OE Data Management Goal Team**

## LOOKING AHEAD

- **Discern, categorize, and prioritize the needs for policy, guidance, and standards**
- **Continue to research and review existing policies for adoption**
- **Develop closer alignment with IPT working groups to better focus policies on specific data management functions**

# INTEGRATED PRODUCT TEAM

A key recommendation of the October 2000 Frontier Report was for NOAA to establish a broad-based data management task force to design and implement an integrated and comprehensive data management system. In October 2002, NESDIS accepted this charge and formed an Integrated Product Team (IPT) in partnership with OE and other NOAA and non-NOAA partners.

Under the leadership of the NOAA Central Library Director, the IPT forms a framework for stakeholders in the OE data management mission. The IPT

membership has expanded and contracted since its inception. Working groups and Tiger Teams have formed, set and achieved goals, dissolved and reformed in an adaptive manner in response to accomplishments and the evolving data management mission.

During 2006, the IPT continued to evolve. The core NESDIS Team was joined by OE staff and new strategic partners to an unprecedented degree. The chart below summarizes the 2006 IPT working groups and participant agencies.

## 2006 IPT working groups and participant agencies

	Executive Committee	Documentation	Products	Data Management	CIMS			Data Policy	Okeanos Data Strategy
					CIMS - Proposal	CIMS - Cruise Planning	CIMS - Data Collection		
Institute for Exploration									X
National Coastal Data Development Center	X	X	X	X	X	X	X	X	X
National Geophysical Data Center	X	X		X					
National Marine Sanctuaries Program							X	X	
National Oceanographic Data Center	X	X	X	X					
National Ocean Service - Special Projects	X		X						
NOAA Central Library	X	X	X	X					
NOAA Marine and Aviations Operations	X					X	X		X
NOAA Ocean Exploration Program	X	X	X	X	X	X	X	X	X
NOAA Undersea Research Program	X		X		X	X	X	X	

## STRATEGIC PARTNERSHIPS

The National Undersea Research Program (NURP) has been an integral part of the Integrated Product Team (IPT) since its inception in 2002. A proposal management tool developed at NURP, called the Management Information System (MIS), was one of the basic functional components integrated into the OE Cruise Information Management System (CIMS) design. As NOAA moves toward the establishment of a coordinated national ocean exploration program through the organizational integration of OE and NURP, strategic planning for OE data management has been expanded to include NURP participants. NCDDC is a member of the OE-NURP Data Management Goal Team and participated in a November 2006 workshop to discuss the IPT and the current status of OE data management activities. During 2006, NURP participation in IPT working groups increased. The IPT has responded with an increased focus on understanding NURP data management needs.

The National Marine Sanctuaries Program (NMSP) and OE enjoy a longstanding partnership in exploration. During 2006, this partnership expanded to include NMSP participation in the IPT. As part of the CIMS working group, NMSP staff contributed to the development of software requirements, shared operational forms, and participated in the July 2006 interactive CIMS test. In anticipation of the 2006 *Davidson Seamount: Exploring Ancient Coral Gardens* cruise, NCDDC staff trained NMSP personnel to use OE data management tools. Cruise information was gathered using these tools and was returned to NCDDC for integration into the OE end-to-end data management system.

The NOAA Marine and Aviation Operations (NMAO) is working in close collaboration with OE in preparing the Shipboard Computing Systems (SCS) and planning the data management strategy for the Okeanos Explorer. NCDDC has provided input to NMAO on how the CIMS Data Collection module might integrate with the Okeanos Explorer. The goal of this integration is to generate metadata for unprocessed video and sensor data streaming into the remote science consoles and to the NOAA archive centers. NMAO is also a partner in defining requirements for the CIMS Cruise Planning module.

As part of the South East Deep Sea Corals Initiative (SEADESC) project, three principal investigators from different agencies agreed to share individual research toward a common goal – the characterization of complex bottom habitats. Working with OE, NCDDC assisted in gathering this information and in developing common formats to facilitate public dissemination of SEADESC data products.

**For suggestions or more information, contact:**

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