TESTIMONY BY

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On

Maritime Transportation in the Arctic: The Role of the United States

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AOOS
Alaska Ocean Observing System

IOOS
Integrated Ocean Observing System

Chairman Hunter, Ranking Member Garamendi, Congressman Young, and Members of the Subcommittee:

My name is Molly McCammon, and I have been executive director of the Alaska Ocean Observing System for the past 15 years, based in Anchorage, Alaska. Thank you for inviting me to participate in this hearing on the role of the United States in Maritime Transportation in the Arctic. The Alaska Ocean Observing System (AOOS) is the Integrated Ocean Observing System (IOOS) Regional Association (RA) mandated by Congress to work with the federal agencies, local and state governments, tribes and private industry to coordinate statewide monitoring for Alaska's nearly 44,000 miles of coastline and offshore environments, which is larger than the combined seaboard of the United States.

The Alaska Arctic has been experiencing dramatic changes in the past decade. Already we are seeing extremely low sea ice extent in the winter, particularly in the Bering Strait and Chukchi Sea, as well as later freeze-up dates in the fall, thus paving the way for longer – and potentially riskier - Arctic navigation seasons, with an increased likelihood of a nearly ice-free Arctic in this century. The U.S. and nations such as Russia, China, Korea, and Japan are eyeing increased access and use of this new Arctic Marine Highway for shipping, offshore oil and gas and mining activities, and commercial fishing, and thus, potentially competing with subsistence activities and indigenous food security. For that reason, the marine waters and coastlines of the Beaufort, Chukchi and Bering Seas, which comprise the entirety of the U.S. Arctic, make this region of great importance to national and international security.

Fig. 1. Map showing the 11 Regional Associations in the IOOS Program, with the Alaska Ocean Observing System (AOOS) denoted by the red arrow. AOOS is responsible for observing in two oceanic boundaries including the Arctic and North Pacific and is the only RA with an Arctic border and adjacency to two nations: Canada and Russia.

The Need

The U.S. Arctic in Alaska needs a robust marine and coastal observing infrastructure providing real-time surface current, sea ice, water level and weather data to support national interests in this region, as documented in multiple planning and strategic documents by NOAA, the Navy, and the Coast Guard, as well as numerous reports by the National Academy of Sciences. Yet, to date, the U.S. Arctic has been significantly under-observed, especially compared to other U.S. coasts. Similar to many regions of the world that lack power, easy road access and robust communication systems, the Alaska Arctic is a challenging environment for obtaining sustained observations, especially in real-time. However, this information is essential for forecasting and reporting on ocean conditions to improve navigation safety, assessing and planning for risks and incident response including oil spills and search and rescue operations, and responding to coastal hazards such as longer periods of mobile ice and increased impacts of waves and storms on coastlines and communities.

The Role of AOOS and Our Partners

To meet this need, AOOS is partnering with the National Weather Service, the Marine Exchange of Alaska, the Office of Naval Research, the Department of Homeland Security's Arctic Domain Awareness Center, the Bureau of Ocean Energy Management, the University of Alaska, and other federal and state agencies, private industry, and NGOs to identify and fill observing gaps, demonstrate new observing technologies and infrastructure, and develop data and information products and applications. AOOS adds several unique capabilities to the mix of entities helping to meet ocean and coastal observing needs in Alaska's Arctic. These include: our Congressional mandate to work with the private sector; our broad-based governing board made up of state and federal agencies, the University of Alaska and other Alaska research institutions, and representatives of the private sector including marine navigation, fisheries, oil and gas industries, and tribes; strong stakeholder engagement and outreach programs; the ability to quickly deploy assets and easily pool funding from multiple sources, including the private sector; and use of the AOOS Data Assembly Center with the largest collection of Arctic data, models, and visualization tools, powered by a state of the art high performance computer center.

OBSERVING TECHNOLOGIES AND TOOLS

High Frequency (HF) radars & remote power modules: These systems measure real-time hourly speed and direction of surface currents over a large region of the coastal ocean, from a few kilometers offshore up to 200 km, and can operate under any weather conditions. The products can be used operationally for sea state conditions, search and rescue operations, navigation and oil spill response and are crucial inputs into circulation models and forecasts. Although most of the west and east coasts of the U.S. have full HF radar coverage, Alaska has only three sites in the Chukchi and Beaufort Seas currently in operation with support from AOOS in support of offshore oil and gas operations. With new funding in NOAA's FY 17 budget, AOOS will be installing two additional radars in the Bering Strait region in the summer of 2019, although four would be ideal. There is no radar coverage in the Aleutian Island passes, also part of the official U.S. Arctic, which, as part of the Great Circle route between North America and Asia, experience extensive vessel traffic and threats from navigation incidents. The Alaska radars are sustained by remote power modules developed by the University of Alaska Fairbanks, and run on renewable energy (wind and solar) for "off-the-grid" use.

X-band sea ice radars: Images of near-shore sea ice conditions (up to approximately 20 km or 11 nautical miles) are recorded every four minutes and sent via internet to the University of Alaska, where they are processed to derive maps of ice velocity, divergence and convergence. The imagery and animations are regularly used by local subsistence hunters, analysts at the National Weather Service's Anchorage Ice Desk, and commercial and civilian mariners for navigational purposes when mobile sea ice poses a potential threat to their vessels. Only one sea ice radar is in regular use in the Utqiaġvik (Barrow) area, but the equipment is old and needs replacement. Additional radars would be extremely valuable.

Wave buoys: These buoys measure and transmit data on surface currents, waves and sea surface temperatures – all critical data for safe navigation and validating models and forecasts. Managing these buoys has been logistically challenging, as seasonal sea ice has restricted use to occasional seasonal deployments in the Bering Strait and Chukchi Sea. However, with longer periods of

ice-free seasons, usage of these buoys becomes more realistic. One new wave and current buoy will be deployed by AOOS outside the Port of Nome in summer 2018. At least five more are needed in key transportation areas: Unimak Pass, Bristol Bay, Bering Strait, Kotzebue Sound, and Barrow.

Real-Time Ice Freeze-up Detection Buoys: Real-time ice observations are typically restricted to seasonal mooring operations that can only be conducted with a ship during ice-free conditions. However, it is exactly during the breakup and freeze-up transitions when observations are most needed for accurate ice forecasting and modeling efforts. Recently, the IOOS Ocean Technology Transition (OTT) program supported AOOS, the University of Alaska and industry partner Pacific Gyre to pilot an ice detection buoy system for two seasons in the Chukchi Sea to provide real-time temperature and salinity data throughout the water column running up to the day of freeze-up. The mooring remains in the water without recovery while the surface buoy detaches on command at freeze-up, allowing this system to remain in place throughout the freeze-up process. With increased ship traffic, deployment of these buoys becomes increasingly realistic, and could significantly lengthen the period of real-time ocean observations during the late fall and early winter in the Arctic. Only one is in use at this time; more are needed.

Water Level Observations Where Conventional Methods Don't Work: Accurate water level observations are fundamental for safe navigation, mapping and charting, storm-surge forecasting, informed emergency response, and ecosystem management, and Alaska's extensive and remote shorelines are especially under-instrumented, leaving coastal populations and infrastructure exposed. This is in part because of obstacles including seasonal ice, lack of coastal infrastructure and rapid coastal erosion, all which render conventional water level sensing technologies inapplicable. The entire west and north coasts of Alaska have only four NWLON (National Water Level Observing Network) tide gauges, providing the most precise and robust measurements. At least one more is needed in Kotzebue Sound, as well as replacement of one that was destroyed during a fire in Port Moller.

The NWLON in-water systems are expensive and don't work in most regions with shore-fast ice. Numerous activities are underway to trial alternative technologies in remote Alaska to help fill gaps in coastal water level observations. These include: bottom-mounted pressure sensors on subsurface moorings that will provide year-round (although not real-time) simultaneous and co-located waves and water level data; bridge-mounted, Iridium satellite telemetered, ultrasonic gages over tidal rivers in nine remote Alaska communities providing real-time data; and rapid deployment of portable water level sensors in coastal communities impacted by fall/winter storm surges providing post-storm data to improve forecasts.

Of particular interest is the use of GPS reflectometry techniques, a land-based method that provides water level information at accuracy levels necessary for computing principal tidal constituents, estimating tidal datums, and providing observations needed to improve storm surge and inundation forecasts. The approach uses reflected satellite GPS or GNSS signals to determine the height of a reflecting surface, such as the ocean, relative to a stable GPS antenna of fixed local height, recording variations in water levels as changes in the position of the antenna relative to the reflecting water surface. These systems are lower-maintenance, require less power, and are easier and less expensive to install and maintain compared to traditional

water level gages, while still providing highly accurate water level information to meet the immediate needs. AOOS and the National Weather Service are supporting two separate pilot projects, with additional locations now being considered for potential deployments along low-infrastructure regions across the state.

Use of Automatic Identification System (AIS) stations: The Marine Exchange of Alaska maintains a network of real-time vessel tracking stations across Alaska. AOOS is now equipping many of these stations with weather sensors that report localized wind conditions alongside vessel tracking information. These stations could be further enhanced to report local subsistence activity or other community observations to vessels transiting nearby. There now are eight real-time AIS systems equipped with weather sensors in the Arctic (four in the Aleutians, two in the Bering Sea and two along the North Slope). Two more Arctic installations are planned for 2018[CJ1].

Another use of the AIS system, in particular throughout the rapidly changing Arctic region, is AOOS development of an historic database of vessel traffic data, providing data synthesis, archive, and display for use in a variety of associated decision-support tools. The goal is to enhance usability of this increasingly valuable dataset for analyzing potential oil spill impacts from vessel groundings and collisions, developing risk management measures for maritime domain awareness, ensuring subsistence use avoidance, and planning and prioritization for hydrographic (bathymetric) surveys necessary for establishing modern navigational chart information as the region becomes more accessible due reduced seasonal sea ice.

Ecosystem Monitoring: A key element of national security and marine domain awareness is an understanding of the changing marine ecosystem and providing for long-term ecosystem and climate trend data. AOOS is working with partners to establish a network of fully instrumented and state of the art ecosystem moorings to serve as year-round anchors for associated ship surveys in the three major basins representing the Arctic: the Bering, Chukchi and Beaufort Seas. The Chukchi Sea Ecosystem Moored Observatory is completely built out and now provides continuous multi-disciplinary, year-round observations within Shell Oil's past oil and gas lease area, a known Arctic biological hotspot. Due to the presence of sea ice in this region for much of the year, the moorings do not have a surface expression and cannot report data in real-time, but are uploaded during the annual mooring turn-around cruises that occur during the open water season. These instruments are producing high temporal resolution time series throughout the entire year, including the under-sampled and poorly understood seasons when sea ice inhibits more traditional ship-based sampling.

Another AOOS pilot effort uses autonomous buoyancy-controlled gliders to observe sub-surface water column conditions and track marine mammals in near real-time. A passive acoustic device mounted inside the glider together with hull-mounted hydrophones maps the presence of marine mammals along the glider trajectory. Data are sent to the project computer via Iridium satellite whenever the glider surfaces for communication and mission instruction. With improved lithium battery capacity, the glider can now operate more than 90 days, enabling it to cover the majority of the eastern Bering and Chukchi Seas in a single deployment. The information is illuminating how marine mammals, especially those that may be threatened or endangered, interact with and

adapt to changing environmental conditions. Use of such gliders on an operational basis could greatly enhance Arctic marine domain awareness in the future.

AOOS Data Assembly Center and Arctic Data Portal: AOOS now operates a centralized regional data assembly center (DAC) with web-based analytical and visualization tools and products. AOOS – and the AOOS DAC - was recently certified by NOAA, ensuring that it meets federal standards for data management and quality control. The AOOS DAC, and a specific Arctic data portal, serves real-time, contemporary and historical data assets from international, federal, state, and regional governmental programs, as well as research and observing activities conducted by private industry (oil and gas, shipping and fishing), non-governmental organizations and international research cooperatives. The portal is built on AOOS's enterprise-level infrastructure that offers hardened cyber security, system backup and redundancy, and High Performance Computing (HPC) and storage resources for high-availability data access. The AOOS Arctic portal (http://portal.aoos.org/arctic) is designed to help users find, access, and analyze data for planning, research, decision making and emergency response in the Arctic. Users can take advantage of the portal's sophisticated charting abilities, including comparisons between data sources, binning by time, and plotting of climatologies and anomalies to discover and explore data. Custom compilations and data comparison chart can be created, saved, and shared to spotlight environmental events or geographic locations.

Recommendations

1. As the Arctic continues to become more accessible and receive greater attention and use, the United States needs to invest in additional observing assets in the region. A modest investment in dollars would be invaluable in ensuring that the U.S. has the marine domain awareness to manage that usage, respond to potential emergencies such as an oil spill or search and rescue incident, and provide for the nation's security in the face of increased international presence in the Arctic.
2. All of the activities described above depend on substantial partnerships and leveraging of resources. These should be fostered and enhanced with additional mechanisms for transferring and sharing of funds among federal agencies and with the private sector.
3. Many of these activities depend on our integration within the national Integrated Ocean Observing System (IOOS) Program, an innovative partnership between 17 federal agencies and 11 regional systems dedicated to addressing the need for timely and accurate data and information about the nation's oceans and coasts, with NOAA as the lead Federal agency. The Integrated Coastal Ocean Observing System Act of 2009 provides the foundation for this system, and H.R. 237, the Integrated Coastal and Ocean Observation System Act Amendments of 2017, sponsored by Alaska Congressman Don Young, is now before the House Natural Resources Committee. A companion bill has already passed the Senate. Adequate funding for this program is essential.

Conclusion

I appreciate the opportunity to speak to you today about the United States' role of ocean and coastal observing in the emerging Arctic. We refer to this region as the new Arctic Marine Highway, and similar to any traditional highway, the U.S., with its state, local and private sector partners must provide the services, protections and enforcement essential to making this strategic

region scientifically understood, economically productive, and environmentally safe. Thank you for your time.