Statement of

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Using New Ocean Technologies: Promoting Efficient Maritime Transportation and Improving Maritime Domain Awareness and Response Capability

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On behalf of Seabird-Scientific I wish to thank Chairman Hunter, Ranking Member Garamendi, and members of the Subcommittee for the opportunity to address the committee regarding the roles and impact that modern ocean observing holds for our country's public interests and maritime economy. I am Casey Moore, President of Sea-Bird Scientific. In being here today, I represent the over 200 scientists, engineers, trained technical, marketing and sales, and support associates that comprise our company. I also speak in support of other businesses, researchers and resource managers throughout our nation engaged in development, operation, and application of our ocean observing capabilities.

Sea-Bird Scientific develops and manufactures oceanographic sensors, systems and deployment platforms for the Oceanographic Science and Monitoring communities. Our products are used around the world with well over 50% of our revenues from international sales. While our products now hold global reach, our technical capabilities emerge directly from collaboration and partnership with US and Canadian academic research institutions, science agencies, and naval research and operations organizations. Our core capabilities are in development and manufacture of sensors for measuring physical, biological and chemical properties throughout the ocean. These sensors determine temperature, salinity, dissolved oxygen, phytoplankton abundance, nutrient concentrations, pH and numerous other chemical and biological parameters. As ocean technologies these products differentiate themselves by being able to provide accurate, stable and precise measurements, often unattended for months to years, in very challenging marine environments. Sea-Bird Scientific instruments are used in numerous applications. These range from the global scale such as understanding ocean circulation and global heat transport budgets, to local environments where ocean acidification and hypoxia threaten critical resources and people's livelihoods.

Ocean observations are not a new concept in supporting maritime transportation, public health and safety, and environmental protection. For example, sea-state parameters, such as wave height and tides, have been use by the Coast Guard and maritime industry for years. What is new are the technology advancements in sensors and communications that allow for detailed observations from remote areas to be used to solve immediate problems. Network capabilities currently give responders, operators and researchers the ability to pull together data from remote sensing tools such as satellites and HF radar and autonomous platforms equipped with water property sensors, fundamentally changing the game:

- Water property parameters from fixed assets such as buoys and tide gauges provide new information for real-time use and critical decision making by agencies and industries;
- Costly and limited discreet ship-based operations have been augmented and replaced by robotic autonomous samplers for the surface and vertical water column;

- HF radars provide near-continuous sea state data along our coasts;
- Remote imagery from satellites effectively map physical, biological and chemical processes across the surface of the ocean.

Using these technologies, local and regional ocean observing systems have teamed with federal and state agencies, academic researchers and public stakeholders to form a nationally scaled Integrated Ocean Observing System (IOOS). IOOS serves an increasingly important role in managing the observing infrastructure, and uses the scientific information derived from the observing networks to supply application products and information content in support of its stakeholders – maritime based industries, tribes, recreational boater and fishers, and communities.

Water property sensors play integral roles in these emerging observing capabilities and are used for a broadening array of applications. Developing and established uses include:

- Ocean health and biodiversity monitoring to drive regulation and advanced management of fisheries, recreation, and coastal habitat;
- HABs monitoring and warning systems for early response to reduce negative human-health and commercial impacts;
- Determining roles, impacts and forecasting for response to long term weather pattern prediction;
- Forecasting impacts of storm events for response preparations;
- Monitoring major ocean pollution events for early response, mitigation and understanding impacts;
- Maintaining strategic economic zone interests.

These examples not only demonstrate the growing utility of these measurements but also point to the public's need for them. To be clear the investments in these tools, and in ocean observing systems, are in large measure managed through the public sector. While industries such as oil and gas sector have invested significantly in developing ocean observing, it is only through the sponsorship of federal science and defense agencies that our capabilities lie where they do today. This sponsorship represents significant investment, which has driven even larger returns – both economic, and in basic protection of human populations living on our coasts and using our oceans. I pose to the committee two examples of how ocean observing efforts have impacted recent events. With these I attempt to show, not only the role of our industry and the relevance of how water property and other observing technologies were applied, but also point to critical gaps that remain and require further leadership, sponsorship and investment.

In late 2012, Hurricane Sandy exacted heavy damage on the eastern seaboard of the US. The storm and resulting storm surge are a well-documented saga. Perhaps less publicized was how damages and possible loss of life were averted through use of regional IOOS assets. In a summary narrative supplied by the Marine Technology Society to the National Ocean Service office at NOAA, IOOS buoys and moorings specifically enabled the following actions.

- Regional transport authorities used IOOS assets to indicate the potential storm track. Merchant shipping interests diverted container vessels containing approximately 23000 TEUs, from NY and NJ destinations to other safe ports. Accounting for two ports alone, actions resulted savings estimated at 6 billion USD.
- The Navy moved 80 ships out of the storms reach from its Hampton Road facility. While this effort cost over $10 million to execute, based upon previous major storm events at the facility, estimated savings from avoided pier and ship damages were approximately $500 million.
- In Hoboken, New Jersey, alone, over 1700 local businesses and homes were destroyed or damaged from flooding by the storm surge. While the property damage resulting from this event was enormous, given foresight from data and forecasting information, the Hoboken mayor avoided a much larger disaster by ordering timely evacuation of over 34000 people living on first floors and in basements in the city.

While these events in many respects validated the utility for ocean monitoring, they belie an important point. We could have done better. Current observing capabilities along the east coast are only a fraction of those envisioned by the IOOS. In this case a denser installation base of buoys and in-water monitoring aspects could have further reduced storm track and intensity uncertainty and further enabled response teams to reduce economic and human tolls from the hurricane. As one specific example higher spatial resolution vertical sampling of the ocean temperature would have provided greater accuracy in determining the storm intensity upon reaching landfall. This could save millions in preparations and better enabled response efforts.

The 2010 BP oil spill from the Macondo well points both to the need of broader ocean observing infrastructure and to the emerging role that water property measurements might play in support of regulation and response efforts. This incident is one of the more well publicized pollution events in recent history. The immediate aftermath of the rupture resulted in a flurry of episodic observing efforts to determine the fate and impact of the oil released into the environment. New and existing sensing technologies for tracking the oil itself were employed, along with a wide array of supporting environmental measurements to monitor ocean health after the spill. Significant data was gathered by numerous research organizations, agencies, and businesses assigned to address the spill. This information definitely helped responding agencies provide scope and focus during initial response, but in light of the scope and cost of the efforts, it held only limited impact in providing actionable information in determining dispersion and fate to help manage response. Existing observing infrastructure was extremely limited, especially through the deeper water column. Moreover data and some methods for the oil detection were unproven, and not qualified. Finally the data coming from the various ad hoc efforts were difficult to assimilate since there was no central data management and control in place at the onset.

After the spill, the prospect of funds supplied by BP prompted the shoreline states of the Gulf of Mexico to fund science centers that will determine how best to deploy and use ocean and coastal observing systems in the future. In addition the Coast Guard and NOAA invested in subsequent studies for oil detection methodologies. These studies are ongoing, and show that many technologies deployed during the aftermath of the crises were effective and could be used in various ways to better understand the fate of oil within the water. This has since allowed scientists to better understand and qualify data acquired during the spill and in establishing best practices for the future. Finally, Gulf of Mexico Research Initiative (GoMRI) funding, resulting from early settlements, continues to support academic, state government and business consortiums. These efforts may lead to various new sensor technologies and observing applications.

While these efforts will benefit scientific understanding, four years after the spill, little or no funding has been released to the State Centers or to the regional IOOS organizations and partners to expand ocean observing efforts in the Gulf. The potential for a similar pollution event would, in and of itself, justify broader deployment of fixed and autonomous assets for ongoing monitoring. The Gulf also holds significant notoriety for storms and HAB events. It holds some of the US' major fisheries, and is a major transportation conduit into and out of our territorial waters. This is a case in which there is not only a clear and timely need, but with vast dollars in play, as a result of subsequent and ongoing settlement processes, there is a potential path for funding. Many suffered from the BP spill – coastal habitats and the human eco system of businesses and communities along the coast were all hurt. I do not presume that dollars supplied in settlement should not go in support of restoring these communities. I do suggest that a small fraction of settlement monies in expanding ocean observing capacity will help everyone in these communities and will serve them many times over in helping them better respond to, mitigate and manage future challenges.

At a national level a fully capable ocean observing network requires substantial investment. Independent studies provided to IOOS show that costs for a full build-out and operation of national ocean observing network, including, satellite and remote platforms, in water assets, needed sensor development data management and control, and operations and maintenance, will exceed $3 billion annual investment. While this is a large number it is important to remember that approximately 45% of our country's GDP is now concentrated into coastal regions. Economic and human impacts of ocean events and our need to effectively regulate and respond will only increase. One common model we use in describing the future of our industry, is that we see ocean observing networks and systems eventually growing into an analog of our national weather network. This analogy is apt. Effective monitoring of the ocean extends our ability to gain greater acuity in understanding long term weather patterns, or climate. With greater forecasts we can better manage resources to mitigate and manage, as opposed to simply falling victim to changing conditions. This will not only benefit the fisher in Oregon, but also the farmer in Kansas. With this thought in mind I contend that 50 years ago we likely had no idea how deeply ingrained our national weather network would become so entwined in our lives. In an era in which we have unprecedented capacity and know-how to assimilate and manage data from our environment, is there any reason to believe that that we will not benefit from similar expansion of our ocean observing capabilities?

I once again wish to thank the Chairman, Ranking Member, and committee for the opportunity to provide testimony in this important matter.