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Introduction

Good morning Chairman Hunter, Ranking Member Garamendi, and Members of the Subcommittee. My name is David Westerholm, and I am the Director of the Office of Response and Restoration at the National Oceanic and Atmospheric Administration (NOAA), within the Department of Commerce. Thank you for inviting NOAA to testify before you today on NOAA's work to implement U.S. policy in the Arctic.

For over two hundred years, NOAA and its predecessor organizations have provided foundational data, products, and services to support safe, efficient maritime commerce, which is a cornerstone of our Nation's economy. Today, as sea ice retreats and interest in Arctic economic use grows, NOAA is working hard to increase its presence in the Arctic, which includes the Aleutian Islands, Bering Sea, Chukchi Sea, Beaufort Sea, and vast terrestrial areas of northern and western Alaska as defined by the Arctic Research and Policy Act of 1984. NOAA has a long history of Arctic science, service, and stewardship, including weather and climate services, nautical charting and other navigation services, natural resource management, and spill preparedness and response. NOAA has issued an Arctic Report Card every year, starting in 2006, providing a clear, reliable, and concise source of environmental information on the current state of the Arctic. In 2011, NOAA issued its Arctic Vision and Strategy to define the substantial role that it plays in the region and to provide direction for the future. The NOAA Arctic Action Plan released this year builds on the Vision and Strategy by providing information on NOAA's Arctic activities in 2014-2015.

NOAA is using state-of-the-art technology and innovative partnerships to improve Arctic marine navigation, provide ocean and coastal observations and weather forecasts, deliver hazard assessment, preparedness, and response, promote environmental stewardship, and provide other information and expertise to communities, the maritime industry, and navigation interests in and around Alaska. These efforts directly support NOAA's Arctic Vision and Strategy and are described in NOAA's Arctic Action Plan. NOAA envisions an Arctic where decisions and actions related to conservation, management, and use are based on sound science and support healthy, productive, and resilient communities and ecosystems. The agency seeks a future where the global implications of Arctic change are better understood, predicted, and managed.

Arctic Marine Navigation

Under its authorization to provide nautical charts covering the U.S. Exclusive Economic Zone, NOAA is responsible for charting the U.S. Arctic and provides other foundational data and services that support safe marine navigation and domain awareness. Accurate and up-to-date nautical charts are critical to safe marine navigation and require not only bathymetric data, but also data on shoreline features, water levels, seafloor characteristics, precise positioning, and other observations and measurements of value to mariners. NOAA is continuing to make progress in charting and mapping the Arctic region's ocean and coasts, so long obscured by perennial ice, according to reliable, modern standards. Given the vast expanse of water and coastline to be charted and mapped, NOAA is prioritizing and synchronizing charting efforts to make more effective use of resources and attain faster progress. To this end, NOAA is investing in hydrographic surveys in the Arctic as well as shoreline mapping missions and tide and current surveys in order to enhance its provision of navigation products and services in the region. For example, over the past three years, NOAA has acquired, using both NOAA ships and private sector survey assets, 1,330 square nautical miles of charting data in the Arctic.

In 2013, NOAA issued an update to its Arctic Nautical Charting Plan, which identifies regions where inadequate chart coverage should be improved, given available resources. This update was informed by consultations with maritime interests, the public, and other federal, state, and local agencies, in order to keep pace with the rapidly changing Arctic environment and the associated increase in maritime commerce and energy development activities. One such example is the Arctic's Delong Mountain Terminal, a shallow-draft port that services the Red Dog Mine on Alaska's northwest coast. This month, NOAA published a new chart for the terminal area, which fills in historically sparse depth measurements using recently acquired survey data. The Red Dog Mine is one of the world's largest producers of zinc concentrate, a fact that further underscores the economic value of a new chart for this Arctic port. The terminal's shipping season lasts only about 100 days, so shipping efficiency is vital. This is the third new Arctic chart that NOAA has issued in the past three years, the others being for Kotzebue Harbor in 2012 and Bering Strait North in 2013.

NOAA is working with partners to augment its capacity to provide a stronger geospatial foundation and the data needed for safe navigation, science, and more-informed coastal decision-making in the Arctic. This approach will leverage existing coordination by agencies involved in integrated ocean and coastal mapping and the predecessor groups to the new Alaska Geospatial Council. Partners with echo-sounder equipped vessels such as the U.S. Coast Guard, U.S. Navy, the academic fleet, and private industry may be able to collect depth data en route between Dutch Harbor and the Arctic Ocean for analysis and possible charting by NOAA. The highest priority focus of this effort will be 40,000 square nautical miles in need of surveys in order to reduce transit risks from the Aleutian Islands through the Bering Strait and to/from Alaskan coastal communities. Employing this integrated mapping concept will result in more accurate data and charts along the most-utilized Arctic open water routes, allowing NOAA to focus its resources on the more challenging coastal areas for harbors of refuge, port access, and coastal community resilience.

Land elevation data in Alaska currently has errors of up to a meter or more. To fix this and establish a highly precise vertical positioning framework for the U.S., NOAA is collecting airborne gravity data across the Nation. Under its Gravity for the Redefinition of the American Vertical Datum initiative, NOAA has completed about 50 percent of the Alaskan Arctic and expects the data collection effort in Alaska to be completed by the end of 2019.

During the past decade, NOAA – in close collaboration with the U.S. Coast Guard and other federal partners – has gathered and analyzed data and seafloor samples to determine the outer limits of the U.S. Extended Continental Shelf (ECS) in the Arctic. The data collected to make these shelf extension determinations will provide a rich baseline for understanding the diversity of this maritime zone and for setting future exploration, research, and resource management priorities. The data acquisition phase for this effort in the Arctic is essentially complete. NOAA continues to work with the State Department, U.S. Geological Survey, U.S. Coast Guard, and other partners on ECS delineation. The focus has shifted to analyzing the extent of the U.S. continental shelf under the provisions of Article 76 of the Law of the Sea Convention, as well as conducting the exploration and research necessary to identify and evaluate potential new marine resources, and to identify and characterize marine ecosystems and habitats in this changing environment. While the widespread benefits are not limited to the continental shelf and its resources, the only way we can maximize legal certainty and best secure international recognition of our sovereign rights with respect to the U.S. extended continental shelf in the Arctic and elsewhere is through accession to the Law of the Sea Convention.

Coastal and Ocean Observations

NOAA's coastal and ocean observations, when combined with up-to-date nautical charts and precise positioning information, provide mariners with a clearer picture of potential dangers that may threaten navigation safety.

NOAA operates and maintains nine long-term National Water Level Observation Network (NWLON) stations in the Aleutian Islands and northward in Alaska that provide real-time water level data and the vertical reference for tidal datums along the coast. All existing NWLON stations measure water levels on one-minute intervals and provide the data to NOAA's Tsunami Warning Centers to help improve tsunami warnings, forecasts, and inundation models. In the Arctic, NOAA is focusing its efforts on improving water level datum coverage as well as obtaining better data on currents. Short-term water level gauges are being deployed to support hydrographic surveying, and the NOAA VDatum modeling project is working to seamlessly transfer between tidal and geodetic datums. NOAA is also developing water level measurement technology that can endure the harsh climate of remote Arctic areas.

The U.S. Integrated Ocean Observing System regional partner, the Alaska Ocean Observing System (AOOS), is working to improve information collection and dissemination by providing easy access to a network of critical ocean and coastal observations, data, and information products. AOOS' primary activities include centralizing data with web-based tools and products, working with marine users to improve ocean monitoring, and fostering collaborations to meet multiple stakeholder needs. AOOS focuses on four areas: safe marine operations, coastal hazard mitigation, tracking ecosystem and climate trends, and monitoring water quality.

Weather and Sea Ice Forecasts to Support Marine Navigation
NOAA provides forecasts, warnings, and information for marine, aviation, and other weather interests, which are critical for maritime domain awareness in the Arctic. Major stakeholders and partners, including the U.S. Coast Guard and the State of Alaska, require weather, water, and sea ice information for planning and decision-making, to serve communities and to manage the region's many resources. People in the Arctic rely heavily on aviation, marine weather, and sea ice information for safe transportation and access to goods and services. Forecasts and warnings are delivered through a number of media, from the Internet to high-frequency radio broadcasts.

Increasing air and ocean temperatures, thawing permafrost, loss of sea ice, and ecosystem shifts are evidence of widespread growing change in the Arctic. Critical environmental, economic, and national security issues are emerging that may have significant impacts on human lives, livelihoods, and coastal communities. Meeting the information needs for Alaska, with its vast size, remote population, and cultural diversity, presents NOAA with unique challenges. Partners, emergency managers, and communities in the Arctic deal with extremes in temperature, darkness, and sea ice, further complicating decisions and possible actions.

There is limited physical infrastructure for emergency response needs for the 34,000 miles of Alaska's tidal shoreline. Extreme travel distances, a lack of available logistics, and fluctuating maritime surface and air assets in the region, including a U.S. Coast Guard scalable presence, dramatically increases response times, in addition to the noted seasonal and extreme weather challenges. For example, a decision to deliver heating fuel to a coastal community in the Arctic may require weather and sea ice outlooks weeks in advance to ensure safe navigation. Evacuation of coastal communities that might take several hours in Connecticut, for example, may take several days in remote Alaska during the winter, when daylight hours are fewer and emergency response is hindered by darkness. These unique challenges make NOAA's decision support services vitally important to Arctic communities.

NOAA's polar-orbiting satellites (NOAA-15/18/19) provide diverse environmental data collection capabilities with the Argos Data Collection and location System (DCS), in partnership with others. Globally, more than 21,000 active Argos platforms are being tracked by over 1,900 users in 115 countries, with 957 of these operating in the Arctic (41 in the Antarctic). The Argos system consists of in-situ data collection platforms equipped with sensors and transmitters and Argos instruments currently operational aboard three NOAA, two European, and one Indian polar-orbiting satellites. A unique capability of the Argos DCS is independent geolocation, which permits applications such as drifting ice and ocean buoys for collection of meteorological and oceanographic observations, wildlife studies, and tracking fishing vessels and larger ships.

To achieve weather and sea ice forecasts, the State of Alaska utilizes polar-orbiting satellite data in addition to conventional ground observations which are made difficult because of Alaska's vast and complex terrain. Because it is so far north, Alaska also cannot take advantage of the Geostationary Operational Environmental Satellite (GOES) coverage used by the lower 48 states and Hawaii. The Suomi National Partnership Program satellite (Suomi NPP), the first of the next generation polar-orbiting satellite, Joint Polar Satellite System (JPSS), is therefore paramount for space-based observation to support weather forecasts and environmental assessments necessary for maritime domain awareness in the Arctic. NPP sounders and imagers continuously survey the

globe with the most frequent update across the poles, and sounders provide the critical atmospheric observations needed to forecast severe weather events out to seven days so that effective planning to safeguard lives and property can take place.

Weather and sea ice forecasting are closely linked, and forecasts are often provided together. Weather conditions affect the development and movement of sea ice, and the loss of sea ice in the Arctic impacts the weather and climate. The present rate of sea ice loss, with its regional and global impact, creates an urgency to improve sea ice predictions at all time scales, from the short term (i.e., daily to weekly) to seasonal and decadal time scales. NOAA provides Arctic sea ice analysis and forecast services from local to regional scales through the National Weather Service, and at basin to global scales through the U.S. National Ice Center in collaboration with the U.S. Navy and Coast Guard. The National Ice Center participates in a close international relationship and data exchange with the Canadian Ice Service and the Canadian Meteorological Centre of Environment Canada. The National Snow and Ice Data Center archives much of the National Ice Center data and makes these data available for initializing weather and ocean models which are used for research and long term status and trends of sea ice.

Accurate weekly sea ice information is important for many stakeholders to operate in the marine environment, including the U.S. Coast Guard, Arctic coastal communities and Alaska Native populations, the oil and gas and fishing industries, first responders to emergencies, and scientific researchers. To improve weekly sea ice forecasts, NOAA is developing and refining higher spatial resolution regional sea ice models for Alaska. Increased temporal and high resolution remote-sensing data are also being pursued to enhance monitoring of ice conditions and to provide accurate current conditions critical for safety and efficiency of coastal transportation in Arctic regions, and in support of response and mitigation activities during environmental and man-made hazards, disasters, and emergencies.

The ability to provide accurate advanced sea ice predictions of the seasonal timing of the freeze-up and melt-out of sea ice has direct implications for U.S. commerce and industry. For example, in 2012, the Bureau of Ocean Energy Management asked NOAA to assist in reviewing an oil and gas industry request to extend the drilling season in the Chukchi Sea based on the possibility of a late freeze-up of sea ice. NOAA provided a probability-based sea ice forecast indicating an unusually rapid freeze-up. The resulting decision to deny the extension request mitigated risks for offshore drilling operations.

Weather analysis and prediction capabilities are currently less skillful in the Arctic than in other parts of the United States. Major challenges for long-term modeling being addressed by NOAA include the lack of good physical data regarding winds and clouds. Although accurate forecasts and models depend upon the availability of observations, existing observations in the Arctic are very limited in both geographic scope and frequency. NOAA will continue to improve Arctic marine weather, storm surge, and sea ice forecast services. Forecast improvements will be made by enhancing and integrating different types of observations of the atmosphere, sea ice, and ocean, and by directly combining sea ice and climate models with weather forecast models. Improved sea ice and marine weather forecasting would assist the energy, maritime shipping, and transportation industries as well as infrastructure planning, economic development, and ecosystem stewardship.

Hazard Assessment and Response

Decreased summer sea ice is already leading to marginal growth in Arctic commerce, tourism, and oil and gas exploration. The chances of oil spilling from either a vessel or exploratory drilling facility are likely to increase in the future, and NOAA has a role in the readiness and effectiveness of spill response capabilities in the Arctic. NOAA is responsible for delivering scientific support to the U.S. Coast Guard for marine hazards, including oil spills and marine debris. In addition, the Oil Pollution Act of 1990 established NOAA as a trustee for natural resources and outlined a framework for conducting natural resource damage assessment and restoration of natural resources that have been contaminated by the discharge or threatened discharge of oil. The Comprehensive Environmental Response, Compensation and Liability Act provided similar authorities for hazardous substances, pollutants, or contaminants that could endanger human health and/or the environment.

Under the National Oil and Hazardous Substances Pollution Contingency Plan, NOAA provides scientific support in chemistry, trajectory modeling, natural resources at risk, and data management to the federal On-Scene Coordinator for oil and hazardous material spills. NOAA's Alaska regional Scientific Support Coordinators would provide scientific support to USCG in the case of any spills in Alaska waters. In addition to spill response software and mapping tools, NOAA provides standard techniques and publishes guidelines for observing oil and assessing shorelines.

NOAA participates in interagency cross-training exercises for emergency responders, including response to oil in sea ice. NOAA is involved in joint training and workshops with other Arctic nations on oil spill response activities in the Arctic, such as the use of mechanical recovery, dispersants, and in situ burning following transboundary spill events.

To support preparedness for spill response and natural resource damage assessment in the Arctic, NOAA has been compiling and developing baseline information on natural resources in the Arctic and preparing Arctic injury assessment sampling guidelines. NOAA has also engaged Alaska communities in preparing for spill response and natural resource damage assessment and restoration. For example, NOAA is working with partners at all levels of government and with Alaska Native organizations to develop an Arctic marine mammal disaster response plan to outline protocols for responding to marine mammal strandings and protecting species that local communities rely upon for subsistence. NOAA also works actively with the Department of the Interior to ensure that NOAA's expertise is applied in reviewing oil spill response plans and applications for exploratory drilling permits.

In 2012, NOAA launched the Arctic Environmental Response Management Application (Arctic ERMA®). ERMA® is a web-based tool that assists both emergency responders and environmental resource managers in dealing with incidents that may harm the environment. This system integrates and synthesizes data into a single interactive map, providing quick geo-spatial visualizations and improving communication and coordination. ERMA® brings together all of the available information needed for an effective emergency response in the Arctic's distinctive conditions, such as the extent and concentration of sea ice, the locations of ports and pipelines, and the presence of vulnerable cultural and environmental resources. Arctic ERMA® was tested

during the 2013 Arctic Shield, an operational exercise conducted by the U.S. Coast Guard's 17th District, which highlighted the Coast Guard's plans to protect the maritime community in the Arctic and to strengthen partnerships with federal, state, local, tribal and community members. This operation gave the Coast Guard and its partners an opportunity to exercise capabilities to ensure the organization has the right resources to conduct Arctic operations. Arctic ERMA® provided the Common Operational Picture for the scientific studies taking place, including the operational tests where there was an oil proxy as a target for multiple sensors and unmanned aerial and Remotely Operated Vehicle systems accomplished at the edge of the receding Arctic ice aboard the Coast Guard's icebreaker HEALY. Arctic ERMA® will be used again on Arctic Shield in 2014. NOAA appreciates the opportunity and looks forward to participating in this important effort.

As the Arctic becomes more accessible to maritime traffic (e.g., cargo and tanker vessel traffic through the Bering Strait and Unimak Pass, commercial fishing traffic, and increased cruise and recreational vessels), the potential for incidents will also grow. As noted earlier, accurate charts and other aids to navigation are essential for safe navigation, and for response to spills and other marine hazards. Accurate charts and aids to navigation are also key spill prevention tools and critical to selecting places of refuge for a stricken vessel, as well as staging of marine assets for any large response or salvage efforts.

Stewardship: Natural Resource Management and Regulatory Activities

NOAA is responsible for research on marine species and their habitats in the coastal oceans of the Arctic region. These waters support some of the most important commercial fisheries in the world, as well as rich, productive ecosystems. NOAA protects Arctic living marine resources and their habitats under the Magnuson-Stevens Fishery Conservation and Management Act, the Marine Mammal Protection Act, and the Endangered Species Act. NOAA is committed to furthering the goals of fishery sustainability, including taking a precautionary management approach where necessary. For example, in 2009, under the Magnuson-Stevens Act, the Secretary of Commerce approved the Arctic Fishery Management Plan, which covers U.S. federal waters of the Chukchi and Beaufort seas. The plan prohibits commercial fishing north of the Bering Strait until more information is available to support sustainable fisheries management.

Partnerships in the Arctic

NOAA participates in international and interagency groups that unite various stakeholders around common causes in Alaska and the Arctic, including the Committee on Marine Transportation, the Interagency Arctic Research Policy Committee, the international Arctic Council and World Meteorological Organization. The objective of these partnerships ranges from enhancing science to promoting safe navigation and emergency response. NOAA works closely with several of its sister agencies on Arctic issues, notably the U.S. Coast Guard. NOAA and the U.S. Coast Guard have also improved ties on common mission areas relating to navigation safety, pollution prevention and cleanup, and fishery enforcement in the Bering Sea through development of the 2013 U.S. Coast Guard and NOAA Cooperative Maritime Strategy. NOAA is also an active member of both the national and regional components of the Interagency Working Group on the Coordination of Domestic Energy Permitting in Alaska. This group leads federal agency coordination on regulating and permitting energy development in Alaska, including offshore oil and gas drilling and renewable energy efforts.

NOAA's partnerships in the Arctic region with the private sector are also growing. An excellent example is the 2011 data-sharing Memorandum of Agreement between NOAA, Shell, ConocoPhillips, and Statoil. This precedent-setting document is advancing Arctic science and improving operational safety by making valuable data on weather, sea ice, ocean, and environmental studies available to researchers, planners, industry operators, and the public through the AOOS Arctic Data Portal funded by NOAA and Arctic ERMA®.

NOAA also has longstanding partnerships through the Geographic Information Network of Alaska (GINA). GINA is a mechanism supported by the University of Alaska for sharing data and technical capacity among Alaskan, Arctic, and world communities. Established in 2001 as an initiative of the President of the University of Alaska, GINA promotes collaboration at the local, state, and federal levels by increasing community-wide participation in the discovery and use of geospatial data. GINA's products and services greatly expand the range of available analysis capabilities in order to better address research and management requirements. Earth Observing satellite data from NOAA, NASA, and foreign satellites that downloaded at the NOAA Fairbanks Satellite Operations Facility is shared with many state, federal, and private sector users through GINA.

NOAA is always seeking productive ways to strengthen its partnerships with the State of Alaska and the Alaska Native community. NOAA values its long-standing partnerships with Alaska Native groups, and NOAA and the State of Alaska are working together on oil spill response logistics and education and water quality and contaminants surveys. Currently, the State of Alaska is accepting public comment on its own Arctic strategy, and NOAA is looking forward to coordinating with the State on its implementation once the strategy is finalized.

Conclusion

NOAA plays a unique and important role in providing critical informational infrastructure to support safe, reliable, and efficient marine navigation in the Arctic. Local, state, federal, and international partnerships are critical to achieving successful Arctic operations in a unique and challenging environment. Thank you for the opportunity to discuss some of those efforts with you. We would welcome the opportunity to provide the Committee with greater detail on any of NOAA's Arctic activities and services.