DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
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IN REPLY REFER TO

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17 Jan 03

Admiral James D. Watkins
Chairman
U.S. Commission on Ocean Policy
1120 20th Street, NW
Suite 200 North
Washington, DC 20036

Dear ~~Admiral~~ Admiral Watkins:

Enclosed are answers to the three questions posed to me by the U.S. Commission on Ocean Policy in the letter dated December 9, 2002. Thank you for this opportunity to follow up on the testimony I presented to the Commission, October 30, 2002, as part of the Data Management panel. I was pleased to be able to present the data policies and operational principles for the Navy meteorology and oceanography community to the Commission. These additional questions have enabled me to expand on some of the ideas that were presented in the original testimony.

Please do not hesitate to contact my office if you have any further questions. My point of contact is Dr. Cynthia Decker (N962DB) 202-762-0272.

Sincerely,

RICHARD W. SPINRAD, Ph.D.
Technical Director
Oceanographer of the Navy

Enclosure: 1. Answers to questions

Copy to: DoD Task Force

P.S. Delighted to see Ocean Commission's serious interest in IOOS

U.S. Commission on Ocean Policy
Testimony of Dr. Richard Spinrad, Office of the Oceanographer of the Navy
Answers to Follow-Up Questions (December 2002)

1. How can the Nation leverage the Navy's investment in oceanographic infrastructure to best serve national as well as defense needs?

The U.S. Navy has developed one of the most advanced and capable infrastructures in the world for collection and management of ocean data. The full leveraging of this infrastructure by NOPP will be crucial to the successful implementation of an integrated ocean observing system (IOOS) in the U.S. The Navy remains fully committed to playing a prominent role in the success of the IOOS.

The Navy's infrastructure for oceanography encompasses oceanographic operations, research, and education. The Oceanographer of the Navy is the program sponsor for operational oceanography, which is carried out by the Commander, Naval Meteorology and Oceanography Command through the Naval Oceanographic Office (NAVOCEANO) at Stennis Space Center, MS, the Fleet Numerical Meteorology and Oceanography Center (FNMOC) in Monterey, CA, and by Navy's METOC centers, detachments, and METOC officers around the world. Oceanographic research is managed by the Office of Naval Research and performed by the Naval Research Laboratory, academic and industrial laboratories, and the Navy Systems Commands. Oceanographic graduate education is primarily carried out by the Naval Postgraduate School, though robust ocean education programs have also been implemented by other Navy offices and non-DoD institutions. A summary description of this infrastructure has been provided by DoD to the U.S. Commission on Ocean Policy under separate cover. There are several complementary ways in which the Nation can leverage this investment in oceanography infrastructure.

First, the Navy has a far larger investment in infrastructure for *operational* oceanography than any other federal agency. NAVOCEANO is Navy's primary production center for operational oceanography, and can serve as a model for implementation of a national operational oceanography center. The Navy's infrastructure can, and should, be leveraged to support overall national operational capabilities in collection of ocean data as well as data management, archiving, assimilation, and fusion. In order to most effectively develop these capabilities for civilian as well as military purposes, the Navy and the National Oceanic and Atmospheric Administration (NOAA), in particular, should form a well-coordinated program in operational oceanography that builds on the existing infrastructure in both agencies to implement a long-term strategic plan for the development of new infrastructure to meet future needs. The plan being developed by Ocean.US, the national office for integrated and sustained ocean observations, will be an integral part of an operational strategy, addressing as it does, both a regional and a global observing and data management system. In addition, infrastructure that exists in other federal agencies should also be incorporated into such an operational system. For this reason, the National Oceanographic Partnership Program (NOPP) can provide the leadership for this activity, since NOPP includes the 14 federal agencies with ocean responsibilities. In order to manage such a system, an interagency office for U.S. operational oceanography is needed that would include, at a minimum, personnel and funding commitments from Navy and NOAA. Such a program office already exists in NOPP's Ocean.US office and its authority need only be expanded to meet the needs of a national operational oceanography system. Although control of activities and funding for Navy operational oceanography programs would not be ceded to Ocean.US, Navy's operational oceanography activities could certainly be coordinated with, and leveraged by the Ocean.US office.

There is a need to demonstrate that a national capability exists that can employ already-existing oceanographic data management architectures, processes, and infrastructure to successfully retrieve ocean observations from disparate sources and integrate them to satisfy operational use requirements. NOPP, through Ocean.US is contemplating funding a pilot project in FY 03 for this purpose. When proven successful, such a program will inspire development of future plans for national operational oceanography.

The Navy also has a considerable investment in oceanographic research infrastructure. These capabilities can also be leveraged for the nation through better coordination with the research arms of other agencies such as NOAA and the National Aeronautics and Space Administration (NASA) and research agencies such as the National Science Foundation (NSF). NOPP can provide this leveraging capability.

Finally, Navy has a unique process to coordinate its research programs with the goals of its operational support through a rigorous budgeting and requirements process. This process involves all stakeholders, requires product review, and incorporates design/performance metrics. It also has a production system organized by capabilities (data acquisition, archiving, assimilation, and fusion), and includes efficient delivery of products to diverse and widely dispersed customers (the right product to the right user at the right time). This capability can be mimicked in NOPP through coordination with the Ocean.US joint program office.

2. What additional resources would Navy require to implement the program you described during the public meeting?

Currently, implementation of existing operational oceanography programs in support of Navy's mission requires approximately $270 million per year, covering the NAVOCEANO Survey Operations Center, the fleet of survey ships, and the Warfare Support Center (WSC) at NAVOCEANO, which generates tailored data assimilation and fusion products in response to customer requests. The WSC can serve as a model for a national operational ocean data assimilation and fusion center that meets civilian needs. The WSC cost approximately $16M to establish (building, equipment, communications infrastructure) and has an annual operating expense of approximately $5M, leveraging as it does the existing data acquisition activities and other infrastructure at NAVOCEANO. An additional annual expenditure would likely be needed to support a civilian center's data management capabilities for a broad customer base 24 hours per day, seven days per week; to obtain accurate cost figures, the customer base would first need to be determined (e.g., would support be limited to federal, state, and local government agencies). In order to implement a national capability, we recommend a mission-based approach that allows for addressing a broad range of requests for products from non-traditional sources, not limited to databases, imagery, or model output.

The Navy recognizes that operational programs must evolve to meet changing needs. Rational evolution can only occur in conjunction with robust basic and applied research programs that both respond to operational requirements and identify the need for new requirements as knowledge expands. Basic research is needed to lay the foundation for the next-generation observing system and its products. Applied research is needed to support pilot projects and pre-operational projects for the transition of research to operations. A robust process for accepting transitions from research to civil operations could also be based on the processes used in Navy.

3. You made a compelling argument that there is a huge volume of data expected from remote sensors, and a smaller amount from ISOOS. What is the value of the small amount of data from ISOOS?

The amount of data from *in situ* sensors is not the crux of the issue; the type and quality of these data are. Data from these sources are important for three fundamental reasons: they reflect the variability of the full water column below the surface as well as the bottom of the ocean; they include critical measurements of variables that cannot be detected remotely; and they provide the fundamental references for calibration/validation of remote sensors/data.

Remote sensors in space (satellites) and the atmosphere (aircraft) provide large volumes of data about the environment because they are able to effectively take very dense measurements across wide surface areas of the ocean. *In situ* sensors (moorings, drifters, etc.) under-sample the entire volume of the ocean but these fewer data are nevertheless of typically high quality and critical importance. Remote sensors generally measure only the surface "skin" of the ocean (upper few meters of the water column) due to limitations in the ability of the sensor wavelengths to penetrate beyond that depth. Some remotely-collected data (such as altimetry measurements) may be depth-integrated but not depth-resolved.

In addition, assessments can be obtained from remote sensors for only certain variables (e.g. sea surface height, surface winds, and sea surface temperature). There remain many processes in the ocean occurring at depth that are crucial for our understanding of how the entire system functions. Many important variables (such as salinity, density, pH, subsurface currents, sound speed, nutrient concentrations, and distribution and abundance of living organisms at the species level) cannot be measured by remote sensors, either accurately or at the required resolution. For those reasons, the *in situ* sensors of the ISOOS will provide crucial data to complement those coming from remote sensing systems.

In addition, *in situ* data are necessary to calibrate (i.e. provide "ground truthing" for) the remote sensors and validate the data obtained from them. Otherwise, users have no idea over time how accurate are the data from these systems.

It is important that any comprehensive ocean observing system include both remote and *in situ* sensors to obtain an accurate, complete understanding of the interrelated, dynamic processes that occur in the world's oceans.