

# The National Oceanographic Partnership Program, Ocean.US, and Real Movement Towards an Integrated and Sustained Ocean Observing System

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The National Oceanographic Partnership Program (NOPP) was legislatively established in 1997 in Public Law 104-201 to promote a number of national goals through improved knowledge of the oceans and to strengthen oceanographic efforts by creating partnerships among Federal agencies, academia, industry, NGOs and other stakeholders of the national oceanographic community. NOPP is a formal collaboration of fourteen U.S. government agencies that are directly involved in oceanographic research, operations and education. In the area of ocean observation and prediction, NOPP areas of interest and investment have included data assimilation and modeling, fostering the development of technologies for ocean observing systems, and, in particular, providing a national leadership forum to foster the development and maintenance of an integrated and sustained ocean observing system that will meet national needs, while also serving as the U.S. component of a global ocean observing system. In response to Congressional interest, two reports were completed in 1999 under the auspices of NOPP that provide a framework and strategy for achieving a fully integrated and sustained capability for ocean observations through the establishment of a program office, Ocean.US, to oversee this national enterprise. In May 2000, Congress was informed of the decision to establish Ocean.US and, following a period of discussions and interagency negotiations, the Office was formally established in October of 2000. Early actions of Ocean.US included establishing an independent physical presence in the national Capitol region and building a staff from personnel from the principal NOPP agencies.

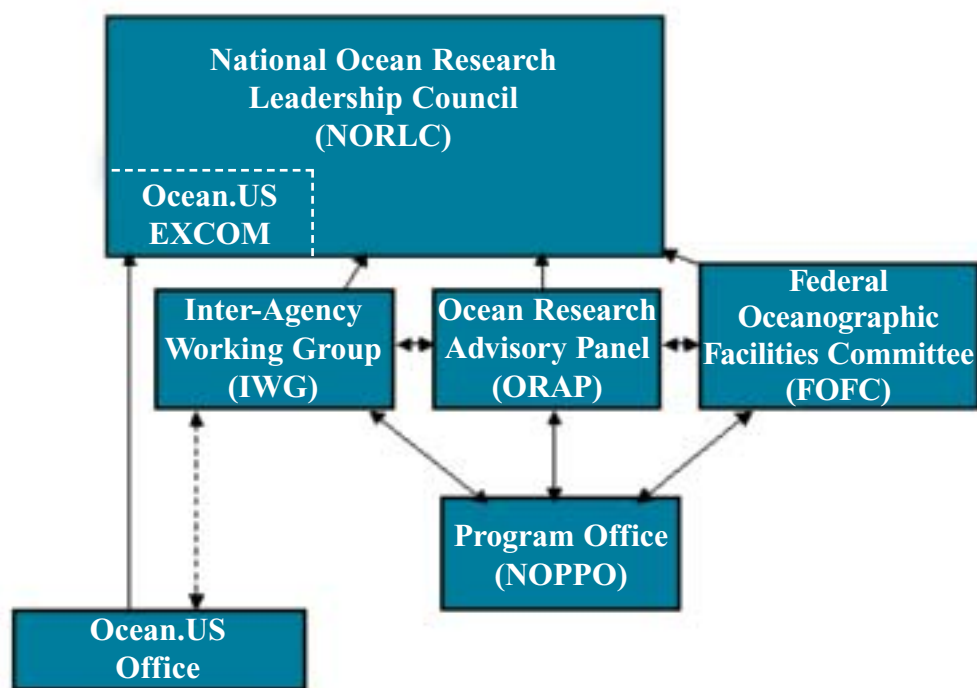
In March 2002, Ocean.US hosted and led a national ocean observing workshop at the Airlie Center located in Warrenton, Virginia that resulted in two central documents reflecting the national ocean community consensus on the way forward towards achieving an integrated and sustained ocean observing system (IOOS). The documents articulate a design for the IOOS consisting of a global module, a national backbone of coastal observing stations, and a federation of regional observing systems, which are seamlessly

integrated through a competent and robust Data Management and Communications (DMAC) System. In May of 2002, Ocean.US delivered the Workshop meeting Summary Plan for such a system to the National Ocean Research Leadership Council (NORLC), which immediately forwarded the plan to the President's Science Advisor. In February 2003, following formal review of the Summary Plan by the National Science and Technology Council, the Plan was officially forwarded, unaltered, to the Congress by the White House. Follow on events have included a Regional Observing Summit in Washington, D.C. and the delivery of the DMAC Plan to Ocean.US.

## Introduction

The oceans are of fundamental importance to our society. They are energy sources and modifiers of our weather, a buffer for the security of our nation, vast reservoirs of living resources, natural laboratories for scientists and educators, highways for national and international commerce and places of recreation for our citizenry. Human population growth and its preferential concentration in coastal regions around the world however is subjecting the oceans, particularly the coastal ecosystems, to increasing pressures and damaging their ability to deliver the goods and services, with those services ranging from the dilution of human effluent to serving as nursery grounds for commercial fisheries, upon which we have come to depend. In order to make rational, scientifically sound decisions about a host of activities that impact the ocean and coastal ecosystems, we must have two fundamental capabilities: first, we must be able, on a comprehensive and cosmopolitan basis, to monitor the present state of the ocean and coastal ecosystems, and second, we must be able to make robust predictions about the future states of these ecosystems. We have neither of these capabilities today.

As a nation, the United States has historically responded to these two grand challenges in an uncoordinated and frequently competitive fashion. Thus, when considering the sum of all ocean monitoring



**Figure 1.** The leadership structure of the National Oceanographic Partnership Program (NOPP). The Leadership Council (NORLC), the Ocean Research Advisory Panel (ORAP) and the NOPP Program Office (NOPPO) were legislatively mandated in PL 104-201. The Inter-Agency Working Group (IWG), Ocean.US and the Federal Oceanographic Facilities Committee were formed and/or placed under the NORLC by direction of the Principals on the Leadership Council.

**Table 1:**  
**NOPP Member Agencies**

United States Navy  
 National Oceanic and Atmospheric Administration (NOAA)  
 National Science Foundation (NSF)  
 National Aeronautics and Space Administration (NASA)  
 Department of Energy (DoE)  
 Environmental Protection Agency (EPA)  
 U. S. Coast Guard (USCG)  
 U. S. Geological Survey (USGS)  
 Defense Advanced Research Projects Agency (DARPA)  
 Minerals Management Service (MMS)  
 Office of Science and Technology Policy (OSTP)  
 Office of Management and Budget (OMB)  
 Department of State (DoS)  
 U.S. Army Corps of Engineers (USACE)

related efforts across the various governmental components of our federalist structure (e.g., federal, tribal, state and local), these programs are frequently duplicative, are inherently inefficient from a resource expenditure standpoint, and, most importantly, they fail to deliver information and knowledge on the causes and consequences of anthropogenic actions and natural variability in a timely enough manner to allow their incorporation into scientifically sound decision making about the ocean and coastal environment. This need not be the case. There has been a convergence of interests and understanding about the importance of developing and maintaining an integrated and sustained ocean observing system (IOOS) in both the international and national arenas over the past decade. Because of this decadal focus on sustained ocean observations and convergence of interests in the political realm that understand the importance of developing this vital national capability, the time has come to close the gap between scientifically sound, long-term ocean observations and the decision making process.

## Background

The need for sustained and comprehensive ocean observing and prediction has taken on increased urgency during the last decade. Formal planning for the international Global Ocean Observing System (GOOS) began during this period (Intergovernmental

Oceanographic Commission, 1998) under the aegis of the United Nations Environmental Program, the Intergovernmental Oceanographic Commission (IOC), the World Meteorological Organization (WMO), and the International Council for Science. The international concept for GOOS consists of two interconnected modules: a global, open-ocean module, and a coastal module.

In the United States, the past decade also saw increased focus on the planning for a sustained and integrated U.S. component for the international GOOS effort. Following a number of Congressional hearings beginning in 1994, the formal federal response to this need resulted in the creation in 1997 of The National Oceanographic Partnership Program (NOPP) and its oversight body, the National Ocean Research Leadership Council (NORLC) shown in Figure 1, which were legislatively established (Public Law 104-201) to promote a number of national goals through improved knowledge of the oceans and to strengthen oceanographic efforts by creating partnerships among Federal agencies, academia, industry and other members of the oceanographic community. This was followed in 1998 by the formation of the United States GOOS Steering Committee (USGSC) that was initially charged with developing the requirements for the U.S. IOOS though its role has been considerably expanded.

NOPP itself is a formal collaboration of fourteen U.S. government agencies (Table 1) that are directly involved in oceanographic research, operations and education. The National Oceanographic Partnership Program was established for the following purposes:

1. To promote the national goals of assuring national security, advancing economic development, protecting quality of life, and strengthening science education and communication through improved knowledge of the ocean; and

2. To coordinate and strengthen oceanographic efforts in support of those goals by:

- Identifying and carrying out partnerships among Federal agencies, academia, industry, and other members of the oceanographic scientific community in the areas of data, resources, education, and communication, and
- Reporting annually to Congress on the Program.

The program goal is to achieve more by agencies working together as a cohesive unit than a single agency, or even a subset of agencies, can accomplish alone. Through NOPP, the public and private sectors can work together to support larger and more comprehensive projects, promote sharing of resources, and foster community-wide innovative advances in ocean science, technology, and education. Through NOPP, these

agencies identify broad issues of importance to oceanography and fund activities that involve partnerships from academia, government, industry and non-profit organizations. Areas of specific interest include fostering the development of capabilities for ocean observing systems, data assimilation and modeling, and pre-college education. Particular emphasis has been focused on developing a plan for a U.S. integrated ocean observing system that would meet national needs, while also serving as the U.S. component of a global ocean observing-system.

In this regard and in response to a Congressional request for "a plan to achieve a truly integrated ocean observing system", the report, "Toward a U.S. Plan for an Integrated, Sustained Ocean Observing System" was prepared by a joint federal/non-federal Task Team (NORLC, 1999a). This led to a set of implementing recommendations in the Ocean Research Advisory Panel (ORAP) report "An Integrated Ocean Observing System: A Strategy for Implementing the First

Steps of a U.S. Plan" that was delivered in December 1999 (NORLC 1999b). On May 22, 2000, based on the ORAP Report implementation recommendations, the NORLC approved the establishment of an office having the charter to integrate existing and planned elements to establish a sustained ocean observing system to meet the common research and operational agency needs in the following areas:

- Detecting and forecasting oceanic components of climate variability
- Facilitating safe and efficient marine operations
- Ensuring national security
- Managing resources for sustainable use
- Preserving and restoring healthy marine ecosystems
- Mitigating natural hazards
- Ensuring public health

The formation of this interagency program office was jointly announced by the Chief of Naval Research, the Administrator of NOAA, and the President of the Consortium for Ocean Research and Education on May 25, 2000 at a joint hearing of the House Resources Subcommittee on Fisheries, Conservation, Wildlife, and Oceans and the Armed Services Subcommittee on Military Research and Development to examine the status of implementing the recommendations of the ORAP report.

## Initial Tasks of the Interagency Program Office

While the end goal of this multi-year effort is the establishment of a robust and sustained ocean

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observing system for the nation, early efforts of the program office and its small staff necessarily focused on more pedestrian, but essential administrative and logistic issues that would permit the ultimate vision to be achieved. Among these were the establishment of a physical and virtual, web-based presence, the securing of sufficient resources for office operation and beginning the process to define the way forward in this collaborative national effort.

Having informed the Congress of the formation of an interagency program office to oversee the national integrated and sustained ocean-observing system (IOOS), one of the first challenges facing the agencies of NOOP was deciding what to name it. Discussions at the monthly Interagency Working Group (IWG) meetings, then led by Dr. Steve Ramberg, centered on this issue with a number of ideas offered but ultimately discarded. Dr. Mel Briscoe suggested the classical name "Oceanus" to subtly reflect the connection of the ocean with the United States but the journal of the same name published by Woods Hole Oceanographic Institution precluded its adoption. Undeterred, Mel suggested Ocean.US and the name stuck. (Briscoe, M: personal communication, 18 Sep 2003).

Drafting and modifying a formal interagency Memorandum of Understanding (MOU) between the agencies that would actually establish the office occupied the months following the Congressional hearings in May of 2000. By October of that year, agency concerns had been addressed, effective resistance had been largely eliminated and the MOU was ready for signatures. The MOU specified that Ocean.US would come into formal existence upon the fourth signature from an NORLC Principal and it was assumed that the leaders of the "Four N's" (e.g., Navy, NOAA, NSF and NASA) that provide the bulk of NOPP resources would be the first four signatories. Indeed, the leaders of the Navy, NOAA and NSF signed the MOU within two weeks of each other and the document was ready for signing by NASA but that agency's legal team had some concerns so NASA withheld its approval for a period of time. The Director of the Mineral Management Service, Mr. Walt Rosenbush, was the fourth NORLC Principal to sign the MOU bringing Ocean.US into formal existence on October 25, 2000. The MOU has now been signed by nine federal agencies, including NASA.

The process of selecting a suitable location for Ocean.US generated a rather surprising amount of tension as the federal agencies wrestled with the implications of the interagency office and their understandable desire to keep the office under close observation. The Navy suggested empty space at the Naval Observatory in Georgetown would be a nice location

and NOAA opined that Silver Spring offered suitable facilities. Both offers were generous and sincere and both were rejected for the same reason—locating Ocean.US at facilities controlled by any single NOPP agency would have implied a particular agency parochialism that would have doomed the effort from

the start. In an effort to lessen the volume of this debate, a minor calculation of the geographic centroid of the actual physical locations of the offices of the fourteen NORLC principals was performed (the calculated centroid was at the southern end of Roosevelt Island in the Potomac River near the Francis Scott Key bridge). While this was not meant to have any compelling impact, it lightened the solemnity of the issue and allowed the search for a physical location for Ocean.US to focus in regions of the National Capital Region not intrinsically connected with any

particular NOPP agency. The present location of Ocean.US in Arlington, Virginia is a reasonable one in this respect.

By August of 2001, the physical office space for Ocean.US had been leased and renovated, furniture and computers procured, staff identified and seconded from the participating NOPP agencies and a web presence established. Having its own identity accelerated the activities of Ocean.US and permitted its full-time focus on the principal goal of developing, articulating and obtaining approval for the plan to achieve the national IOOS.

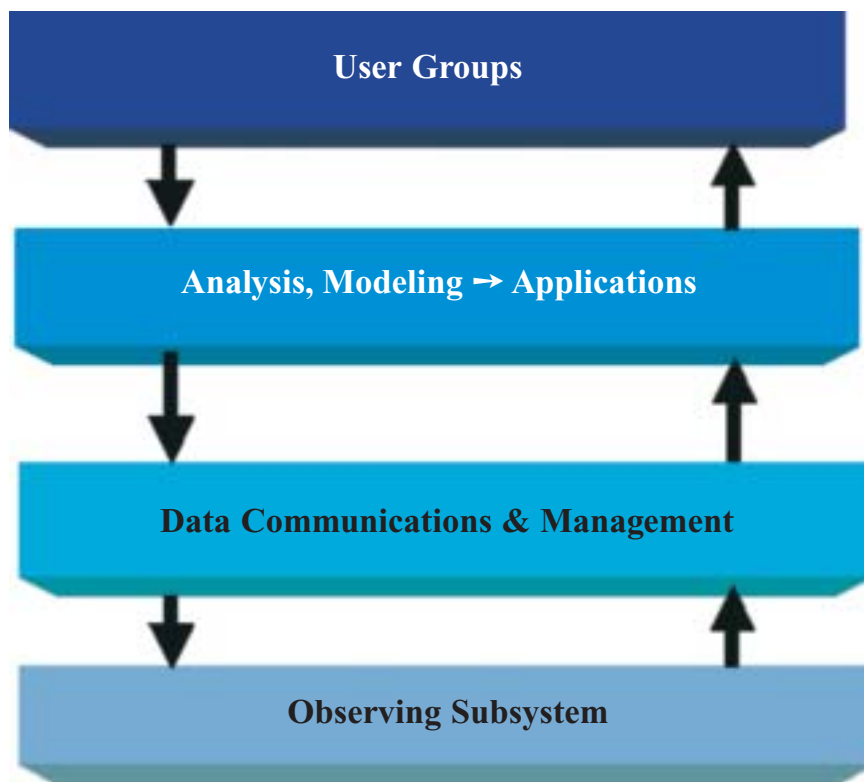
## The IOOS—A Description of the Vision

In discussing the national IOOS effort, it is important to describe the pivotal efforts of the US GOOS Steering Committee (USGSC) in the years preceding the formal physical establishment of Ocean.US. The USGSC performed stellar service in building a strong, multi-faceted, IOOS-supporting constituency across the many ocean community stakeholder groups (i.e., government, private sector, industry, NGOs, etc.) The supporting expert body that is the USGSC provided guidance and input with respect to technical and scientific aspects of a national IOOS. Ocean.US is strictly Federal, and is staffed by representatives from the NOPP agencies. The U.S. GOOS Steering Committee has mixed membership from the public and private sectors; it functions on behalf of the NOPP agencies interested in the IOOS and serves as an interface to stakeholders. In a sense, the two organizations are symbiotic—and their actions are closely coordinated. The USGSC worked diligently to build the national technical framework upon which the federal efforts of Ocean.US were constructed. This meant that Ocean.US did not have to start the process of designing and implementing a national IOOS from a clean slate; the USGSC's efforts had already articulated the broad

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**Figure 2.** The IOOS is user-driven since users needs and requirements dictate which parameters are measured, how data are managed and analyzed, and the speed with which data and products become available to users. To accomplish this linkage between user needs and measurements, a robust two-way flow of data and information is required between three necessary subsystems: (1) the Observing Subsystem, (2) The Data Communications and Management Subsystem, and (3) the Analysis, Modeling and Applications Subsystem.

technical outlines of this national effort. In this respect, the configuration of the developing national IOOS itself, which is to be the U.S. contribution to the international GOOS effort, necessarily parallels that of the international GOOS in consisting of two components: a global, open-ocean component; and a coastal component focused the coastal waters to the edge of the nation's Exclusive Economic Zone (EEZ). The global component will be of primary interest to users in the scientific, climate, national security, and marine operations sectors. The coastal component will be of interest to these sectors plus a host of others, including state and local marine resource managers, public health, recreation, homeland security, and transportation.

The global component is considered to be entirely a federal responsibility with observations funded through the various operational and scientifically focused federal agencies; note however that not all elements will necessarily be carried out by the agencies. As is the case now, some of these efforts if they are research focused will be conducted by academia while

others may be cost shared with the states or contracted to the private sector.

In the coastal regions, the federal government is expected to fund a suite of core observations contributing to the coastal component; these federally funded coastal observations, including the existing federal efforts within the EEZ, are termed the coastal backbone observations. Other entities (Tribal, state, regional and local governments, the private sector, academia and non-governmental organizations) will contribute supplemental observations they are presently collecting to the coastal component, and with additional resources, will densify ocean observations to address particular regional needs through the establishment of Regional Observing Associations. These Associations will together form a U.S. federation of coastal ocean observing systems.

To seamlessly integrate across both the global and coastal observing modules and between the various Regional Associations, a robust and fully competent data management and com-

munications (DMAC) system must be funded and developed. Historically, the ocean community has been consistent in its treatment and funding of data management and communication—it has done this vital function poorly. For the IOOS to succeed, data management and communications are being considered and funded from the inception of this national effort, not as an afterthought.

The integrated ocean observation system itself will be an end-to-end heterogeneous, distributed system of linked elements, with organizational structures and interfaces developed where common good is identified. The IOOS, therefore, is conceived to be a system-of-systems, consisting of the physical links, servers, and other elements that contribute to user-defined missions, regardless of their ownership or operational responsibility. The context of an end-to-end system is central to the successful development of the national IOOS since only such a construct will be able to routinely generate user-relevant products over the long term necessary to develop a constituency that will demand the continued funding of the IOOS effort.

The concept of the end-to-end nature of the IOOS is shown in Figure 2 and it consists of the following, interrelated components connected by a two-way flow of information and data:

- The Observing Subsystem consisting of the platforms, sensors, instrumentation and techniques necessary to measure required parameters at the temporal and spatial scales relevant in addressing particular to detect and predict changes in coastal indicators;
- The Data Communications and Management Subsystem which consists of the hardware and software to provide physical telemetry, exchange protocols and standards for quality assurance and control, data dissemination and exchange, archival, user access); and
- The Analysis, Modeling and Applications subsystem consisting of data assimilation and blending techniques, data and knowledge synthesis and analysis; and the procedures for translating data and knowledge into user-specified products

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## The IOOS—Achieving Consensus on the Vision

Although the broad outlines of the national IOOS were understood as described above, it was necessary to achieve a national consensus on the specifics of what the U.S. ocean observing system should do, how it should be organized and governed, and what the priorities should be in its implementation. To achieve this broad community consensus, Ocean.US in collaboration with the member agencies of the National Oceanographic Partnership Program and the U.S. Global Ocean Observing System Steering Committee, hosted a workshop March 10–15, 2002, at the Airlie Center in Warrenton, Virginia to develop a strategic design plan for the integrated U.S. Ocean observing system.

Important aspects in developing an integrated ocean observing system plan that were specifically addressed at the Ocean.US Workshop included reaching national ocean community consensus on the following:

- What ocean observing systems are needed to meet broad societal and scientific goals,
- What ocean observing systems are available or planned,
- What gaps exist between ocean observation requirements and our present or planned capabilities, and
- What are the resource implications inherent in addressing these gaps in a phased, prioritized manner?

Staying consistent with the assigned charge of Ocean.US, the societal and scientific goals addressed at the Workshop were grouped under the seven broad categories of: Detecting and forecasting oceanic components of climate variability; Facilitating safe and efficient marine operations; Ensuring national security; Managing resources for sustainable use; Preserving and restoring healthy marine ecosystems; Mitigating natural hazards; and Ensuring public health

It was imperative that the external ocean community be directly involved in this process to ensure the resulting consensus reflected the broadest scope of affected users and providers of ocean data and information. Accordingly, great care was taken to achieve a balance amongst the workshop participants from across the spectrum of stakeholders in the oceanographic community. This balance necessarily included representatives of Federal, state and local governments, industry,

academia, non-governmental organizations and others concerned about the impact and importance of integrated and sustained ocean observations. Further, the workshop had in attendance individuals with the necessary expertise to allow the successful attainment of the workshop goals. Finally, individuals with understanding of the needs of the many users of data from an integrated ocean observing system were identified and actively participated in this workshop.

The workshop endeavored to articulate the community consensus on what constitutes the core set of ocean measurements or observations that satisfies the maximum number of goals of the federated system. Based on this consensus, various observing technologies were examined to determine the optimum methods for measuring various ocean phenomena in terms of:

- What is ready to implement now?
- What should be funded to transition from research to operations?
- What technological or observational efforts would benefit from focused research efforts?

At the workshop, consensus was reached on the vision for the observing system, the core elements of the system that should be federally supported, and a process to charge a separate group of experts to develop a community plan for the needed data management and communications (DMAC) components of the IOOS. Based on that workshop and review/advice by the U.S. GOOS Steering Committee, Ocean.US prepared an initial design and implementation plan for the integrated and sustained ocean observing system for the United States (Ocean.US, 2002a) and a detailed, scientific workshop proceedings report (Ocean.US, 2002b).

The initial design and implementation plan noted that successful development of the IOOS requires the




establishment of (a) a process for selectively incorporating, enhancing and supplementing existing observing programs, (b) an integrated data management system, (c) procedures for migrating new knowledge and technologies from research into the operational observing system, and (d) mechanisms for ongoing evaluations of system performance to ensure user needs were being addressed. This Ocean.US report estimated the additional annual cost of a fully-implemented IOOS to be approximately \$500M in constant dollars and that an initial investment should be provided to allow for the funding of high-priority efforts to permit the IOOS to be fully functional by the end of the decade.

The Ocean.US report was approved by the NORLC and transmitted to the White House via the Office of Science and Technology Policy on May 23, 2002. Following a review of the report by the National Science and Technology Council, the White House forwarded the Ocean.US report unaltered to the Congress on February 26, 2003.

Subsequent Ocean.US activities have included the hosting of a national Regional Observing System Summit and the demanding work of drafting of a three part, detailed implementation plan for the IOOS (Ocean.US, 2003: Implementation of the Initial U.S. Integrated Ocean Observing System, available on line: [http://www.ocean.us/documents/docs/ioos\\_plan\\_6.11.03.pdf](http://www.ocean.us/documents/docs/ioos_plan_6.11.03.pdf)) Additionally, the group chartered to develop the community consensus on the specifics for the Data Management and Communication Plan has completed its initial efforts and has made its report available for public comment (Data Management and Communications Steering Committee, 2003: The U.S. Integrated Ocean Observing System (IOOS) Plan for Data Management and Communications, available on line: [http://www.dmac.ocean.us/dacsc/imp\\_plan.jsp](http://www.dmac.ocean.us/dacsc/imp_plan.jsp))

## Summary

The oceans are of fundamental importance to the health, national security and economy of the United States. Decades of focused investments in ocean observing and predicting have produced numerous examples of substantive societal benefit resulting from improved knowledge of ocean parameters and behavior. However, more complex and difficult questions about the ocean, particularly in the coastal regions, remain to be answered. Addressing these more complex issues requires innovative approaches to stimulate collaborative ventures between academia, industry, and tribal, local, state and federal government entities. The National Ocean Partnership Program (NOPP) has focused substantial resources on such collaborative efforts over the last several years and its recent decision to establish a focused interagency, collaborative approach to this matter through the establishment of Ocean.US has accelerated the effort to deploy and maintain an integrated and sustained ocean observing and predicting capability for the nation. 

## Acknowledgements

The success of paradigm-defining programs such as the National Oceanographic Partnership Program, Ocean.US, and the IOOS are dependent upon the actions, professionalism, and commitment of an exceptionally large number of people. Any attempt to note the profound impacts of all those involved in establishing NOPP and Ocean.US in a short paragraph is thus doomed to inadequately acknowledge all those whose efforts were vital to the success to date of this enterprise. Recognizing this, but believing that the actions of a few will illustrate the impacts of many, I offer the following. Beginning in the early 1990's, ADM James Watkins, then President of the Consortium of Oceanographic Research and Education, and Rick Spinrad, the Technical Director of the Consortium, were instrumental in developing and sponsoring the effort that lead to the creation of NOPP. Once NOPP was established they continued to be tireless supporters of this effort as each moved on to other senior leadership roles in the community. At the Office of Naval Research (ONR), Steve Ramberg played a quietly powerful leadership role in the leading the Interagency Working Group of NOPP and successfully nurturing the increasingly multi-agency sponsorship of numerous NOPP projects. Mel Briscoe provided cogent counsel on a wide variety of issues—far more than merely providing the name of Ocean.US. Tom Nelson, also working at ONR, was a principal leader involved in all NOPP programmatic actions—he is greatly missed by all who had the good fortune to know him. The initial staff at Ocean.US, Steve Piotrowicz, Tom Malone, Patrick Dennis, Muriel Cole, Roz Cohen, Larry Atkinson, and for an important interval, Shelby Walker, braved the bureaucratic minefields in establishing the office and articulating the ocean community's vision through the Airlie Center endeavor, with superb grace—the community is fortunate to have them and those that continue to staff the office and support this vital endeavor.

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