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ON

STATUS OF OCEAN OBSERVATION SYSTEMS IN THE UNITED STATES

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Mr. Chairman, members of the Subcommittee and distinguished colleagues, I want to thank you for inviting the Navy to participate in this hearing on the status of Ocean Observation Systems in the United States. The U.S. Navy has a long history of ocean observations, dating back to the early 1840s, and this program continues with increasing importance today.

While our needs are mission driven, we also recognize the need and responsibility to contribute to a national enterprise in Ocean Observing Systems. The Chief of Naval Operations Sea Power 21 Strategy, with its three essential pillars of Sea Strike, Sea Shield and Sea Basing, has placed increasing demands on the Naval Oceanography Program to better characterize the ocean environment to optimize naval operations on a global scale, but with particular emphasis on the coastal or littoral regions of the world. Our goal is to convert ocean observations into information and knowledge to support the warfighting needs of the Navy. The Naval Oceanography Program is focused on developing an architecture and phased investment and implementation strategy for battlespace sensing and observations at the time and space scales consistent with naval operations. Working together with the Office of Naval Research and partnering with the member agencies of the National Oceanographic Partnership Program (NOPP) we are proud of the leadership role and major contributions we are making to the national effort to establish an Ocean Observing System.

As military weapon systems and platforms become increasingly sophisticated, the impact of the environment becomes a more critical factor to their performance. Accurate knowledge of the environment maximizes combat effectiveness by helping decision makers pick the right platform, choose the right weapon, enter the right settings, pick the right target area, use the right tactics, and select the right time! System performance increasingly requires higher resolution data and more rapid refresh rates.

Before the Navy can fully realize the strategic and tactical advantage of the oceans, a comprehensive understanding of the ocean environment is required. Environmental characterization is a critical component of intelligence preparation of the battlespace. To achieve this, the Department of the Navy adaptively samples high-resolution ocean data, including bottom topography, volumetric current, temperature, and salinity measurements as well as surface wave data via in-situ and remote sensing sources. The Navy continuously monitors the ocean environment allowing us to better understand our operating environment and maintain our ocean stewardship role.

The Integrated Ocean Observing System (IOOS) has two components; the global ocean component and coastal U.S. waters component. The Navy's needs also focus on these components with emphasis on coastal regions of the world where the Navy operates. The Navy's participation in observing system efforts includes those operational activities that fall under the responsibility of the Oceanographer of the Navy, along with the science and technology activities of the Office of Naval Research that underlie the strategic surveys and database needs required to support fleet operations and weapons systems development.

The Oceanographer of the Navy, through the Commander Naval Meteorology and Oceanography Command, conducts multi-function oceanographic surveys in the ocean basins of the world and in coastal regions to provide a baseline for a variety of parameters. In addition, the Navy operates global forecast models that integrate real-time environmental data from a variety of sources, merges climatological data, and produces numerical models of atmospheric and oceanic parameters. These models are dependent on timely input data provided from in situ and space-based observations.

The Office of Naval Research (ONR) has invested in the development of most of the observing tools now in use in the ocean. Many of the knowledge bases about regions of the world oceans other than U.S. waters have come from ONR-funded programs or investigators. ONR's ocean science and technology niches in the federal funding system are in marine meteorology, small-scale ocean physics, optical oceanography, bioacoustics, coastal geosciences, and instrumentation development.

In the global ocean, ONR funds major programs developing and validating large-scale numerical models of the ocean using whatever data sources may exist, both research and operational. The model outputs provide the basis for Navy sound-velocity forecasts in support of sonar operations, and provide the boundary conditions for coastal and regional ocean models everywhere in the world. This work is done as part of the Global Ocean Data Assimilation Experiment (GODAE), to leverage the interests of other nations and agencies.

In the U.S. coastal ocean, ONR research efforts provide understanding of a variety of coastal systems and how Naval operations can best be performed in those environments, and act as test-beds for the development and testing of new technologies for observing the ocean. This understanding and technology are useful elsewhere in the ocean such as in those areas that are denied to us for research and operational purposes.

Another challenge will be our ability to manage efficiently the increasing data flow through sophisticated data networks. The various existing data collection resources must accept standardized formats that facilitate the dissemination, ingestion, and integration of data into processing systems and interactive databases.

The Integrated Ocean Observing System, which will provide ocean data in support of both operational and research requirements, is being advanced by a number of U.S. government agencies under the auspices of the National Oceanographic Partnership Program (NOPP). Navy has been closely aligned with NOPP since the program's inception. In fact, the Secretary of the Navy served as Chairman of NOPP's National Ocean Research Leadership Council (NORLC) for the first four years and currently serves as Vice Chair. The long-term and sustained ocean observing system will be implemented and coordinated through a NOPP interagency office, Ocean.US. The U.S. Navy strongly supports Ocean.US, and, in fact, provided its first director. Ocean.US's efforts to develop an observing system of regional associations based on a national backbone ranks among the most important national ocean initiatives currently underway. The U.S. Commission on Ocean Policy Preliminary Report recognized the importance of this observing system and recommended the development and implementation of a sustained, national Integrated Ocean Observing System.

Navy's reasons for strongly supporting the development of the integrated ocean observing system are compelling. In any military engagement, battlespace awareness is paramount; tactical application of environmental knowledge is a strong force multiplier. This is especially true in the complex and dynamic marine environment. The Navy/Marine Corps team is an expeditionary force required to respond rapidly to contingencies anywhere on the globe. Knowledge of the marine environment is critical to maintaining the tactical edge and allowing U.S. forces to operate more safely and efficiently. A network of ocean observations that are integrated and assimilated into a global operational system and resulting database is a major asset to any sea-based military operation, and also presents significant advantages for commercial and academic interests.

The lack of data over the oceans was recognized as early as 1842 when Navy Lieutenant Matthew Fontaine Maury, then Superintendent of the Navy's Depot of Charts and Instruments, began collecting weather and ocean data routinely recorded in the official log books of both naval and commercial ships. These data were compiled on a series of wind and current charts for all the world's oceans.

We no longer need to rely on ships' logs. Technology has increased our ability to observe the oceans through the use of satellites, moored and drifting buoys and platforms, sea floor cables, tidal gauges,

coastal radar, unmanned vehicles, directed ship surveys and shipboard observations.

Observations from space are an essential component of the Integrated Ocean Observing System. Since 1998 representatives of the major international satellite space agencies have been working on an Integrated Global Observing Strategy (IGOS). The U.S. has been a leader in this activity, and the Navy contributes to this and national planning through its own satellite remote sensing systems and its involvement in the next generation National Polar-orbiting Operational Environmental Satellite System (NPOESS). The Navy currently operates two oceanographic satellite systems; GEOSAT Follow On (GFO) which is a radar altimeter that measures sea surface height, and Coriolis/Windsat, which is used to also measure sea surface wind speed and direction and is an important risk reduction program for the future NPOESS. While both systems are designed to support Navy needs, data are being made available to civil agencies and the research community to further understanding of the ocean on global scales.

NPOESS is an interagency program involving the Defense Department, NOAA and NASA. In addition, the European Organization for Exploitation of Meteorological Satellites (EUMETSAT) is also a participant and demonstrates the global nature of observing systems and partnerships. The Navy is an active participant in the NPOESS program through Coriolis/Windsat and direct participation in the Integrated Program Office, as well as providing two potential ground sites for processing the data at the Naval Oceanographic Office and the Fleet Numerical Meteorology and Oceanography Center. In fact, both NPOESS and IGOS provide opportunities for interagency and international partnerships by which to achieve new levels of synergy and cooperation. Satellite remote sensing is also an emphasis of the U.S. Interagency Working Group on Earth Observations (IWGEO). Navy participates in this effort that is linked to an international process to establish a Global Earth Observation System of Systems (GEOSS).

The Navy's world-class military survey fleet collects high-resolution ocean data with state of the art sensors. These vessels are critical to our ability to collect and analyze data. Navy operates oceanography and meteorology centers worldwide to process, model, disseminate, and archive data and products. These advanced facilities include production centers such as the Naval Oceanographic Office at the Stennis Space Center in Bay St. Louis, Mississippi, and the Fleet Numerical Meteorology and Oceanography Center in Monterey, California. In addition, the Naval Oceanographic Office, in collaboration with the Marine Corps Intelligence Center provides worldwide riverine support to joint operations. The National Ice Center, a tri-agency center involving the Navy, the National Oceanic and Atmospheric Administration (NOAA), and the United States Coast Guard, is responsible for sea and lake ice observations and forecasts for Arctic and Antarctic Oceans and their marginal seas as well as the Great Lakes and Chesapeake and Delaware Bays.

Within our own coastal waters, observations are obtained from a wide variety of sources to support Navy and Coast Guard operations, marine engineering enterprises, the commercial fishing industry, state and local governments, and academia. Efficient integration of these independent data sources presents a host of challenges related to communications and database management.

IOOS will provide a network to facilitate integration of data currently available, as well as increasing the distribution and types of ocean observations. These observations should encompass the physical, chemical and biological characteristics of the water column, as well as meteorological and coastal riverine characteristics. There will be many benefits to this system, including a better understanding of climate variability, marine resource and ecosystem management, safer marine operations, public health and national security. It is in the realm of national security that the Navy has the most vested interests.

When we talk about national security, there are two broad categories that should be considered: contingency operations abroad and homeland defense.

The U.S. Navy has a global presence and often serves as America's first response to international crises. Consequently, we must be prepared to respond to an emergency anywhere, anytime. For speed of transit and response, as well as safety of forces, environmental knowledge is critical.

Sea Power 21 is the Navy's strategic vision and transformational roadmap for 21st Century naval operations. It relies on three conceptual pillars: Sea Strike, Sea Shield, and Sea Basing.

Sea Strike is the ability to project dominant, decisive, and persistent offensive power from the sea in support of joint warfighting objectives through networked sensors, combat systems, and amphibious ground forces. Sea Shield is the ability to project naval defensive power to assure access and protect joint forces ashore.

Sea Basing provides enhanced operational independence and support for joint forces through networked, mobile, and secure sovereign platforms operating in the maritime domain. It envisions the sea as an independent and secure maneuver space for joint forces as they project power ashore. Weapons, sensors, and networked command and control functions will ensure a more defensible battle space while facilitating operational mobility, logistic support, and strategic flexibility.

Sea based forces have historically been limited by the operational reach of weapons, limits of communications systems, logistic chains, and the vagaries of the environment. Today's precision missiles and strike aircraft have significantly increased the mission radius, with naval forces able to strike hundreds of miles inland, as demonstrated in Operation Enduring Freedom in Afghanistan. With advances in satellite technology and digital information, the capabilities of communication systems continue to improve with astonishing speed.

Although sea basing is predicated on the idea that the sea can be a great ally, there's no denying that at times the sea can be a formidable opponent. Globally distributed sea based forces will need to rely on accurate and rapid weather and sea condition forecasts, and that requires data derived from ocean observations.

Modern diesel submarines are facile and lethal prowlers of the shallow littoral zone and we are witnessing a renewed emphasis on antisubmarine warfare. Understanding the thermal distribution in the water column will help predict sonar performance and highlight shadow zones, or acoustic blind spots. Likewise, knowledge of the bathymetry and characteristics of the ocean floor will assist submarine hunters as they search and destroy stealthy prowlers hiding in the complex undersea geography.

A competent characterization of the subsurface world is also critical to mine warfare, a serious threat in strategic chokepoints, harbors and ports, and coastal landing zones. Sea Strike includes the amphibious landing of ground troops and special operations forces, and here again environmental knowledge is a critical component to the safety and success of operations.

Mining of harbors is a threat, and accurate bottom surveys are necessary to establish a baseline for mine countermeasure ships as they search for "mine-like" objects buried in the sediment.

In almost every aspect of modern warfare, accurate and timely environmental characterization serves as a force multiplier. But contingency operations require rapid response, and that gives us scant time to complete an environmental assessment. A networked system of global ocean observations would greatly facilitate a comprehensive characterization of the operating environment.

IOOS will also be a great asset in the area of homeland defense. According to NOAA's National Ocean Service, the United States has over 95,000 miles of tidal shoreline that are vulnerable to asymmetric attack. Contaminants capable of causing mass casualties may be set adrift on tidal currents from offshore, harbors may be mined, and ships scuttled at strategic navigational chokepoints.

This integrated network of ocean observations will increase our knowledge of tidal currents and coastal circulation and increase the fidelity of our numerical ocean models. This knowledge will be essential to the prediction and consequence management of waterborne contaminants. Similarly, a network of offshore weather sensors will give us important atmospheric data to improve our ability to forecast the downwind distribution of airborne radiological, chemical, or biological contaminants.

Our reliance on real-time data to characterize the operational environment and to initialize and refine our numerical models is a compelling reason to support the development of a network of global observations.

While timely and accurate knowledge of the ocean environment is a "force multiplier" for Navy, knowledge of the oceans is also a "force multiplier" for non-defense purposes as well. The Navy is part of a National Ocean Infrastructure designed to coordinate and leverage existing programs to maximize taxpayer investment in ocean research, conservation, and development. Navy has invested heavily in this national ocean infrastructure. Examples of this investment include recapitalization of the national academic oceanographic research vessel fleet (providing five new or converted ships in the last decade alone), periodic review and declassification of appropriate naval oceanographic data in accordance with national policies for access by the civilian community.

The Navy has already partnered with other agencies to support regional observing systems such as the Gulf

of Maine Ocean Observing System (GoMOOS), the Gulf of Mexico Coastal Ocean Observing System (GCOOS), the Northern Gulf of Mexico Littoral Initiative (NGLI), and the Monterey Bay Innovative Coastal Ocean Observing Network (ICON). The success of these regional systems is paving the way for a national, and ultimately an international observing system. In America's coastal waters there are many sensors already in use by commercial, academic and government activities, but getting their data into a national shared network will require a federal support structure of data management and modeling.

The Navy has extensive expertise in ocean information management and generation of operational information products, which it can apply to national ocean information management efforts. As such, the Navy has and will continue to coordinate with NOAA on ocean and coastal data and information management issues.

The Navy is an active member of the Executive Committee overseeing Ocean.US whose charge is the establishment of the Regional Coastal Ocean Observing System. As we move toward the implementation of the IOOS, we have also joined in a partnership with NOAA to engage industry to develop a synergistic project using disparate data sources to support specific multi-agency requirements.

Finally, the Navy is a strong advocate and participant in the international Global Ocean Data Assimilation Experiment (GODAE), an operational proof-of-concept demonstration for bringing existing ocean data assimilation developments and applications together. To this end the Navy is currently providing a U.S. GODAE data server operated by the Fleet Numerical Meteorology and Oceanography Center (FNMOC) in Monterey, California. This server is an integral node in the GODAE architecture. In addition to assimilated data, it will includes atmospheric and oceanic numerical model fields from both FNMOC and the NOAA National Center for Environmental Prediction (NCEP), as well as a number of Navy operational products.

In summary, throughout virtually all of its history the Navy has understood the need to explore, observe and understand the ocean. That need is as important today as it was before. The CNO's Sea Power 21 strategy requires that we understand and exploit the ocean to support all phases of naval operations, which, in turn, has placed increased demands for higher temporal and spatial resolution from in situ and satellite observing systems. The Navy also has a long-standing commitment to support national initiatives and participate in interagency and international activities. The Integrated Ocean Observing System is another example of Navy commitment to national priorities. The Oceanographer of the Navy and the Office of Naval Research ensure that the full breadth of the Navy is contributing strongly and in appropriate ways to the IOOS. Among other things, we have been involved in the National Oceanographic Partnership Program from its inception, we have provided one of the directors of Ocean.US and host the office, we host the international GODAE data server, participate in the interagency NPOESS program, and importantly, through ONR, have supported the development of most of the observing tools now in use in the ocean. Clearly the Navy's observing system needs and programs are directed at providing the essential data, information and knowledge required to continuously describe the battlespace to support naval operations. Nonetheless, we are committed to being a partner in the national efforts to build and operate an Integrated Ocean Observing System.

Today vast portions of the ocean remain unexplored. An ocean observing system will benefit national security and the nation, and permit us to expand our knowledge of the majority of the planet.

Thank you Mr. Chairman and I look forward to answering any questions the Subcommittee may have.