



PROPOSAL FOR FY2016-2020
Implementation and Development of Regional Coastal Ocean Observing System:
Alaska Ocean Observing System

In response to Federal Funding Opportunity NOAA-NOS-IOOS-2011-2002515
FY 2011 Implementation of the U.S. Integrated Ocean Observing System
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BY

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ON BEHALF OF

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Funding requested:

Funding Year	Total Funding Request	Holdback for NOAA partners	Total Grant Request
FY11:	\$4,000,000	\$50,000	\$3,950,000
FY12:	\$4,000,000	\$50,000	\$3,950,000
FY13:	\$4,000,000	\$50,000	\$3,950,000
FY14:	\$4,000,000	\$50,000	\$3,950,000
FY15:	\$4,000,000	\$50,000	\$3,950,000
TOTAL:	\$20,000,000	\$250,000	\$19,750,000

This project complies with the IOOS Programmatic Environmental Assessment.

PROJECT SUMMARY

Project Title: Implementation and Development of the Alaska Ocean Observing System

Recipient Institution: Alaska SeaLife Center on behalf of the Alaska Ocean Observing System

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Alaska Department of Fish and Game

Alaska Landscape Conservation Cooperatives

Alaska Sea Grant

Arctic Domain Awareness Center

Arctic Observing Network

Bureau of Ocean Energy Management

Cook Inlet Regional Citizens Advisory Council

Exchange for Local Environmental Knowledge in the Arctic

IOOS Association

Kachemak Bay National Research Reserve

NOAA Kasitsna Bay Laboratory

National Weather Service

Marine Exchange of Alaska

NOAA CO-OPS

North Pacific Research Board

North Slope Science Initiative

Oil Spill Recovery Institute

Ocean Tracking Network

Pacific Marine Environmental Laboratory

PWS Regional Citizens Advisory Council

Shell U.S. in Alaska

U.S. Army Corps of Engineers

U.S. Coast Guard

U.S. Geological Survey

University of Alaska Fairbanks International

Arctic Research Center

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The Alaska Ocean Observing System (AOOS) is the IOOS Regional Association (RA) responsible for monitoring nearly 44,000 miles of coastline and offshore environments. AOOS manages the statewide observing system as well as three distinct coastal and ocean observing systems. It is unique not only for its size, but also because it is the only RA in the United States that includes an Arctic boundary.

The AOOS mission is to provide coastal and ocean observations, forecasts, and data information products to meet agency and stakeholder needs. AOOS has three strategic priorities within its mission: 1) to sustain marine ecosystems and fisheries, and track climate change and trends; 2) to promote safe marine operations; and 3) to mitigate natural hazards and their impacts on coastal communities. Climate change is only one of the impending drivers currently affecting Alaska. Others include an upswing in marine traffic, groundbreaking industrial activities in the Arctic, escalating coastal erosion and inundation affecting many subsistence communities across the state, and the dramatic retreat of sea ice, especially in the Arctic. These factors all heighten the need for sustainable, reliable and accessible marine information.

This proposal builds upon already established and ongoing activities, and carefully balances the challenges of providing real-time observations in Alaska in order to use limited resources wisely. The mere size of the region alone requires extensive collaboration and leveraging with other programs to accomplish the AOOS mission. To augment these efforts, AOOS pursues additional funding opportunities, and offers data synthesis services to other organizations. This enhances data sharing and integration into the AOOS data portal, while adding value to separate activities managed by other organizations.

Stakeholder priorities shape the Board-approved AOOS goals, which are to: 1) Increase access to existing coastal and ocean data; 2) package information and data in useful ways to meet the needs of stakeholders; and 3) increase observing and forecasting capacity in all regions of the state, with a priority on the Arctic and the northern Gulf of Alaska.

The activities proposed herein have been adapted and supplemented to address the strategic priorities in light of emerging issues as well as historical obligations, and will continue to address the program goals and enhance the AOOS mission by focusing on the following activities:

- Sustaining a regional management structure, including board, committees, and core staff, to continue supporting the integration and expansion of ocean observing activities and decision-support tools in Alaska;
- Expanding *in-situ* observations, with an emphasis on filling priority data gaps to provide the environmental intelligence needed to support response activities that improve public safety (storm prediction, coastal erosion, flooding) and safe maritime operations;
- Increasing weather, sea state and ecosystem observations and making these accessible to planners, forecasters, affected communities, and scientific and research groups;
- Continuing to build and leverage existing efforts (both AOOS & external) to develop a complete integrated network of physical, chemical and biological observations, including an Ocean Acidification Network;
- Establishing the AOOS Ocean Data Explorer as the regional Data Assembly Center for Alaska, including the development of products and visualization tools for stakeholders;
- Enhancing regional modeling testbeds in order to expand coverage and complement existing regional and statewide model forecasting capability, especially for harmful algal blooms, ocean circulation and sea state conditions, and providing 3-D and 4-D model data visualization products accessible on the AOOS website;
- Promoting greater awareness of the value of Alaska's coasts and oceans through enhanced stakeholder engagement and outreach programs, activities, and social media as well as news media outlets.

Stakeholders include state and federal resource managers, oil spill responders, search/rescue teams, commercial/recreational fishers and boaters, subsistence users, coastal communities, and industries such as shipping, oil/gas, and mining. Benefits include increased marine domain awareness and improved ability to provide early warning information to coastal communities now being impacted by a changing climate and subsequent environmental conditions. The AOOS Ocean Data Explorer is a one-stop resource that includes not only real-time data, but also historical data, modeling observations, and predictions of weather, ocean, and sea ice. Stakeholders and the public will have access to increased information and decision support tools through the AOOS data portal in this effort.

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I. AOOS OVERALL APPROACH & PRIORITIES

Goals: The goals of the Alaska Ocean Observing System (AOOS), as identified through stakeholder engagement, adopted by the AOOS Board and reflected in this proposal, are to 1) increase access to existing coastal and ocean data; 2) package information and data in useful ways to meet the needs of stakeholders; and 3) increase observing and forecasting capacity in all regions of the state, with a priority on the Arctic and the northern Gulf of Alaska.

Background: Developing an integrated ocean observing system at high latitudes creates unique challenges. In addition to the harsh environment, the region encompassed by AOOS is made up of nearly 44,000 miles of coastline, larger than the marine systems in the rest of the United States combined. No other observing system in the United States has such climate extremes, significant geographic distances, and limited observing infrastructure. Although the population of Alaska is small (about 735,000), 80% of the residents live on the coast, including a large indigenous population that relies on the ocean for survival.

Approach: This proposal builds upon existing efforts, takes into account the challenges of providing real-time observations in Alaska, places a premium on access to and integration and synthesis of existing data and data sources, and relies extensively on collaborations. The proposal leverages funding with other programs and provides coordination and synthesis services to better integrate and add value to existing research and monitoring activities. It also draws upon the 2011 AOOS Preliminary Build-out Plan and the 2013 AOOS Arctic Build-out Plan as guidance, as well as the plethora of regional and national plans, especially those for the U.S. Arctic (see Appendix B).

Geographic approach: The Board has placed a priority on expanding observation capacity in the Arctic (Beaufort and Chukchi Seas) and in the northern portion of the Gulf of Alaska (GOA). The GOA includes Prince William Sound and Cook Inlet, two regions with high vessel traffic, including oil and gas tankers, large commercial fisheries critical to the state's economy and dynamic and complex circulation systems that border the main population centers of Alaska.

The Arctic as a national priority: One of the priority objectives in the National Ocean Policy (NOP) highlights changing conditions in the Arctic and specifically calls upon the nation to: "Address environmental stewardship needs in the Arctic Ocean and adjacent coastal areas in the face of climate-induced and other environmental changes." AOOS has used the NOP Implementation Plan, NOAA's Arctic Vision & Strategy, the U.S. Navy Arctic Roadmap, the U.S. Coast Guard and Arctic Strategy, the U.S. Arctic Research Commission Goals & Objectives, the Arctic Marine Shipping Assessment, the Alaska Arctic Policy Commission Report, and other recent documents in developing its Arctic monitoring activities. With local, regional and national needs in mind, AOOS also completed an Arctic Build-out Plan in 2013 to map out an approach to accomplish collective Arctic observing goals that increases the environmental intelligence and infrastructure needed for Arctic Marine Domain Awareness.

Approach to funding scenarios: Although the proposal seeks \$4 million a year over a five-year period, the activities described in the most detail are for a \$2.5 million a year scenario, which is similar to the current award. A \$4 million a year scenario would fill priority observing gaps, enhance the proposed regional modeling testbed and provide increased observations and data products needed by stakeholders. A \$1.5 million a year scenario would sustain core staff coordination, outreach and facilitation activities, basic data assembly center functions, and only those observing activities that rely on AOOS support. These differences are illustrated in Appendix E.

Key focus areas: AOOS focuses its efforts on four major thematic areas: marine operations; coastal hazards and inundation; ecosystems, fisheries and climate trends; and water quality.

II. KEY FOCUS AREAS

A. Marine Operations

Goal: To improve safety of marine operations (including search and rescue and oil spill response), AOOS will focus on sustaining weather and sea state observations, more effectively disseminating weather information to users, and developing related information and decision support tools for stakeholders, especially related to the emerging Arctic Marine Highway.

Audience and Benefits: Alaska's marine operations and stakeholders are diverse, ranging from oil tankers and container ships to ferries, commercial and charter fishing boats, recreation vessels and marine subsistence users. Weather conditions change quickly, are locally specific, and are not always captured by Alaska's limited coastal and marine weather stations. The state is home to a \$6 billion fishing industry, offshore oil exploration in Cook Inlet and the Arctic, a Marine Highway System serving local and visitor traffic, and cruise ships carrying a million passengers per year. Ninety-five percent of Alaska's goods cross Cook Inlet, navigating through dynamic sea ice and extreme tidal and circulation variation, to arrive at the Port of Anchorage. As Arctic sea ice retreats and the Northwest and Northern Route passages stay ice-free for longer periods, more vessels will pass through Alaskan waters, take shipments to international destinations or tour the Arctic for recreation. Representative stakeholders include commercial fishermen and recreational boaters, subsistence users, port and harbor managers, local citizen advisory groups and communities, regional research institutes, federal and state agencies and industrial interests including offshore oil and gas companies such as Shell Oil Company.

B. Coastal Hazards and Inundation

Goal: To improve the ability to forecast and plan for changing storm and sea ice conditions and their impacts on coastal communities and habitats, AOOS will focus on increasing water level and wave observations and related products for stakeholder decision-making.

Audience and Benefits: The impacts of climate change have become readily apparent in Alaska. As our nation's only Arctic state, Alaska is experiencing dramatic reductions in sea ice cover, increased storm surge, thawing coastal permafrost, and consequent coastal erosion and infrastructure damage. These conditions are endangering coastal communities, most of which are home to Alaska Natives. In a statewide assessment by the Government Accounting Office in 2003, flooding and erosion affects 184 out of 213 Native villages, 31 of which are considered to be in imminent danger. Many may require expensive engineering fixes or community relocation. Meanwhile, better forecasting for storm surge and inundation is needed to help local people prepare for dangerous storm events. The need for wave buoys and water level sensors has been loudly voiced and documented in both state and national plans. Despite this, NOAA's National Data Buoy Center (NDBC) has struggled to maintain existing buoys in Alaska, and several key buoys are no longer operational. Stakeholders include coastal subsistence communities including the Yukon-Kuskokwim, Bering Strait, Northwest Arctic and North Slope regions, as well as oil and gas companies active in offshore drilling and exploration, agency managers, the U.S. Army Corps of Engineers, National Weather Service forecasters, shippers, fishermen, and the U.S. Coast Guard.

C. Ecosystems, Fisheries and Climate Trends

Goal: To understand marine climate variability and ecosystem change in the long term, as well as how local conditions affect ocean circulation and ecosystem productivity in the short term, AOOS will build upon and leverage existing programs to develop an integrated network of physical, chemical, biological and community-based ocean observations and a synthesized State of Alaska's Coasts and Oceans Report.

Audience and Benefits: Alaska's coastal waters support a rich and diverse ecosystem, home to one of the world's largest fisheries, as well as abundant populations of pelagic and migratory seabirds and

protected marine mammals. Ecosystem change in Alaska has direct social and economic implications that are likely to be more profound with the advances of climate change. Representative stakeholders include the fishing industry (commercial and recreational), federal and state management entities, subsistence-based communities, and academic and agency researchers.

D. Water Quality

Goal: To understand and respond to current and future changes to Alaska's marine waters, AOOS will support monitoring of ocean acidification and marine debris and explore opportunities for providing data products and decision-support tools for contaminants and watershed/ocean linkages.

Audience and Benefits: Ocean acidification (OA) has emerged as a potentially high impact issue in Alaska, with the relatively shallow shelf seas in the northern Gulf of Alaska, the Bering Sea, and the Chukchi Sea already experiencing seasonal OA manifestations. Given the productivity of the Alaskan marine environment, increased acidity could lead to significant ecosystem effects, with wide-reaching environmental and economical impacts. There is also increasing concern over industrial activities affecting Alaska's freshwater and marine ecosystems, including potential mercury contamination of Alaska fish. In Southeast Alaska, neighboring Canadian mining activities have raised worries about the impacts of a mine-waste breach on transboundary waters that pass through Alaska. Representative stakeholders include the fishing industry, federal and state management entities, policy makers, emergency responders, academic and agency researchers, and local residents.

III. REGIONAL GOVERNANCE & MANAGEMENT SUBSYSTEM

The Alaska Ocean Observing System (AOOS) is the regional association for Alaska as part of the national Integrated Ocean Observing System (IOOS). Within AOOS are three geographically, culturally and economically diverse regional coastal and ocean observing sub-systems (Gulf of Alaska, Bering Sea/Aleutian Islands and Arctic). AOOS began in July 2003 as a consortium of partners operating under a Memorandum of Agreement (adopted in 2005, and revised 2009, see www.aos.org). It is the intent of AOOS to become formally certified in 2016 as the Regional Association for Alaska.

- *Board:* AOOS is governed by a Board of Directors, currently made up of 19 federal and state agencies, research entities, and private sector organizations (see www.aos.org for members). Once the membership reaches 25 or more members, the Board may choose to elect a subset of members to serve as directors. An Executive Committee, made up of the AOOS officers and a representative of the fiscal sponsor, acts on behalf of the AOOS Board between meetings.
- *Committees and Advisory Groups:* AOOS uses one standing committee and numerous ad hoc committees and working groups for guidance. The Data Management Advisory Committee (DMAC) is composed of technical experts, including both data users and providers, and provides technical advice to the AOOS Data Team and program staff. Ad hoc advisory groups are topic or regionally specific and convened as needed.
- *Program staff:* AOOS currently employs three full-time staff: an Executive Director, a Director of Operations and Development, and a Program Coordinator. A fourth half-time staff member is the Director of Special Projects. AOOS is also contributing FY 2015 funds in to support a full-time Alaska Sea Grant coastal resilience position, and future funding may be desirable. Staff members manage all program components, engage with stakeholders to identify program requirements, implement the observing system with contractors to meet stakeholder needs, work with the data team to develop products for users, and collaborate with other regional, national and international ocean observing initiatives, including the national IOOS office and other IOOS Regional Associations.

- *Fiscal sponsor:* The Alaska SeaLife Center, an incorporated nonprofit, acts on behalf of AOOS as its fiscal sponsor, and performs all its legal, financial and administrative functions. The fiscal sponsor fee is based on the direct costs of those services.
- *Alaska regional partnerships and collaborations.* Numerous collaborative initiatives have begun in Alaska designed to inform or guide science or resource management issues, particularly in the face of climate change. These include the North Slope Science Initiative (NSSI), the Alaska Climate Change Executive Roundtable (ACCER), the Alaska Center for Climate Assessment and Policy Steering Team (ACCAP is the NOAA RISA for Alaska), Alaska Sea Grant and its advisory group, the U.S. Fish and Wildlife Service (FWS) Alaska Landscape Conservation Cooperatives, and NOAA's regional collaboration team. AOOS will continue to be an active participant in all of these initiatives.
- *Process for identifying user needs.* Due to the vast geographic size with limited transportation corridors, and the diversity of coastal and marine issues in the state, the AOOS board determined it would be more effective to use existing communication pathways and forums (advisory committees, professional organizations, conferences and workshops), as well as specific stakeholder engagement events, to provide input to AOOS rather than maintain a standing "stakeholder committee". These activities are summarized in Section IV below and described in more detail in Appendix C.

IV. OUTREACH, STAKEHOLDER ENGAGEMENT & EDUCATION

Goal: Our goal is to increase awareness of ocean issues in Alaska and engage with stakeholders to identify and respond to their needs for ocean observations and information products.

Background: The AOOS Board has made stakeholder outreach, facilitation, coordination, and partnership building one of the cornerstones of the AOOS program, and the Executive Director and staff devotes significant time to these efforts. AOOS has a strong reputation in Alaska as one of the few multi-agency, multi-disciplinary organizations whose mission includes facilitating and coordinating marine-related efforts. More details can be found in Appendix C.

Objectives and Approaches:

1. *AOOS website and publications.* AOOS uses its website as its primary outreach tool to feature ocean observing news and highlight data resources and new user products. The site archives all meeting documents and reports, and connects users with the data tools developed by the AOOS data team. AOOS also maintains an active Facebook page, disseminating news and resources to a broad audience, and uses blogs as an outreach tool (see the AOOS Blob Tracker for an example, linked from the AOOS homepage). Hard copy documents continue to make up a central part of the outreach approach, including an AOOS primer, data tools brochures, bi-monthly newsletter, and topic-specific handouts that are widely circulated.

2. *Stakeholder interaction.* Stakeholder activities include hosting AOOS meetings on specific topics, providing demonstrations of the AOOS data portal to targeted user groups around the state, and circulating online surveys to get input on projects and observing gaps. AOOS receives consistent user feedback about the AOOS data portal through a feedback tab on the website, and systematically responds to the submitters, documents and reviews their recommendations, and implements the top priorities.

3. *Stakeholder working groups.* AOOS will continue to facilitate four informal working groups made up of scientific and technical experts and impacted stakeholders. These are: 1) ocean acidification research, monitoring and outreach leading to a statewide OA Network; 2) integrated water level observations network; 3) impacts of the Blob (Pacific anomalies) in Alaska; and 4) long-term observing system coordination and integration. AOOS may respond to other needs as they develop.

4. *Education activities.* Now that COSEE Alaska has ended, AOOS will continue to partner with marine education and outreach entities such as the Sitka Science Center, Prince William Sound Science

Center, Alaska SeaLife Center, Kachemak Bay National Estuarine Research Reserve, and the Kasitsna Bay Laboratory to promote virtual field trips, educator lessons plans and other activities.

5. *AOOS Short Film Contest*. AOOS will continue its annual Ocean Film Contest, begun in 2014, to promote ocean issues and awareness of AOOS. The short films showcase a variety of captivating stories to hundreds of viewers in venues around the state, as well as through the AOOS website and Facebook page.

6. *Alaska Marine Policy Forum*. Co-hosted with Alaska Sea Grant, AOOS supports bi-monthly teleconferences with participants from across the state interested in marine funding, legislation and state and federal policy issues. Speakers include congressional and state staff, as well as other contributors discussing timely topics.

7. *IOOS Outreach Committee*. AOOS continues to serve on the volunteer IOOS Outreach Committee, which provides a forum for discussing effective outreach strategies and techniques, sharing products and coordinating efforts among the 11 RAs and the IOOS Program Office. AOOS continues to work with other RAs to communicate its impact through shared success stories, training and shared experiences with social media and other tools. The committee intends to meet in person once during the next five years to develop common outreach materials that reflect the federal-regional IOOS partnership, and to develop a strategy for shared outreach (conferences, exhibitions, etc.) and user engagement.

V. OBSERVING SYSTEM SUBSYSTEM

A. Overall Approach

Given Alaska's immense geographic scope, remoteness and harsh environmental conditions, as well as the paucity of existing observations, AOOS is not able to create or sustain the ideal ocean observing system with its current resources. For that reason, the AOOS Board, based on stakeholder and local and scientific expert input, has chosen largely to augment existing observation programs, contribute to observing consortia and fill in key observation gaps with new assets until additional and sustainable funding becomes more readily available.

B. Marine Operations

1. *Sustain weather observations in the Gulf of Alaska (GOA)*. AOOS will continue its efforts to provide accurate, real-time weather observations in Prince William Sound and Cook Inlet. In partnership with the Oil Spill Recovery Institute, the Prince William Sound Science Center (PWSSC) and the Cook Inlet and Prince William Sound Regional Citizens Advisory Councils, AOOS will provide funding to the PWSSC to maintain eight SnoTel weather stations providing real-time web accessible data. Webcam images from these stations are accessed through the AOOS real-time sensor map by pilots, boaters, lodge owners, fishermen, and recreationists, and are one of the most popular resources on the AOOS website. The weather data are used in both real-time and for modeling and forecasting. *If additional funds become available, more stations will be added, including a site at the Valdez Marine Terminal in Port Valdez and one near Naked Island and Hinchinbrook Entrance in Prince William Sound. Additionally, three land-based anemometers will be installed to monitor barrier jet winds at Hinchinbrook Entrance, Cape Suckling and Icy Cape.*

2. *Increase access to weather observations using AIS*. AOOS will continue its partnership with the Marine Exchange of Alaska (MXAK), begun in 2011 to disseminate real-time weather data and forecasts to vessels using Automatic Identification System (AIS) transmitters. By establishing joint weather/AIS stations at existing AIS locations, and installing new stations in remote areas, real-time weather information can be displayed on a vessel's AIS display in a more reliable and clear manner and at greater distances than the method in which weather information is presently

disseminated (via VHF radio voice broadcasts). With most commercial vessels required to be equipped with AIS by the International Maritime Organization (IMO) treaties, AIS is one of the most reliable means of communicating weather and other environmental information (e.g., weather, ice reports) to vessels operating in coastal waters out to 50 miles offshore. When complete, the technological solutions will be shared with other IOOS members for nationwide application of this new capability. Overall, this will enhance maritime safety throughout all the IOOS regions. *At least two-to-four new stations will be added and maintained each year depending on funding levels.*

3. *Sustain critical wave buoys for navigation safety.* Continued funding will support operation and maintenance of the Coastal Data Information Program (CDIP) buoy in Cook Inlet, jointly sponsored by AOOS and the U.S. Army Corps of Engineers, and the wave buoy in Norton Sound, jointly sponsored by AOOS and the Norton Sound Economic Development Council. Both provide essential real-time sea state conditions for recreational, commercial and subsistence mariners. *With full funding, up to two additional CDIP wave buoys would be purchased for deployment in Bristol Bay, Prince William Sound or Southeast Alaska, all of which would contribute to implementation of the NOAA National Wave Plan in Alaska.*

4. *Mapping surface currents with high frequency radars (HFRs).* Current funding contributes to the operation and maintenance by the University of Alaska Fairbanks of four HFR sites on the Chukchi and Beaufort Sea coasts (Point Lay, Wainwright, Point Barrow and Cape Simpson). These sites are operational during the open water season, July through mid-November. The project is a joint collaboration with Bureau of Ocean Energy Management (BOEM) and Shell Oil Company conducted in a region of offshore oil exploration. Data are used to guide the development and evaluation of oil spill trajectory models, ocean research, and in real-time for operational applications. *Full funding could leverage development of two new HFR sites at key shipping transit areas, including the Bering Strait, Unimak Pass in the Aleutian Islands and Cook Inlet.*

5. *Port of Anchorage observations.* AOOS is initiating collaborations with port managers, barge and cargo companies and the Marine Exchange of Alaska to enhance observations at the Port of Anchorage, which handles 95% of the consumer goods for 85% of Alaska and is one of 19 national strategic seaports for the U.S. Department of Defense. The port's expansion and modernization has the potential of modifying adjacent nearshore ocean conditions, increasing the need for more observations. *With full funding, additional observations in the form of current meters, web cameras, wave buoys and weather stations will make the port safer and more efficient.*

C. Coastal Hazards and Inundation

1. *Increase water level observations in western and northern Alaska.* Accurate water level observations are key for a number of purposes: 1) to operationally forecast in real-time for storm surge and coastal inundation warning systems; 2) to monitor seasonal changes in river mouth entrances used by tugs and barges delivering fuel and other cargo to Alaska's river-based villages; 3) to establish baseline sea level data for shoreline mapping and tracking sea level trends; and 4) to improve nearshore ocean models for coastal planning, infrastructure development (harbors, airports, etc.) and resource habitat management (e.g., waterfowl), as well as for research purposes. Permanent water level gauges north of the Aleutian Islands are operated at Nome on the Bering Sea, Red Dog at the Kivalina River on the southern Chukchi Sea, and Prudhoe Bay on the North Slope. A fourth gauge is being installed in 2016 in Unalakleet, south of Nome in Norton Sound. These four sea level stations are responsible for providing coverage for almost half of Alaska's coastline. AOOS is partnering with the National Weather Service, NOAA's Center for Operational Oceanographic Products and Services (CO-OPS), Alaska Department of Natural Resources

(ADNR), U.S. Army Corps of Engineers, Western and Arctic Landscape Conservation Cooperatives, U.S. Geological Survey (USGS), the University of Alaska Anchorage Arctic Domain Awareness Center (U.S. Department of Homeland Security), and others to develop and implement an Integrated Water Level Observing Network. AOOS is coordinating the ad hoc water levels working group to help set priorities for various types of water level sensors. Based on the priorities established by this group and AOOS funding, AOOS will support ADNR and the University of Alaska Anchorage to install sensors at village and coastal sites most vulnerable to inundation, flooding and erosion.

2. *Increase wave observations for water level forecasting and planning.* Wave observations provide real-time sea state conditions and also support water level forecasting and planning. Key gaps remain in implementing the IOOS National Operational Waves Observation Plan in Alaska. *With full funding, AOOS will purchase and install additional 3-5 wave buoys for deployment in key gap regions including the Chukchi Sea, Bristol Bay in the Bering Sea, and in the Gulf of Alaska.*

3. *Pilot new program for coastal vessel traffic.* *With full funding, AOOS will develop a proof-of-concept program to field test the use of remote water level sensors at the mouths of key river systems for transmission to tug and barge operators using the Internet and the AIS network.* The unpredictable nature of river mouths increasingly interferes with vessel traffic due to natural variations in channels. Water level patterns are modified by long-term environmental factors, such as permafrost thaw, increased coastal erosion from higher frequency storms, and changes in precipitation. All of these factors put shipping activities at increased risk of grounding and escalates the chances of oil/fuel spills.

4. *Crowd-source non-NOAA hydrographic (water depth) survey data to improve navigation safety.* The recent incident involving of a vessel near Dutch Harbor Alaska serves as a reminder that the Alaska coastal and shelf bathymetry data are insufficient in many locations for navigation and maritime safety. This has become a red flag issue for the state. AOOS has already been exploring a collaboration with NOAA's Office of Coast Survey and Integrated Ocean and Coastal Mapping Program, the U.S. Coast Guard, Alaska state agencies and the maritime industry to facilitate the collection, aggregation, sharing and reuse of hydrographic survey data by non-NOAA partners. *With full funding, this project team will develop ways to facilitate third-party data provision, including potential web-based crowd-sourcing tools that enable selection and display of a planned route, online training in minimum standards for calibration and data acquisition, trackline survey guidance, and data storage and archive.*

D. Ecosystems, Fisheries and Climate Trends

D. 1 Sustained Observation Network

The 2011 AOOS Preliminary year Build-out Plan includes support for a long-term sustained observing network to track climate trends and support ecosystem-based management of fisheries and endangered and threatened species. The goal is to unite these observations – made with moorings, ship and glider transects, instrumented fish and marine mammals, passive acoustic sampling, community observers and other platforms - into a unified system. AOOS is partnering with management agencies, academic partners and the Distributed Biological Observatory (DBO) program to help maintain long time series data collection, develop consistent data collection protocols, synthesize new and existing data, and ensure that data are accessible and usable.

1. *Sustain ship-based sampling along the Seward Line.* AOOS will contribute to a consortium led by University of Alaska Fairbanks (UAF) to support two cruises a year along the Seward Line, the most comprehensive long-term multidisciplinary sampling program in the coastal Gulf of Alaska. This line has been sampled continuously since October 1997, with some measurements dating back to late 1970s. Observations over the past 17 years have fundamentally revised our understanding of the coastal Gulf of Alaska ecosystem, which is critical to Alaska's fisheries and subsistence and coastal community

economies. *With full funding, a glider could be purchased to improve spatial and temporal monitoring of this line, and use for opportunistic ecosystem sampling during El Nino and La Nina events in the GOA.*

2. *Support ecosystem moorings in Alaska's Large Marine Ecosystems.* AOOS is building a network of fully instrumented ecosystem moorings in the Chukchi, Beaufort and Bering Seas and the Gulf of Alaska to serve as year-round anchors for the Distributed Biological Observatory (DBO). AOOS began the ecosystem mooring program with a consortium led by UAF with the first mooring deployed in 2014 in the central Chukchi Sea offshore of Wainwright. This is a critical region for observing the through-flow of water between the northern Bering Sea and the interior Arctic, and a location of large primary productivity in an Arctic shelf sea. AOOS funding in this proposal will add sensors to this mooring, as well as establish an additional mooring in the Beaufort Sea, with spare moorings and sensors to aid in annual turnaround and maintenance. AOOS funds are used for equipment purchases, with data analysis and operational costs covered by other partners. *With full funding, additional sensors will be added to existing moorings that are not fully instrumented in the Bering Sea (M8 and M2, supported by NOAA's Pacific Marine Environmental Laboratory) and the Gulf of Alaska (GAK 1, supported by the Exxon Valdez Oil Spill Trustee Council).*

3. *Pilot use of glider surveys to monitor ocean conditions and marine mammals.* AOOS will continue supporting the pilot implementation of a real-time marine mammal detection system deployed on a Slocum buoyancy controlled glider currently operating in the northeastern Chukchi Sea. This pilot project is testing the capabilities of an AOOS-funded autonomous marine mammal detection and classification system (DMON/LFDCS), designed specifically for sub-Arctic and Arctic species. The pilot project is now in its third year. Future partners include BOEM and the North Pacific Research Board (NPRB), whose additional support will allow for purchase of a backup glider, refinement of the call library, and support for some of the deployment costs. The glider will operate for six weeks in a biological hot spot in the Chukchi Sea that coincides with Shell Oil Company's oil and gas exploration area. The data are documenting oceanographic conditions and monitoring, and the habitats of bowhead, fin, humpback, North Pacific right, beluga, and killer whales, as well as walrus and bearded seals. All of these species could be impacted by increased human activities in the region, as well as by climate change. *As funding allows, additional flights could supplement the ecosystem moorings and the DBO surveys.*

4. *Support community based monitoring.* This project combines a key set of standardized geophysical and local expert-driven observations to improve the understanding of interannual to decadal-scale change in coastal ice conditions and their impact on human activities. The methodology for advancing these goals has already been developed with strong community engagement and development of a database. Data entry is web-based through a public access portal developed through the Exchange for Local Environmental Knowledge in the Arctic (ELOKA), a project funded by the National Science Foundation. *With full funding, AOOS will increase the collection of coastal sea ice information at additional villages along the western and northern coasts of Alaska, as part of a community-based coastal ice observation program already piloted by UAF scientists.*

5. *Use of telemetered animals.* Animal telemetry data are currently being piloted for incorporation into the AOOS Ocean Explorer Portal, and telemetered animals equipped with sensors are increasingly being used to provide broader spatial coverage for ocean monitoring where other platform logistics are not feasible or are too expensive. *With full funding, AOOS will seek to incorporate additional animal telemetry data into its data portal as it becomes available.*

D.2. Regional sentinel observations

The AOOS Build-out Plan includes supporting more intensive, shorter-term monitoring activities at key sites around the state, especially in regions with local scientific capacity. AOOS has already begun hosting collaborations among these entities to better coordinate and integrate such efforts. AOOS provides

small amounts of funding to these local efforts, which are then leveraged by our partners to develop larger programs. *With full funding, AOOS will be able to provide more support to these and potentially other projects.*

1. *Sentinel monitoring in Prince William Sound (PWS).* AOOS seeks to meet short-term and long-term fisheries and ecosystem-based management needs by contracting with the PWS Science Center and partnering with the PWS Regional Citizens Advisory Council and the Oil Spill Recovery Institute, to maintain intensive sentinel monitoring in PWS as a Prince William Sound Observing System. Partners are seeking additional funding for glider transects, moorings and ship cruises, and additional sensors and equipment. Priorities for AOOS are to support:

a. *Weather stations:* AOOS will continue to fund the six SNOTEL stations deployed at sea level in PWS since 2005, and two stations at alpine elevations. Each station measures temperature, wind velocity, precipitation, and solar radiation, and includes a webcam. The main mission is to provide real-time weather observations, but also to provide information for hydrological and circulation models, as well as oil spill trajectory modeling.

b. *PWS Ocean Tracking Network:* AOOS will continue to support a partnership with Dalhousie University's Ocean Tracking Network to operate and maintain six acoustic arrays across the major entrances to PWS (Hinchinbrook Entrance, Montague Strait, and the four Southwest Passages). The array is used to document the movements and survival of marine animals and fish (salmon, sharks, and whales) carrying acoustic tags and how both are influenced by oceanographic conditions.

2. *Sentinel monitoring in Cook Inlet.* AOOS partners with NOAA/UAF's Kasitsna Bay Laboratory, Cook Inlet Regional Citizens Advisory Council, the Kachemak Bay NERR and the Gulf Watch Alaska long-term monitoring program funded by the Exxon Valdez Oil Spill Trustee Council. This partnership is collecting oceanographic data along repeated transects in Kachemak Bay and lower Cook Inlet. Data are used to improve a harmful algal bloom risk assessment tool; support development of risk assessment tools for ocean acidification, pathogens (vibrio) and invasive species; assess estuarine responses to climate change; and provide validation for development of the National Ocean Service's Cook Inlet ocean circulation model and transition of the model to an operational forecast system. *With full funding, acoustic Doppler current profiler surveys and current meter moorings will be used to measure depth-dependent flow in Kachemak Bay and lower Cook Inlet and leverage additional moorings in the inlet.*

3. *Sentinel monitoring in Southeast Alaska.* *With full funding, AOOS will initiate a new partnership with the Sitka Sound Science Center to enhance its capacity to serve as a sentinel station for Southeast Alaska.* This would include support for oceanographic buoy observations and long-term monitoring of kelp forests and pinto abalone populations as sentinels of climate change.

4. *Sentinel monitoring in other regions.* AOOS will continue to seek opportunistic funding to develop and enhance sentinel monitoring in other regions of the state that have local science capacity and resources to support such operations, such as Kodiak, Pribilof Islands, Kotzebue and Barrow. We will also seek out opportunities to add sensors to existing platforms around the state to enhance local observing capacity, such as adding conductivity sensors to tide stations (that already have temperature measurements) along the coast to better understand large-scale oceanographic changes in salinity.

E. Water quality

1. *Ocean acidification (OA) monitoring.* AOOS will continue to partner with the UAF Ocean Acidification Center and the NOAA OA Program to maintain OA sampling along the Seward Line in the northern Gulf of Alaska during May and September. The data will help quantify the physical and biogeochemical controls on OA in the region, including the influence of glacial runoff, meteorological forcing (upwelling) and longer-term trends caused by climatological forcing. Samples of dissolved inorganic

carbon, total alkalinity, partial pressure of CO₂, pH, carbonate mineral saturation states, particulate organic carbon, dissolved organic carbon, and oxygen isotopes will be analyzed and combined with observations of specific pelagic and benthic calcifying organisms to monitor how keystone species in the food web are responding to increased intrusion of atmospheric CO₂. AOOS will also contribute to the consortium that supports two moorings (Bering Sea and Gulf of Alaska) equipped with a surface and bottom sensor package to measure pCO₂, pH, temperature, salinity, nitrate, oxygen, chlorophyll, and turbidity to quantify the seasonal and interannual variability in the ocean carbonate system. The surface package contains a meteorological and atmospheric monitoring station and transmits both surface water and atmospheric parameters in real-time via satellite telemetry. With funding from the OA Program and the IOOS Marine Sensor Technology Transfer program, “Burkolator” instruments equipped with sensors that measure these parameters have been installed in Seward at the Alutiiq Pride Shellfish Hatchery.

AOOS will hold an OA technology workshop in winter 2016 to develop a coordinated Integrated Ocean Acidification Monitoring Strategy for Alaska with the multiple partners currently monitoring OA. The goals of the workshop are to identify preferred technologies and methodologies for making accurate and meaningful OA measurements, and to develop a phased approach to a coordinated network. Best practices for sampling and data sharing will also be defined to the best state of the technology. *Based on that workshop, we will identify priorities for any additional AOOS and partner funding, which could include additional Burkolators at hatcheries; adding OA measurements to cruises and a profiling mooring in Prince William Sound; and instrumenting state ferries that routinely transit the Gulf of Alaska.*

2. *Support monitoring of marine debris.* A small amount of funding will go toward partnering with Gulf of Alaska Keeper to monitor the annual accumulation of marine debris on 14 Prince William Sound (PWS) beaches and three beaches in the Gore Point region of the Kenai Peninsula. This effort is part of a long-term study to determine the annual accumulation of marine debris in PWS and the northern Gulf of Alaska shoreline. Debris from container spills and the 2011 Fukushima earthquake are now being tracked. *With additional funding, AOOS could partner with NOAA and the Alaska Department of Environmental Conservation (ADEC) to provide additional support for monitoring marine debris in other locations.*

3. *Support for monitoring for contaminants.* Contaminants in Alaska’s waters may be an increasing problem in the future, especially as industrial activities continue to develop in the watersheds that feed into Alaskan waters, and with increased shipping activities throughout the state. ADEC is currently testing for mercury concentrations in marine fish and identifying any potential public health risks due to consumption of effected species. The Alaska Department of Natural Resources is concerned about watershed and local impacts of large-scale mines. Contaminant monitoring is very expensive, so these efforts are limited. The AOOS Board has asked staff to monitor current activities and consider ways to provide data integration or supportive data for these agency efforts.

VI. DATA MANAGEMENT & COMMUNICATIONS SUBSYSTEM

Goal: The goals of the AOOS Data Management and Communications Subsystem are to serve as the Alaska regional data assembly center (DAC) for Alaska coastal and ocean data collected by AOOS as well as other federal, state, local, private and tribal entities; leverage collaborations with other IOOS regional associations; and develop data and information products to meet stakeholder needs.

Background: AOOS supports a data management system that allows a complex array of oceanographic data types to be well organized, accessible, and understandable. Working on behalf of AOOS with AOOS staff and other partners, Axiom Data Science has developed the AOOS data system to be a scalable, open source platform that uses existing and emerging software resources, high performance compute clusters and interoperability services consistent with IOOS standards and protocols (see Appendix

D for more details). In its current capacity, the AOOS regional Data Assembly Center is the largest data management service in this region.

Developing functional standalone DMAC systems is laborious, time consuming and expensive. IOOS regional associations are similar to one another in that their DMAC systems must meet IOOS DMAC requirements and each regional association must support the local needs of their constituents. The AOOS data framework is now able to directly leverage and benefit from the systems, capabilities and lessons learned through Axiom's contractual support for data management and communications (DMAC) activities for the Southeast Coastal Ocean Observing System (SECOORA, which began summer 2015), Central and Northern California Ocean Observing System (CeNCOOS) and the Integrated Ocean Observing System (IOOS). These relationships will increase access to and use of data by all user groups, allow AOOS data management staff to rapidly develop new capabilities and tools to meet a variety of user needs, and reduce costs and increase performance.

Objectives and Approaches:

1. *Support the cyberinfrastructure that underpins the AOOS Data Assembly Center.* The AOOS data contractor, Axiom Data Science, will ensure that the AOOS data system is healthy, secure and monitored, respond to system problems, and map out future upgrade and expansion strategies. This task includes the support, cultivation and expansion of both the hardware and software, which enable the AOOS data management system to function. Axiom staff will also focus on extending the capabilities of the existing AOOS cyberinfrastructure by exploring and implementing new software server technology. Physical hardware configurations will be optimized and additional server resources deployed to power applications and functionality that are requested by the user community and required for the multiple, integrated-research efforts that AOOS supports. Axiom will work with the broader IOOS community to implement protocols for applying Quality Assurance of Real Time Ocean Data (QARTOD) checks to existing real-time data feeds. This is a database-level enhancement that will ensure quality control is performed on all real-time data being archived and served out of the AOOS data system.

2. *Maintain and enhance the Ocean Data Explorer.* The Ocean Data Explorer is the flagship statewide data portal for AOOS and includes tools to visualize and explore oceanographic and coastal data across Alaska. The custom-built tools allow for dataset cataloging, elastic searches, automated and custom visualization, time-series exploration and extraction, data downloading using static files and multiple interoperable web services, map representation of multiple data layers, and more. This objective focuses on maintaining the portal's backend data storage as well as the front-end user interface. Activities consist of monitoring and documenting the use of the portal, and integrating user feedback and emerging technologies into future system iterations. These include further implementation of AOOS lite (useful for mobile phone and low bandwidth AOOS Web access), and "myAOOS" personalized functions. Future development activities range from visualizing more complex data types (gliders, animal telemetry, CTDs) to providing next generation visualization capabilities to users (e.g., Ocean in 4D).

3. *Maintain and provide access to existing and new products.* Existing products supported by AOOS include the AOOS Real-time Sensor Map, Research Assets Map, Model Explorer, Sea Ice Atlas, and the Cook Inlet Response tool. AOOS is also supporting development of a smart phone application targeted at users in remote Arctic communities. Based on input from the AOOS Data Management Advisory Committee, new products could also include specialized data portals, products or tools for particular subregions or unique Alaska stakeholder groups (e.g., recreational or commercial fisheries, emergency planners, etc.), or topical issues such as Arctic shipping, ocean acidification, and community based monitoring.

4. *Maintain and provide access to existing and new data sets.* As the regional Data Assembly Center for Alaska, AOOS has prioritized ingestion of valuable physical, biological and chemical data sets

collected primarily by federal and state agencies, academic partners and large ecosystem research programs. AOOS provides data management services for many of those programs, including the Russian American Long Term Census of the Arctic, Marine Arctic Research Ecosystem Study, Arctic Marine Biodiversity Observing Network, Arctic Ecosystem Integrated Study, components of the Distributed Biological Observatory, and Gulf Watch Alaska and Herring Research and Monitoring Program. By providing these services (with costs reimbursed) through use of the Research Workspace (a cloud-based data management application designed for storing, documenting and sharing data among members of scientific communities), AOOS has access to all data for inclusion in the AOOS Ocean Data Explorer. *We will continue to pursue other funding to ingest other priority data sets.*

5. *In collaboration with other IOOS regional associations (RAs), develop cross-regional and US-wide data products.* AOOS will work with the other IOOS RAs over the course of the funding cycle to enhance and standardize stakeholder access to data, services and interfaces. This will be done by collaborating with other RA staff to agree on common access methods to existing data services through the use of Application Programming Interface (APIs) and interoperability systems (WMS, WFS, WCS and SOS). It will also include discussing standardized interfaces for exploring and downloading data that focus on data and products common to all regions (e.g., glider data, model nowcasts and forecasts, key climate variables). AOOS spearheaded the development of the data portal and catalog interfaces currently used by AOOS and CeNCOOS and soon by SECOORA, and converging on common data interfaces is one step in providing a consistent "look and feel" for IOOS stakeholders that use data from more than one region.

5. *Collaborate with other state, regional, national and international data management programs.* Axiom Data Science will work closely with the AOOS Data Management Committee and actively participate in national IOOS data management committees and teams. They will also participate in Alaska's Federal-State Data Integration Working Group and develop partnerships with other existing data management systems in Alaska and the Arctic, including those for the USGS Oceanographic Biological Information System (OBIS), the Arctic Observing Network (AON) and the Sustained Arctic Observing Network (SAON).

VII. MODELING, ANALYSIS & PRODUCT DEVELOPMENT SUBSYSTEM

Goal: The goals of this component are to increase the accuracy, reliability and scope of operational ocean products and services for Alaska, add value to existing data and models and develop new products based on stakeholder needs.

Background: AOOS originally proposed to expand ocean modeling efforts initiated in Prince William Sound into a statewide modeling and forecasting framework. Because of the extensive geographic area, paucity of *in situ* observations, limited AOOS resources and lack of support from other potential funders, this has not proven to be a realistic approach. Depending on the amount of funding available, we now propose instead to focus on three main objectives described below:

Objectives and Approaches:

1. *Support existing models and data products developed with prior AOOS funding.*
 - a. Continue annual updates to the Historical Sea Ice Atlas, the Research Assets Map, and the Yukon-Kuskokwim Chinook Run Timing Forecast.
 - b. Continue development of a prototype *AIS Vessel Tracking Tool*. The Marine Exchange of Alaska's Automatic Identification System (AIS) data archive is a valuable source of information that tracks shipping trends across several dimensions (space, time, ship velocity and type). However, the extensive data archive with over 1 billion records prohibits expedient analysis of the entire time series. Raw data are accessed by users either through one-off data requests or a subscription service from the Marine Exchange, but exhaustive processing is required to produce tangible products that, for example, reveal ship route trends in the region. Axiom is working on increasing the accessibility and re-

use of this data resource by developing an advanced spatial/temporal analytic interface powered by high performance computing techniques. The continued effort will significantly increase the accessibility of the AIS data archive by resource management, scientific and policy communities. Products will include output from advanced graphical analytics, such as dynamic heat maps, which show density of shipping routes. It will also allow for user-enabled inputs, and offer interactive graphics that display regional spatial and temporal trends, as well as data overlay capabilities (e.g., mapping vessel traffic patterns over marine mammal migration routes).

- c. *Continue support for operating the ROMS model for Prince William Sound (PWS) and Gulf of Alaska (GOA).* AOOS will continue supporting the PWS and GOA real-time nowcast/forecast operational Regional Ocean Modeling System (ROMS). The model consists of a 3-level nested configuration covering PWS at 1-km resolution, the northeastern GOA at 3-km, and the northeastern Pacific Ocean at 9-km. Nowcasts and forecasts are produced daily, and images, analysis and model output are published daily on the AOOS Model Explorer. The AOOS PWS ROMS model provides critical support for the NOAA Coastal Survey Development Lab's project to develop a real-time forecasting system for Cook Inlet based on ROMS.
- d. *Continue support for AOOS Model Explorer and increase capabilities.* The AOOS data team is exploring methods for serving four-dimensional (4-D) and higher datasets via THREDDS, ncWMS and other NetCDF data management and interoperability systems. The 4-D operational ROMS model for Prince William Sound is an ideal candidate to demonstrate this type of functionality.

2. Develop select new modeling and data products that are priorities for stakeholders. With full funding, AOOS would:

- a. *Develop a "State of Alaska's Coasts and Oceans Report".* Building upon the existing Arctic Report Card, National Marine Fisheries Service (NMFS) Ecosystem Report Cards, Alaska Climate Assessment, the developing Integrated Ecosystem Assessments, and the PICES Status of the North Pacific Ocean, AOOS will work with partners to produce an annual status report that is electronic and web accessible, but also includes a brief summary document in hard copy. This would be a signature AOOS product and complement the existing AOOS Ocean Data Explorer, providing a comprehensive annual assessment of the state of Alaska's oceans and coast.
- b. *Develop new products prioritized by stakeholders.* Stakeholders have identified numerous product needs. AOOS will focus on these priorities for new product development efforts, including a higher resolution historical sea ice atlas, additional fishery run timing forecasts, ocean climatologies, a particle trajectory tool, and spatial analysis tools to analyze vessel traffic corridors for planning purposes.
- c. *Develop new web-based model evaluation tools.* Sophisticated model evaluation tools will better enable managers, scientists, educators and stakeholders to assess model output quality. Advanced tools could be developed to compare these outputs against each other through model-to-model comparisons, and assess model framework utility through model observation comparisons. The AOOS data system currently allows users to place a virtual sensor to extract time series data at a point and specific depth within a numerical modeling grid. AOOS plans to expand upon this capability by developing tools that extract virtual transects (depth curtain profile over a line at a specific time instance) and virtual profiles (changing depth profile over time at a specific location). Users will also be able to directly compare *in situ* observational data from sensors, buoys, gliders and profiling instruments (ADCPs and CTDs) against modeling outputs.

3. Initiate the Alaska Modeling Testbed. Similar to the IOOS Coastal Ocean Modeling Testbed (COMT), the mission of the AOOS Modeling Testbed effort will be to accelerate the transition of advances from the coastal ocean modeling research community to improved operational ocean products and services for Alaska, and thereby increase the accuracy, reliability, and scope of Alaska operational coastal and

ocean forecasting products. For AOOS, a modeling team will be assembled to develop the program’s mission, objectives, and criteria for proposals (e.g., must solve a specific modeling problem, validate an existing model, add operational value to an existing model, etc.). The criteria will be used to select candidate projects, considering a number of factors, including the current status of model in question (e.g., existence and functionality of a model versus building a model from the ground up). Model status will be balanced with stakeholder-identified needs, model priorities and potential for leveraging. Preliminary discussions have been held between AOOS and NOAA National Weather Service on the new Arctic Testbed, and there is the potential for future collaborations on that effort. Two potential modeling needs have already been identified for Year 1 with potential funding partners:

- a. National Ocean Service (NOS): Add value to the NOS Coast Survey Development Laboratory (CSDL) circulation model for Cook Inlet by using hindcast model runs to develop decision support tools. Tools could include particle trajectory analysis (oil spill response planning, larval transport for shellfish), residence time (harmful algal blooms, oil spills), resource management (current/future environmental conditions for crab and groundfish distribution and herring spawning) and climate change scenario testing (impact of snowpack melt and precipitation changes, timing of seasonal changes).
- b. Improve existing circulation models (AOOS ROMS, NOAA GNOME, and Alyeska ATOM) to include surface and subsurface currents in Port of Valdez, home to the Valdez Marine Terminal and tanker loading activities. This would improve our understanding of how oil may move and disperse in confined regions.

VIII. PROJECT BUDGET

Program Components	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Management & Outreach	623,946	640,668	657,856	675,563	693,853	3,291,886
Observing	1,939,718	1,983,300	1,980,366	1,962,684	1,945,354	13,711,422
Data Management	600,000	600,000	600,000	600,000	600,000	3,000,000
Modeling & Products	648,241	587,937	573,683	573,658	572,698	2,956,217
Fiscal Support Fee	188,095	188,095	188,095	188,095	188,095	940,475
Total	4,000,000	4,000,000	4,000,000	4,000,000	4,000,000	20,000,000

Detailed budget information. Appendix A includes an overall project budget and budget narrative, as well as budget information for all subawards. A holdback of \$250,000 over five years is requested for NOAA Kasitsna Bay Laboratory (Holderied) to perform activities described above. AOOS wishes for NOAA to retain these funds and have them used by the specified NOAA office. No equipment described in this proposal is available for lease. All items require a direct purchase.

Base capacity and enhancements. AOOS has submitted a budget request for \$4 million a year for five years, which would minimally meet the need for ocean observing activities in Alaska. Appendix E describes the activities that would occur under the three funding scenarios (\$1.5M, \$2.5M, and \$4M). This proposal focuses on the \$2.5M scenario since that is closest to our current funding level. Under all three funding scenarios, program staff and the data management team would stay roughly the same since these are AOOS Board priorities. The primary difference is in the extent of proposed observations and equipment purchases, and resources devoted to modeling.

IX. MILESTONES & DELIVERABLES

MILESTONES & DELIVERABLES (\$2.5M)	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
REGIONAL GOVERNANCE & MANAGEMENT SUBSYSTEM					
<i>Ongoing board, committee and partnership activities</i>	*	*	*	*	*
<i>Finalize AOOS certification as AK IOOS RA</i>	*				
OUTREACH, STAKEHOLDER ENGAGEMENT & EDUCATION					
<i>Ongoing activities (website, publications, communications)</i>	*	*	*	*	*
<i>Work with partners to develop Ocean Acidification Network</i>	*	*	*	*	*
<i>Develop IOOS-wide materials with IOOS Outreach Committee</i>	*	*	*	*	*
OBSERVING SYSTEM					
Marine Operations					
<i>Sustain weather observations in the GOA</i>	*	*	*	*	*
<i>Increase access to weather observations using AIS</i>	*	*	*	*	*
<i>Sustain critical wave buoys for navigation safety</i>	*	*	*	*	*
<i>Map surface currents with high frequency radars (HFRs)</i>	*	*	*	*	*
<i>Enhance observations at Port of Anchorage</i>	*	*	*	*	*
Coastal Hazards & Inundation					
<i>Increase water level observations in western & northern Alaska</i>	*	*	*	*	*
<i>Increase wave observations for water level forecasting & planning</i>	*	*	*	*	*
Ecosystems, Fisheries & Climate Trends					
Sustained Observation Network					
<i>Sustain Seward Line sampling</i>	*	*	*	*	*
<i>Support ecosystem moorings in Alaska's LMEs</i>	*	*	*	*	*
<i>Glider monitoring of ocean conditions and marine mammals</i>	*	*	*	*	*
Regional sentinel observations					
<i>Support sentinel monitoring in Prince William Sound</i>	*	*	*	*	*
<i>Support sentinel monitoring in Cook Inlet</i>	*	*	*	*	*
<i>Initiate sentinel monitoring in Southeast Alaska</i>	*	*	*	*	*
Water Quality					
<i>Sustain Ocean acidification (OA) monitoring</i>	*	*	*	*	*
<i>Support monitoring of marine debris</i>	*	*	*	*	*
DATA MANAGEMENT & COMMUNICATIONS					
<i>Support AOOS Data Assembly Center cyber infrastructure</i>	*	*	*	*	*
<i>Maintain and enhance Ocean Data Explorer</i>	*	*	*	*	*
<i>Maintain existing data products</i>	*	*	*	*	*
<i>Develop new data products</i>	*	*	*	*	*
MODELING, ANALYSIS & PRODUCTS					
<i>Support existing models & data products</i>	*	*	*	*	*
<i>Continue development of AIS Vessel Tracking Tool</i>	*	*	*	*	*
<i>Continue support for ROMS forecasts for PWS and GOA</i>	*	*	*	*	*
<i>Support and enhance AOOS Model Explorer</i>	*	*	*	*	*
<i>Develop State of Alaska's Coasts and Oceans Report</i>	*	*	*	*	*
<i>Initiate and maintain AOOS Modeling Testbed</i>	*	*	*	*	*
<i>Explore Arctic Marine Highway decision tools</i>	*				

BUDGET INFORMATION - Non-Construction Programs

OMB Approval No. 0348-0044

SECTION A - BUDGET SUMMARY						
Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. AOOS- UAF Walsh	11.012	\$	\$	\$ 243,930.00	\$	\$ 243,930.00
2.						0.00
3.						0.00
4.						0.00
5. Totals		\$ 0.00	\$ 0.00	\$ 243,930.00	\$ 0.00	\$ 243,930.00

SECTION B - BUDGET CATEGORIES

6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY					Total (5)
	(1)	(2)	(3)	(4)		
	6/1/2016-5/31/2016	6/1/2017-5/31/2018	6/1/2019-5/31/2020	6/1/2019-5/31/2020		
a. Personnel	\$ 23,443.00	\$ 24,845.00	\$ 24,784.00	\$ 25,069.00	\$	\$ 98,141.00
b. Fringe Benefits	5,762.00	5,936.00	6,173.00	6,295.00		24,166.00
c. Travel	2,522.00	893.00	950.00	1,013.00		5,378.00
d. Equipment	0.00	0.00	0.00	0.00		0.00
e. Supplies	600.00	600.00	600.00	600.00		2,400.00
f. Contractual	0.00	0.00	0.00	0.00		0.00
g. Construction	0.00	0.00	0.00	0.00		0.00
h. Other	0.00	0.00	0.00	0.00		0.00
i. Total Direct Charges (sum of 6a-6h)	32,327.00	32,274.00	32,507.00	32,977.00		130,085.00
j. Indirect Charges	16,325.00	16,298.00	16,417.00	16,653.00		65,693.00
k. TOTALS (sum of 6i and 6j)	\$ 48,652.00	\$ 48,572.00	\$ 48,924.00	\$ 49,630.00	\$	\$ 195,778.00
7. Program Income	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	\$	\$ 0.00

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BUDGET INFORMATION - Non-Construction Programs

OMB Approval No. 0348-0044

SECTION A - BUDGET SUMMARY						
Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. AOOS- UAF Walsh	11.012	\$	\$	\$ 0.00	\$	\$ 0.00
2.						0.00
3.						0.00
4.						0.00
5. Totals		\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00

SECTION B - BUDGET CATEGORIES							
6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY					Total (5)	
	(1)	6/1/2016-5/31/2020	(2)	6/1/2020-5/31/2021	(3)		(4)
a. Personnel	\$	98,141.00	\$	23,657.00	\$	\$	121,798.00
b. Fringe Benefits		24,166.00		5,572.00			29,738.00
c. Travel		5,378.00		2,166.00			7,544.00
d. Equipment		0.00		0.00			0.00
e. Supplies		2,400.00		600.00			3,000.00
f. Contractual		0.00		0.00			0.00
g. Construction		0.00		0.00		0.00	0.00
h. Other		0.00		0.00			0.00
i. Total Direct Charges (sum of 6a-6h)		130,085.00		31,995.00	0.00	0.00	162,080.00
j. Indirect Charges		65,693.00		16,157.00			81,850.00
k. TOTALS (sum of 6i and 6j)	\$	195,778.00	\$	48,152.00	\$ 0.00	\$ 0.00	\$ 243,930.00
7. Program Income	\$	0.00	\$	0.00	\$ 0.00	\$ 0.00	\$ 0.00

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SECTION C - NON-FEDERAL RESOURCES					
(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e) TOTALS	
8. University of Alaska Fairbanks - PI: Walsh	\$	\$	\$	\$ 0.00	
9.				0.00	
10.				0.00	
11.				0.00	
12. TOTAL (sum of lines 8-11)	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	
SECTION D - FORECASTED CASH NEEDS					
	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
13. Federal	\$ 48,652.00	\$ 12,163.00	\$ 12,163.00	\$ 12,163.00	\$ 12,163.00
14. Non-Federal	0.00				
15. TOTAL (sum of lines 13 and 14)	\$ 48,652.00	\$ 12,163.00	\$ 12,163.00	\$ 12,163.00	\$ 12,163.00
SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT					
(a) Grant Program	FUTURE FUNDING PERIODS (Years)				
	(b) First	(c) Second	(d) Third	(e) Fourth	
16. University of Alaska Fairbanks - PI: Walsh	\$ 48,572.00	\$ 48,924.00	\$ 49,630.00	\$ 48,152.00	
17.					
18.					
19.					
20. TOTAL (sum of lines 16-19)	\$ 48,572.00	\$ 48,924.00	\$ 49,630.00	\$ 48,152.00	
SECTION F - OTHER BUDGET INFORMATION					
21. Direct Charges: 162080		22. Indirect Charges: 81850			
23. Remarks: Indirect rate of 50.5% applied to MTDC					

BUDGET INFORMATION - Non-Construction Programs

OMB Approval No. 0348-0044

SECTION A - BUDGET SUMMARY						
Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. AOOS- UAF Walsh	11.012	\$	\$	\$ 177,287.00	\$	\$ 177,287.00
2.						0.00
3.						0.00
4.						0.00
5. Totals		\$ 0.00	\$ 0.00	\$ 177,287.00	\$ 0.00	\$ 177,287.00
SECTION B - BUDGET CATEGORIES						
6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY					Total (5)
	(1) 6/1/2016-5/31/2017	(2) 6/1/2017-5/31/2018	(3) 6/1/2019-5/31/2020	(4) 6/1/2019-5/31/2020		
a. Personnel	\$ 29,742.00	\$ 15,052.00	\$ 15,237.00	\$ 13,455.00	\$ 73,486.00	
b. Fringe Benefits	7,572.00	3,860.00	3,936.00	3,205.00	18,573.00	
c. Travel	1,681.00	0.00	0.00	2,028.00	3,709.00	
d. Equipment	0.00	0.00	0.00	0.00	0.00	
e. Supplies	600.00	600.00	600.00	600.00	2,400.00	
f. Contractual	0.00	0.00	0.00	0.00	0.00	
g. Construction	0.00	0.00	0.00	0.00	0.00	
h. Other	0.00	0.00	0.00	0.00	0.00	
i. Total Direct Charges (sum of 6a-6h)	39,595.00	19,512.00	19,773.00	19,288.00	98,168.00	
j. Indirect Charges	19,994.00	9,853.00	9,986.00	9,740.00	49,573.00	
k. TOTALS (sum of 6i and 6j)	\$ 59,589.00	\$ 29,365.00	\$ 29,759.00	\$ 29,028.00	\$ 147,741.00	
7. Program Income	\$	\$	\$	\$	\$ 0.00	

Authorized for Local Reproduction

BUDGET INFORMATION - Non-Construction Programs

OMB Approval No. 0348-0044

SECTION A - BUDGET SUMMARY						
Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. AOOS- UAF Walsh	11.012	\$	\$	0.00	\$	\$ 0.00
2.						0.00
3.						0.00
4.						0.00
5. Totals		\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00
SECTION B - BUDGET CATEGORIES						
6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY				Total (5)	
	(1) 6/1/2016-5/31/2020	(2) 6/1/2020-5/31/2021	(3)	(4)		
a. Personnel	\$ 73,486.00	\$ 13,601.00	\$	\$	\$ 87,087.00	
b. Fringe Benefits	18,573.00	3,265.00			21,838.00	
c. Travel	3,709.00	2,166.00			5,875.00	
d. Equipment	0.00	0.00			0.00	
e. Supplies	2,400.00	600.00			3,000.00	
f. Contractual	0.00	0.00			0.00	
g. Construction	0.00	0.00			0.00	
h. Other	0.00	0.00			0.00	
i. Total Direct Charges (sum of 6a-6h)	98,168.00	19,632.00	0.00	0.00	117,800.00	
j. Indirect Charges	49,573.00	9,914.00			59,487.00	
k. TOTALS (sum of 6i and 6j)	\$ 147,741.00	\$ 29,546.00	\$ 0.00	\$ 0.00	\$ 177,287.00	
7. Program Income	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	

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SECTION C - NON-FEDERAL RESOURCES					
(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e) TOTALS	
8. AOOS - UAF Walsh (Climatology)	\$	\$	\$	\$ 0.00	
9.				0.00	
10.				0.00	
11.				0.00	
12. TOTAL (sum of lines 8-11)	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	
SECTION D - FORECASTED CASH NEEDS					
	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
13. Federal	\$ 59,589.00	\$ 14,897.25	\$ 14,897.25	\$ 14,897.25	\$ 14,897.25
14. Non-Federal	0.00				
15. TOTAL (sum of lines 13 and 14)	\$ 59,589.00	\$ 14,897.25	\$ 14,897.25	\$ 14,897.25	\$ 14,897.25
SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT					
(a) Grant Program	FUTURE FUNDING PERIODS (Years)				
	(b) First	(c) Second	(d) Third	(e) Fourth	
16. AOOS - UAF Walsh (Climatology)	\$ 29,365.00	\$ 29,759.00	\$ 29,028.00	\$ 29,546.00	
17.					
18.					
19.					
20. TOTAL (sum of lines 16-19)	\$ 29,365.00	\$ 29,759.00	\$ 29,028.00	\$ 29,546.00	
SECTION F - OTHER BUDGET INFORMATION					
21. Direct Charges: 117799		22. Indirect Charges: 59489			
23. Remarks: 50.5% indirect rate on MTDC					

BUDGET INFORMATION - Non-Construction Programs

OMB Approval No. 0348-0044

SECTION A - BUDGET SUMMARY						
Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. AOOS- UAF Eicken	11.012	\$	\$	\$ 481,854.00	\$	\$ 481,854.00
2.						0.00
3.						0.00
4.						0.00
5. Totals		\$ 0.00	\$ 0.00	\$ 481,854.00	\$ 0.00	\$ 481,854.00

SECTION B - BUDGET CATEGORIES						
6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY					Total (5)
	(1) 6/1/2016-5/31/2017	(2) 6/1/2017-5/31/2018	(3) 6/1/2019-5/31/2020	(4) 6/1/2019-5/31/2020		
a. Personnel	\$ 11,533.00	\$ 11,821.00	\$ 12,116.00	\$ 12,419.00	\$	\$ 47,889.00
b. Fringe Benefits	5,270.00	5,402.00	5,537.00	5,676.00		21,885.00
c. Travel	10,461.00	10,852.00	11,282.00	11,753.00		44,348.00
d. Equipment	0.00	0.00	0.00	0.00		0.00
e. Supplies	10,000.00	8,000.00	8,000.00	8,000.00		34,000.00
f. Contractual	28,500.00	28,500.00	28,500.00	28,500.00		114,000.00
g. Construction	0.00	0.00	0.00	0.00		0.00
h. Other	0.00	0.00	0.00	0.00		0.00
i. Total Direct Charges (sum of 6a-6h)	65,764.00	64,575.00	65,435.00	66,348.00		262,122.00
j. Indirect Charges	33,211.00	32,610.00	33,044.00	33,506.00		132,371.00
k. TOTALS (sum of 6i and 6j)	\$ 98,975.00	\$ 97,185.00	\$ 98,479.00	\$ 99,854.00	\$	\$ 394,493.00
7. Program Income	\$	\$	\$	\$	\$	0.00

Authorized for Local Reproduction

BUDGET INFORMATION - Non-Construction Programs

OMB Approval No. 0348-0044

SECTION A - BUDGET SUMMARY						
Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. AOOS- UAF Eicken	11.012	\$	\$	\$ 0.00	\$	\$ 0.00
2.						0.00
3.						0.00
4.						0.00
5. Totals		\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00
SECTION B - BUDGET CATEGORIES						
6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY				Total (5)	
	(1) 6/1/2016-5/31/2020	(2) 6/1/2020-5/31/2021	(3)	(4)		
a. Personnel	\$ 47,889.00	\$ 6,365.00	\$	\$	\$ 54,254.00	
b. Fringe Benefits	21,885.00	2,909.00			24,794.00	
c. Travel	44,349.00	12,272.00			56,621.00	
d. Equipment	0.00	0.00			0.00	
e. Supplies	34,000.00	8,000.00			42,000.00	
f. Contractual	114,000.00	28,500.00			142,500.00	
g. Construction	0.00	0.00			0.00	
h. Other	0.00	0.00			0.00	
i. Total Direct Charges (sum of 6a-6h)	262,123.00	58,046.00	0.00	0.00	320,169.00	
j. Indirect Charges	132,371.00	29,314.00			161,685.00	
k. TOTALS (sum of 6i and 6j)	\$ 394,494.00	\$ 87,360.00	\$ 0.00	\$ 0.00	\$ 481,854.00	
7. Program Income	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	

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SECTION C - NON-FEDERAL RESOURCES					
(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e) TOTALS	
8. AOOS - UAF Eicken	\$	\$	\$	\$ 0.00	
9.				0.00	
10.				0.00	
11.				0.00	
12. TOTAL (sum of lines 8-11)	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	
SECTION D - FORECASTED CASH NEEDS					
	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
13. Federal	\$ 98,975.00	\$ 24,743.75	\$ 24,743.75	\$ 24,743.75	\$ 24,743.75
14. Non-Federal	0.00				
15. TOTAL (sum of lines 13 and 14)	\$ 98,975.00	\$ 24,743.75	\$ 24,743.75	\$ 24,743.75	\$ 24,743.75
SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT					
(a) Grant Program	FUTURE FUNDING PERIODS (Years)				
	(b) First	(c) Second	(d) Third	(e) Fourth	
16. AOOS - UAF Eicken	\$ 97,185.00	\$ 98,479.00	\$ 99,854.00	\$ 87,361.00	
17.					
18.					
19.					
20. TOTAL (sum of lines 16-19)	\$ 97,185.00	\$ 98,479.00	\$ 99,854.00	\$ 87,361.00	
SECTION F - OTHER BUDGET INFORMATION					
21. Direct Charges: 320169		22. Indirect Charges: 161685			
23. Remarks: 50.5% indirect rate on MTDC					

BUDGET INFORMATION - Non-Construction Programs

OMB Approval No. 0348-0044

SECTION A - BUDGET SUMMARY						
Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. AOOS- UAF Cross	11.012	\$	\$	\$ 481,854.00	\$	\$ 481,854.00
2.						0.00
3.						0.00
4.						0.00
5. Totals		\$ 0.00	\$ 0.00	\$ 481,854.00	\$ 0.00	\$ 481,854.00
SECTION B - BUDGET CATEGORIES						
6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY				Total (5)	
	(1) 6/1/2016-5/31/2017	(2) 6/1/2017-5/31/2018	(3) 6/1/2019-5/31/2020	(4) 6/1/2019-5/31/2020		
a. Personnel	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	
b. Fringe Benefits	0.00	0.00	0.00	0.00	0.00	
c. Travel	988.00	1,033.00	1,083.00	1,136.00	4,240.00	
d. Equipment	15,000.00	15,000.00	15,000.00	15,000.00	60,000.00	
e. Supplies	1,268.00	1,223.00	1,174.00	1,119.00	4,784.00	
f. Contractual	50,900.00	50,900.00	50,900.00	50,900.00	203,600.00	
g. Construction	0.00	0.00	0.00	0.00	0.00	
h. Other	0.00	0.00	0.00	0.00	0.00	
i. Total Direct Charges (sum of 6a-6h)	68,156.00	68,156.00	68,157.00	68,155.00	272,624.00	
j. Indirect Charges	26,844.00	26,844.00	26,844.00	26,844.00	107,376.00	
k. TOTALS (sum of 6i and 6j)	\$ 95,000.00	\$ 95,000.00	\$ 95,001.00	\$ 94,999.00	\$ 380,000.00	
7. Program Income	\$	\$	\$	\$	\$ 0.00	

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Standard Form 424A (Rev. 7-97)
Prescribed by OMB Circular A-102

BUDGET INFORMATION - Non-Construction Programs

OMB Approval No. 0348-0044

SECTION A - BUDGET SUMMARY						
Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. AOOS- UAF Cross	11.012	\$	\$	0.00	\$	\$ 0.00
2.						0.00
3.						0.00
4.						0.00
5. Totals		\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00

SECTION B - BUDGET CATEGORIES

6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY				Total (5)
	(1) 6/1/2016-5/31/2020	(2) 6/1/2020-5/31/2021	(3)	(4)	
a. Personnel	\$ 0.00	\$ 0.00	\$	\$	\$ 0.00
b. Fringe Benefits	0.00	0.00			0.00
c. Travel	4,240.00	1,197.00			5,437.00
d. Equipment	60,000.00	15,000.00			75,000.00
e. Supplies	4,784.00	1,059.00			5,843.00
f. Contractual	203,600.00	50,900.00			254,500.00
g. Construction	0.00	0.00			0.00
h. Other	0.00	0.00			0.00
i. Total Direct Charges (sum of 6a-6h)	272,624.00	68,156.00	0.00	0.00	340,780.00
j. Indirect Charges	107,376.00	26,844.00			134,220.00
k. TOTALS (sum of 6i and 6j)	\$ 380,000.00	\$ 95,000.00	\$ 0.00	\$ 0.00	\$ 475,000.00
7. Program Income	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00

Authorized for Local Reproduction

Standard Form 424A (Rev. 7-97)
Prescribed by OMB Circular A-102

SECTION C - NON-FEDERAL RESOURCES					
(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e) TOTALS	
8. AOOS - UAF Cross	\$	\$	\$	\$ 0.00	
9.				0.00	
10.				0.00	
11.				0.00	
12. TOTAL (sum of lines 8-11)	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	
SECTION D - FORECASTED CASH NEEDS					
	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
13. Federal	\$ 95,000.00	\$ 23,750.00	\$ 23,750.00	\$ 23,750.00	\$ 23,750.00
14. Non-Federal	0.00				
15. TOTAL (sum of lines 13 and 14)	\$ 95,000.00	\$ 23,750.00	\$ 23,750.00	\$ 23,750.00	\$ 23,750.00
SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT					
(a) Grant Program	FUTURE FUNDING PERIODS (Years)				
	(b) First	(c) Second	(d) Third	(e) Fourth	
16. AOOS - UAF Cross	\$ 95,000.00	\$ 95,000.00	\$ 95,000.00	\$ 95,000.00	
17.					
18.					
19.					
20. TOTAL (sum of lines 16-19)	\$ 95,000.00	\$ 95,000.00	\$ 95,000.00	\$ 95,000.00	
SECTION F - OTHER BUDGET INFORMATION					
21. Direct Charges: 340780		22. Indirect Charges: 134220			
23. Remarks: 50.5% indirect rate on MTDC					

BUDGET INFORMATION - Non-Construction Programs

OMB Approval No. 0348-0044

SECTION A - BUDGET SUMMARY						
Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. AOOS- UAF Hopcrof	11.012	\$	\$	\$ 500,000.00	\$	\$ 500,000.00
2.						0.00
3.						0.00
4.						0.00
5. Totals		\$ 0.00	\$ 0.00	\$ 500,000.00	\$ 0.00	\$ 500,000.00
SECTION B - BUDGET CATEGORIES						
6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY				Total (5)	
	(1) 6/1/2016-5/31/2017	(2) 6/1/2017-5/31/2018	(3) 6/1/2019-5/31/2020	(4) 6/1/2019-5/31/2020		
a. Personnel	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	
b. Fringe Benefits	0.00	0.00	0.00	0.00	0.00	
c. Travel	0.00	0.00	0.00	0.00	0.00	
d. Equipment	100,000.00	100,000.00	100,000.00	100,000.00	400,000.00	
e. Supplies	0.00	0.00	0.00	0.00	0.00	
f. Contractual	0.00	0.00	0.00	0.00	0.00	
g. Construction	0.00	0.00	0.00	0.00	0.00	
h. Other	0.00	0.00	0.00	0.00	0.00	
i. Total Direct Charges (sum of 6a-6h)	100,000.00	100,000.00	100,000.00	100,000.00	400,000.00	
j. Indirect Charges					0.00	
k. TOTALS (sum of 6i and 6j)	\$ 100,000.00	\$ 100,000.00	\$ 100,000.00	\$ 100,000.00	\$ 400,000.00	
7. Program Income	\$	\$	\$	\$	\$ 0.00	

Authorized for Local Reproduction

Standard Form 424A (Rev. 7-97)
Prescribed by OMB Circular A-102

BUDGET INFORMATION - Non-Construction Programs

OMB Approval No. 0348-0044

SECTION A - BUDGET SUMMARY						
Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. AOOS- UAF Hopcrof	11.012	\$	\$	0.00	\$	\$ 0.00
2.						0.00
3.						0.00
4.						0.00
5. Totals		\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00

SECTION B - BUDGET CATEGORIES						
6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY				Total (5)	
	(1) 6/1/2016-5/31/2020	(2) 6/1/2020-5/31/2021	(3)	(4)		
a. Personnel	\$ 0.00	\$ 0.00	\$	\$	\$ 0.00	
b. Fringe Benefits	0.00	0.00			0.00	
c. Travel	0.00	0.00			0.00	
d. Equipment	400,000.00	100,000.00			500,000.00	
e. Supplies	0.00	0.00			0.00	
f. Contractual	0.00	0.00			0.00	
g. Construction	0.00	0.00		0.00	0.00	
h. Other	0.00	0.00			0.00	
i. Total Direct Charges (sum of 6a-6h)	400,000.00	100,000.00	0.00	0.00	500,000.00	
j. Indirect Charges	0.00	0.00			0.00	
k. TOTALS (sum of 6i and 6j)	\$ 400,000.00	\$ 100,000.00	\$ 0.00	\$ 0.00	\$ 500,000.00	
7. Program Income	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	

Authorized for Local Reproduction

SECTION C - NON-FEDERAL RESOURCES					
(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e) TOTALS	
8. AOOS - UAF Hopcroft	\$	\$	\$	\$ 0.00	
9.				0.00	
10.				0.00	
11.				0.00	
12. TOTAL (sum of lines 8-11)	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	
SECTION D - FORECASTED CASH NEEDS					
	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
13. Federal	\$ 100,000.00	\$	\$ 100,000.00	\$	\$
14. Non-Federal	0.00				
15. TOTAL (sum of lines 13 and 14)	\$ 100,000.00	\$ 0.00	\$ 100,000.00	\$ 0.00	\$ 0.00
SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT					
(a) Grant Program	FUTURE FUNDING PERIODS (Years)				
	(b) First	(c) Second	(d) Third	(e) Fourth	
16. AOOS - UAF Hopcroft	\$ 100,000.00	\$ 100,000.00	\$ 100,000.00	\$ 100,000.00	
17.					
18.					
19.					
20. TOTAL (sum of lines 16-19)	\$ 100,000.00	\$ 100,000.00	\$ 100,000.00	\$ 100,000.00	
SECTION F - OTHER BUDGET INFORMATION					
21. Direct Charges: 500000		22. Indirect Charges: 0			
23. Remarks: No Indirects cost recovery on Equipment					

BUDGET INFORMATION - Non-Construction Programs

OMB Approval No. 0348-0044

SECTION A - BUDGET SUMMARY						
Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. AOOS- PWSSC	11.012	\$	\$	\$ 474,520.00	\$	\$ 474,520.00
2.						0.00
3.						0.00
4.						0.00
5. Totals		\$ 0.00	\$ 0.00	\$ 474,520.00	\$ 0.00	\$ 474,520.00

SECTION B - BUDGET CATEGORIES						
6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY					Total (5)
	(1) 6/1/2016-5/31/2017	(2) 6/1/2017-5/31/2018	(3) 6/1/2019-5/31/2020	(4) 6/1/2019-5/31/2020		
a. Personnel	\$ 5,548.00	\$ 5,548.00	\$ 5,548.00	\$ 5,548.00	\$ 22,192.00	
b. Fringe Benefits	2,282.00	2,282.00	2,282.00	2,282.00	9,128.00	
c. Travel	0.00	0.00	0.00	0.00	0.00	
d. Equipment	22,000.00	22,000.00	22,000.00	22,000.00	88,000.00	
e. Supplies	6,300.00	6,300.00	6,300.00	6,300.00	25,200.00	
f. Contractual	0.00	0.00	0.00	0.00	0.00	
g. Construction	0.00	0.00	0.00	0.00	0.00	
h. Other	41,950.00	41,950.00	41,950.00	41,950.00	167,800.00	
i. Total Direct Charges (sum of 6a-6h)	78,080.00	78,080.00	78,080.00	78,080.00	312,320.00	
j. Indirect Charges	16,824.00	16,824.00	16,824.00	16,824.00	67,296.00	
k. TOTALS (sum of 6i and 6j)	\$ 94,904.00	\$ 94,904.00	\$ 94,904.00	\$ 94,904.00	\$ 379,616.00	
7. Program Income	\$	\$	\$	\$	\$ 0.00	

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BUDGET INFORMATION - Non-Construction Programs

OMB Approval No. 0348-0044

SECTION A - BUDGET SUMMARY						
Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. AOOS- PWSSC	11.012	\$	\$	\$ 0.00	\$	\$ 0.00
2.						0.00
3.						0.00
4.						0.00
5. Totals		\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00
SECTION B - BUDGET CATEGORIES						
6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY				Total (5)	
	(1) 6/1/2016-5/31/2020	(2) 6/1/2020-5/31/2021	(3)	(4)		
a. Personnel	\$ 22,192.00	\$ 5,548.00	\$	\$	\$ 27,740.00	
b. Fringe Benefits	9,128.00	2,282.00			11,410.00	
c. Travel	0.00	0.00			0.00	
d. Equipment	88,000.00	22,000.00			110,000.00	
e. Supplies	25,200.00	6,300.00			31,500.00	
f. Contractual	0.00	0.00			0.00	
g. Construction	0.00	0.00		0.00	0.00	
h. Other	167,800.00	41,950.00			209,750.00	
i. Total Direct Charges (sum of 6a-6h)	312,320.00	78,080.00	0.00	0.00	390,400.00	
j. Indirect Charges	67,296.00	16,824.00			84,120.00	
k. TOTALS (sum of 6i and 6j)	\$ 379,616.00	\$ 94,904.00	\$ 0.00	\$ 0.00	\$ 474,520.00	
7. Program Income	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	

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SECTION C - NON-FEDERAL RESOURCES					
(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e) TOTALS	
8. AOOS - PWSSC	\$	\$	\$	\$ 0.00	
9.				0.00	
10.				0.00	
11.				0.00	
12. TOTAL (sum of lines 8-11)	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	
SECTION D - FORECASTED CASH NEEDS					
	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
13. Federal	\$ 94,904.00	\$ 23,726.00	\$ 23,726.00	\$ 23,726.00	\$ 23,726.00
14. Non-Federal	0.00				
15. TOTAL (sum of lines 13 and 14)	\$ 94,904.00	\$ 23,726.00	\$ 23,726.00	\$ 23,726.00	\$ 23,726.00
SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT					
(a) Grant Program	FUTURE FUNDING PERIODS (Years)				
	(b) First	(c) Second	(d) Third	(e) Fourth	
16. AOOS - PWSSC	\$ 94,904.00	\$ 94,904.00	\$ 94,904.00	\$ 94,904.00	
17.					
18.					
19.					
20. TOTAL (sum of lines 16-19)	\$ 94,904.00	\$ 94,904.00	\$ 94,904.00	\$ 94,904.00	
SECTION F - OTHER BUDGET INFORMATION					
21. Direct Charges: 390400			22. Indirect Charges: 84120		
23. Remarks: 30% indirect cost recovery on MTDC					

BUDGET INFORMATION - Non-Construction Programs

OMB Approval No. 0348-0044

SECTION A - BUDGET SUMMARY						
Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. AOOS- RSS	11.012	\$	\$	\$ 250,000.00	\$	\$ 250,000.00
2.						0.00
3.						0.00
4.						0.00
5. Totals		\$ 0.00	\$ 0.00	\$ 250,000.00	\$ 0.00	\$ 250,000.00

SECTION B - BUDGET CATEGORIES						
6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY					Total (5)
	(1) 6/1/2016-5/31/2017	(2) 6/1/2017-5/31/2018	(3) 6/1/2019-5/31/2020	(4) 6/1/2019-5/31/2020		
a. Personnel	\$ 25,441.00	\$ 25,441.00	\$ 25,441.00	\$ 25,441.00	\$	\$ 101,764.00
b. Fringe Benefits	12,977.00	12,977.00	12,977.00	12,977.00		51,908.00
c. Travel	1,310.00	1,310.00	1,310.00	1,310.00		5,240.00
d. Equipment	0.00	0.00	0.00	0.00		0.00
e. Supplies	0.00	0.00	0.00	0.00		0.00
f. Contractual	0.00	0.00	0.00	0.00		0.00
g. Construction	0.00	0.00	0.00	0.00		0.00
h. Other	7,967.00	7,967.00	7,967.00	7,967.00		31,868.00
i. Total Direct Charges (sum of 6a-6h)	47,695.00	47,695.00	47,695.00	47,695.00		190,780.00
j. Indirect Charges	2,305.00	2,305.00	2,305.00	2,305.00		9,220.00
k. TOTALS (sum of 6i and 6j)	\$ 50,000.00	\$ 50,000.00	\$ 50,000.00	\$ 50,000.00	\$	\$ 200,000.00
7. Program Income	\$	\$	\$	\$	\$	0.00

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BUDGET INFORMATION - Non-Construction Programs

OMB Approval No. 0348-0044

SECTION A - BUDGET SUMMARY						
Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. AOOS- RSS	11.012	\$	\$	0.00	\$	\$ 0.00
2.						0.00
3.						0.00
4.						0.00
5. Totals		\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00

SECTION B - BUDGET CATEGORIES						
6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY				Total	
	(1) 6/1/2016-5/31/2020	(2) 6/1/2020-5/31/2021	(3)	(4)	(5)	
a. Personnel	\$ 101,764.00	\$ 25,441.00	\$	\$	\$ 127,205.00	
b. Fringe Benefits	51,908.00	12,979.00			64,887.00	
c. Travel	5,240.00	1,309.00			6,549.00	
d. Equipment	0.00	0.00			0.00	
e. Supplies	0.00	0.00			0.00	
f. Contractual	0.00	0.00			0.00	
g. Construction	0.00	0.00		0.00	0.00	
h. Other	31,868.00	7,966.00			39,834.00	
i. Total Direct Charges (sum of 6a-6h)	190,780.00	47,695.00	0.00	0.00	238,475.00	
j. Indirect Charges	9,220.00	2,305.00			11,525.00	
k. TOTALS (sum of 6i and 6j)	\$ 200,000.00	\$ 50,000.00	\$ 0.00	\$ 0.00	\$ 250,000.00	
7. Program Income	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	

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SECTION C - NON-FEDERAL RESOURCES					
(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e) TOTALS	
8. AOOS - RSS	\$	\$	\$	\$ 0.00	
9.				0.00	
10.				0.00	
11.				0.00	
12. TOTAL (sum of lines 8-11)	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	
SECTION D - FORECASTED CASH NEEDS					
	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
13. Federal	\$ 50,000.00	\$ 10,000.00	\$ 10,000.00	\$ 20,000.00	\$ 10,000.00
14. Non-Federal	0.00				
15. TOTAL (sum of lines 13 and 14)	\$ 50,000.00	\$ 10,000.00	\$ 10,000.00	\$ 20,000.00	\$ 10,000.00
SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT					
(a) Grant Program	FUTURE FUNDING PERIODS (Years)				
	(b) First	(c) Second	(d) Third	(e) Fourth	
16. AOOS - RSS	\$ 50,000.00	\$ 50,000.00	\$ 50,000.00	\$ 50,000.00	
17.					
18.					
19.					
20. TOTAL (sum of lines 16-19)	\$ 50,000.00	\$ 50,000.00	\$ 50,000.00	\$ 50,000.00	
SECTION F - OTHER BUDGET INFORMATION					
21. Direct Charges: 238475		22. Indirect Charges: 11525			
23. Remarks:					

BUDGET INFORMATION - Non-Construction Programs

OMB Approval No. 0348-0044

SECTION A - BUDGET SUMMARY						
Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. AOOS- MXAK	11.012	\$	\$	\$ 750,000.00	\$	\$ 750,000.00
2.						0.00
3.						0.00
4.						0.00
5. Totals		\$ 0.00	\$ 0.00	\$ 750,000.00	\$ 0.00	\$ 750,000.00
SECTION B - BUDGET CATEGORIES						
6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY					Total (5)
	(1) 6/1/2016-5/31/2017	(2) 6/1/2017-5/31/2018	(3) 6/1/2019-5/31/2020	(4) 6/1/2019-5/31/2020		
a. Personnel	\$ 25,300.00	\$ 25,300.00	\$ 25,300.00	\$ 25,300.00	\$	\$ 101,200.00
b. Fringe Benefits	2,500.00	2,500.00	2,500.00	2,500.00		10,000.00
c. Travel	18,000.00	13,000.00	12,500.00	13,000.00		56,500.00
d. Equipment	34,000.00	43,000.00	44,500.00	46,000.00		167,500.00
e. Supplies	3,500.00	3,000.00	3,000.00	3,000.00		12,500.00
f. Contractual	0.00	0.00	0.00	0.00		0.00
g. Construction	0.00	0.00	0.00	0.00		0.00
h. Other	0.00	0.00	0.00	0.00		0.00
i. Total Direct Charges (sum of 6a-6h)	83,300.00	86,800.00	87,800.00	89,800.00		347,700.00
j. Indirect Charges	7,625.00	6,700.00	7,900.00	8,100.00		30,325.00
k. TOTALS (sum of 6i and 6j)	\$ 90,925.00	\$ 93,500.00	\$ 95,700.00	\$ 97,900.00	\$	\$ 378,025.00
7. Program Income	\$	\$	\$	\$	\$	\$ 0.00

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BUDGET INFORMATION - Non-Construction Programs

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SECTION A - BUDGET SUMMARY						
Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. AOOS- MXAK	11.012	\$	\$	0.00	\$	\$ 0.00
2.						0.00
3.						0.00
4.						0.00
5. Totals		\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00

SECTION B - BUDGET CATEGORIES						
6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY					Total (5)
	(1)	6/1/2016-5/31/2020	(2)	6/1/2020-5/31/2021	(3)	
a. Personnel	\$	101,200.00	\$	25,300.00	\$	\$ 126,500.00
b. Fringe Benefits		10,000.00		2,500.00		12,500.00
c. Travel		56,500.00		13,000.00		69,500.00
d. Equipment		167,500.00		52,000.00		219,500.00
e. Supplies		12,500.00		2,500.00		15,000.00
f. Contractual		0.00		0.00		0.00
g. Construction		0.00		0.00		0.00
h. Other		0.00		0.00		0.00
i. Total Direct Charges (sum of 6a-6h)		347,700.00		95,300.00	0.00	443,000.00
j. Indirect Charges		30,325.00		5,800.00		36,125.00
k. TOTALS (sum of 6i and 6j)	\$	378,025.00	\$	101,100.00	\$ 0.00	\$ 479,125.00
7. Program Income	\$	0.00	\$	0.00	\$ 0.00	\$ 0.00

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SECTION C - NON-FEDERAL RESOURCES					
(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e) TOTALS	
8. AOOS - MXAK	\$	\$	\$	\$ 0.00	
9.				0.00	
10.				0.00	
11.				0.00	
12. TOTAL (sum of lines 8-11)	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	
SECTION D - FORECASTED CASH NEEDS					
	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
13. Federal	\$ 90,925.00	\$ 22,731.25	\$ 22,731.25	\$ 22,731.25	\$ 22,731.25
14. Non-Federal	0.00				
15. TOTAL (sum of lines 13 and 14)	\$ 90,925.00	\$ 22,731.25	\$ 22,731.25	\$ 22,731.25	\$ 22,731.25
SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT					
(a) Grant Program	FUTURE FUNDING PERIODS (Years)				
	(b) First	(c) Second	(d) Third	(e) Fourth	
16 AOOS - MXAK	\$ 93,500.00	\$ 95,700.00	\$ 97,900.00	\$ 101,100.00	
17.					
18.					
19.					
20. TOTAL (sum of lines 16-19)	\$ 93,500.00	\$ 95,700.00	\$ 97,900.00	\$ 101,100.00	
SECTION F - OTHER BUDGET INFORMATION					
21. Direct Charges: 443000		22. Indirect Charges: 36125			
23. Remarks: 10% indirect per Uniform Guidance					

BUDGET INFORMATION - Non-Construction Programs

OMB Approval No. 0348-0044

SECTION A - BUDGET SUMMARY						
Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. AOOS- SSSC	11.012	\$	\$	\$ 250,000.00	\$	\$ 250,000.00
2.						0.00
3.						0.00
4.						0.00
5. Totals		\$ 0.00	\$ 0.00	\$ 250,000.00	\$ 0.00	\$ 250,000.00
SECTION B - BUDGET CATEGORIES						
6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY					Total (5)
	(1) 6/1/2016-5/31/2017	(2) 6/1/2017-5/31/2018	(3) 6/1/2019-5/31/2020	(4) 6/1/2019-5/31/2020		
a. Personnel	\$ 6,160.00	\$ 18,080.00	\$ 18,664.00	\$ 19,232.00	\$ 62,136.00	
b. Fringe Benefits	1,109.00	3,254.00	3,360.00	3,462.00	11,185.00	
c. Travel	0.00	0.00	0.00	0.00	0.00	
d. Equipment	32,207.00	0.00	0.00	0.00	32,207.00	
e. Supplies	0.00	1,684.00	2,343.00	1,673.00	5,700.00	
f. Contractual	1,100.00	18,649.00	17,300.00	17,300.00	54,349.00	
g. Construction	0.00	0.00	0.00	0.00	0.00	
h. Other	1,091.00	0.00	0.00	0.00	1,091.00	
i. Total Direct Charges (sum of 6a-6h)	41,667.00	41,667.00	41,667.00	41,667.00	166,668.00	
j. Indirect Charges	8,333.00	8,333.00	8,333.00	8,333.00	33,332.00	
k. TOTALS (sum of 6i and 6j)	\$ 50,000.00	\$ 50,000.00	\$ 50,000.00	\$ 50,000.00	\$ 200,000.00	
7. Program Income	\$	\$	\$	\$	\$ 0.00	

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BUDGET INFORMATION - Non-Construction Programs

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SECTION A - BUDGET SUMMARY						
Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. AOOS- SSSC	11.012	\$	\$	\$ 0.00	\$	\$ 0.00
2.						0.00
3.						0.00
4.						0.00
5. Totals		\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00
SECTION B - BUDGET CATEGORIES						
6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY				Total (5)	
	(1) 6/1/2016-5/31/2020	(2) 6/1/2020-5/31/2021	(3)	(4)		
a. Personnel	\$ 62,136.00	\$ 19,808.00	\$	\$	\$ 81,944.00	
b. Fringe Benefits	11,185.00	3,565.00			14,750.00	
c. Travel	0.00	0.00			0.00	
d. Equipment	32,207.00	0.00			32,207.00	
e. Supplies	5,700.00	994.00			6,694.00	
f. Contractual	54,349.00	17,300.00			71,649.00	
g. Construction	0.00	0.00			0.00	
h. Other	1,091.00	0.00			1,091.00	
i. Total Direct Charges (sum of 6a-6h)	166,668.00	41,667.00	0.00	0.00	208,335.00	
j. Indirect Charges	33,332.00	8,333.00			41,665.00	
k. TOTALS (sum of 6i and 6j)	\$ 200,000.00	\$ 50,000.00	\$ 0.00	\$ 0.00	\$ 250,000.00	
7. Program Income	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	

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SECTION C - NON-FEDERAL RESOURCES					
(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e) TOTALS	
8. AOOS - SSSC	\$	\$	\$	\$ 0.00	
9.				0.00	
10.				0.00	
11.				0.00	
12. TOTAL (sum of lines 8-11)	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	
SECTION D - FORECASTED CASH NEEDS					
	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
13. Federal	\$ 100,000.00	\$ 25,000.00	\$ 25,000.00	\$ 25,000.00	\$ 25,000.00
14. Non-Federal	0.00				
15. TOTAL (sum of lines 13 and 14)	\$ 100,000.00	\$ 25,000.00	\$ 25,000.00	\$ 25,000.00	\$ 25,000.00
SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT					
(a) Grant Program	FUTURE FUNDING PERIODS (Years)				
	(b) First	(c) Second	(d) Third	(e) Fourth	
16. AOOS - SSSC	\$ 50,000.00	\$ 50,000.00	\$ 50,000.00	\$ 50,000.00	
17.					
18.					
19.					
20. TOTAL (sum of lines 16-19)	\$ 50,000.00	\$ 50,000.00	\$ 50,000.00	\$ 50,000.00	
SECTION F - OTHER BUDGET INFORMATION					
21. Direct Charges: 208335			22. Indirect Charges: 41665		
23. Remarks:					

BUDGET INFORMATION - Non-Construction Programs

OMB Approval No. 0348-0044

SECTION A - BUDGET SUMMARY						
Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. AOOS- UAF Weinga	11.012	\$	\$	\$ 1,530,000.00	\$	\$ 1,530,000.00
2.						0.00
3.						0.00
4.						0.00
5. Totals		\$ 0.00	\$ 0.00	\$ 1,530,000.00	\$ 0.00	\$ 1,530,000.00

SECTION B - BUDGET CATEGORIES						
6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY				Total (5)	
	(1) 6/1/2016-5/31/2017	(2) 6/1/2017-5/31/2018	(3) 6/1/2019-5/31/2020	(4) 6/1/2019-5/31/2020		
a. Personnel	\$ 39,739.00	\$ 32,244.00	\$ 41,685.00	\$ 33,809.00	\$ 147,477.00	
b. Fringe Benefits	15,504.00	12,415.00	16,270.00	13,025.00	57,214.00	
c. Travel	16,936.00	18,312.00	19,826.00	21,491.00	76,565.00	
d. Equipment	150,000.00	169,655.00	150,000.00	170,449.00	640,104.00	
e. Supplies	14,225.00	9,124.00	10,373.00	7,243.00	40,965.00	
f. Contractual	17,250.00	18,500.00	15,500.00	14,500.00	65,750.00	
g. Construction	0.00	0.00	0.00	0.00	0.00	
h. Other	0.00	0.00	0.00	0.00	0.00	
i. Total Direct Charges (sum of 6a-6h)	253,654.00	260,250.00	253,654.00	260,517.00	1,028,075.00	
j. Indirect Charges	52,345.00	45,750.00	52,345.00	45,484.00	195,924.00	
k. TOTALS (sum of 6i and 6j)	\$ 305,999.00	\$ 306,000.00	\$ 305,999.00	\$ 306,001.00	\$ 1,223,999.00	
7. Program Income	\$	\$	\$	\$	\$ 0.00	

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BUDGET INFORMATION - Non-Construction Programs

OMB Approval No. 0348-0044

SECTION A - BUDGET SUMMARY						
Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. AOOS- UAF Weingart	11.012	\$	\$	\$ 0.00	\$	\$ 0.00
2.						0.00
3.						0.00
4.						0.00
5. Totals		\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00
SECTION B - BUDGET CATEGORIES						
6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY				Total (5)	
	(1) 6/1/2016-5/31/2020	(2) 6/1/2020-5/31/2021	(3)	(4)		
a. Personnel	\$ 147,477.00	\$ 43,728.00	\$	\$	\$ 191,205.00	
b. Fringe Benefits	57,214.00	17,075.00			74,289.00	
c. Travel	76,565.00	23,321.00			99,886.00	
d. Equipment	640,104.00	150,000.00			790,104.00	
e. Supplies	40,965.00	5,032.00			45,997.00	
f. Contractual	65,750.00	14,500.00			80,250.00	
g. Construction	0.00	0.00			0.00	
h. Other	0.00	0.00			0.00	
i. Total Direct Charges (sum of 6a-6h)	1,028,075.00	253,656.00	0.00	0.00	1,281,731.00	
j. Indirect Charges	195,924.00	52,345.00			248,269.00	
k. TOTALS (sum of 6i and 6j)	\$ 1,223,999.00	\$ 306,001.00	\$ 0.00	\$ 0.00	\$ 1,530,000.00	
7. Program Income	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	

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SECTION C - NON-FEDERAL RESOURCES					
(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e) TOTALS	
8. AOOS - UAF Weingartner	\$	\$	\$	\$ 0.00	
9.				0.00	
10.				0.00	
11.				0.00	
12. TOTAL (sum of lines 8-11)	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	
SECTION D - FORECASTED CASH NEEDS					
	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
13. Federal	\$ 50,000.00	\$ 10,000.00	\$ 10,000.00	\$ 20,000.00	\$ 10,000.00
14. Non-Federal	0.00				
15. TOTAL (sum of lines 13 and 14)	\$ 50,000.00	\$ 10,000.00	\$ 10,000.00	\$ 20,000.00	\$ 10,000.00
SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT					
(a) Grant Program	FUTURE FUNDING PERIODS (Years)				
	(b) First	(c) Second	(d) Third	(e) Fourth	
16. AOOS - UAF Weingartner	\$ 50,000.00	\$ 50,000.00	\$ 50,000.00	\$ 50,000.00	
17.					
18.					
19.					
20. TOTAL (sum of lines 16-19)	\$ 50,000.00	\$ 50,000.00	\$ 50,000.00	\$ 50,000.00	
SECTION F - OTHER BUDGET INFORMATION					
21. Direct Charges: 238475			22. Indirect Charges: 11525		
23. Remarks:					

BUDGET INFORMATION - Non-Construction Programs

OMB Approval No. 0348-0044

SECTION A - BUDGET SUMMARY						
Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. AOOS- ADNR Kinship	11.012	\$	\$	\$ 1,530,000.00	\$	\$ 1,530,000.00
2.						0.00
3.						0.00
4.						0.00
5. Totals		\$ 0.00	\$ 0.00	\$ 1,530,000.00	\$ 0.00	\$ 1,530,000.00

SECTION B - BUDGET CATEGORIES						
6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY				Total (5)	
	(1) 6/1/2016-5/31/2017	(2) 6/1/2017-5/31/2018	(3) 6/1/2019-5/31/2020	(4) 6/1/2019-5/31/2020		
a. Personnel	\$ 17,700.00	\$ 17,700.00	\$ 17,700.00	\$ 17,700.00	\$ 70,800.00	
b. Fringe Benefits	5,316.00	5,316.00	5,316.00	5,316.00	21,264.00	
c. Travel	11,340.00	11,340.00	11,340.00	11,340.00	45,360.00	
d. Equipment	0.00	0.00	0.00	0.00	0.00	
e. Supplies	11,100.00	11,100.00	11,100.00	11,100.00	44,400.00	
f. Contractual	0.00	0.00	0.00	0.00	0.00	
g. Construction	0.00	0.00	0.00	0.00	0.00	
h. Other	0.00	0.00	0.00	0.00	0.00	
i. Total Direct Charges (sum of 6a-6h)	45,456.00	45,456.00	45,456.00	45,456.00	181,824.00	
j. Indirect Charges	3,658.00	3,658.00	3,658.00	3,658.00	14,632.00	
k. TOTALS (sum of 6i and 6j)	\$ 49,114.00	\$ 49,114.00	\$ 49,114.00	\$ 49,114.00	\$ 196,456.00	
7. Program Income	\$	\$	\$	\$	\$ 0.00	

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BUDGET INFORMATION - Non-Construction Programs

OMB Approval No. 0348-0044

SECTION A - BUDGET SUMMARY						
Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. AOOS- ADFG Kinsm	11.012	\$	\$	\$ 0.00	\$	\$ 0.00
2.						0.00
3.						0.00
4.						0.00
5. Totals		\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00
SECTION B - BUDGET CATEGORIES						
6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY					Total (5)
	(1)	6/1/2016-5/31/2020	(2)	6/1/2020-5/31/2021	(3)	
a. Personnel	\$	70,800.00	\$	17,700.00	\$	\$ 88,500.00
b. Fringe Benefits		21,264.00		5,316.00		26,580.00
c. Travel		45,360.00		11,340.00		56,700.00
d. Equipment		0.00		0.00		0.00
e. Supplies		44,400.00		11,100.00		55,500.00
f. Contractual		0.00		0.00		0.00
g. Construction		0.00		0.00		0.00
h. Other		0.00		0.00		0.00
i. Total Direct Charges (sum of 6a-6h)		181,824.00		45,456.00	0.00	227,280.00
j. Indirect Charges		14,632.00		3,658.00		18,290.00
k. TOTALS (sum of 6i and 6j)	\$	196,456.00	\$	49,114.00	\$ 0.00	\$ 245,570.00
7. Program Income	\$	0.00	\$	0.00	\$ 0.00	\$ 0.00

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Prescribed by OMB Circular A-102

SECTION C - NON-FEDERAL RESOURCES					
(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e) TOTALS	
8. AOOS - ADNR Kinsman	\$	\$	\$	\$ 0.00	
9.				0.00	
10.				0.00	
11.				0.00	
12. TOTAL (sum of lines 8-11)	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	
SECTION D - FORECASTED CASH NEEDS					
	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
13. Federal	\$ 49,114.00	\$ 12,278.50	\$ 12,278.50	\$ 12,278.50	\$ 12,278.50
14. Non-Federal	0.00				
15. TOTAL (sum of lines 13 and 14)	\$ 49,114.00	\$ 12,278.50	\$ 12,278.50	\$ 12,278.50	\$ 12,278.50
SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT					
(a) Grant Program	FUTURE FUNDING PERIODS (Years)				
	(b) First	(c) Second	(d) Third	(e) Fourth	
16. AOOS - ADNR Kinsman	\$ 49,114.00	\$ 49,114.00	\$ 49,114.00	\$ 49,114.00	
17.					
18.					
19.					
20. TOTAL (sum of lines 16-19)	\$ 49,114.00	\$ 49,114.00	\$ 49,114.00	\$ 49,114.00	
SECTION F - OTHER BUDGET INFORMATION					
21. Direct Charges: 227280		22. Indirect Charges: 18290			
23. Remarks: 16.95% indirect on MTDC					

BUDGET INFORMATION - Non-Construction Programs

OMB Approval No. 0348-0044

SECTION A - BUDGET SUMMARY						
Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. AOOS- UAF Daniels	11.012	\$	\$	\$ 750,000.00	\$	\$ 750,000.00
2.						0.00
3.						0.00
4.						0.00
5. Totals		\$ 0.00	\$ 0.00	\$ 750,000.00	\$ 0.00	\$ 750,000.00
SECTION B - BUDGET CATEGORIES						
6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY					Total (5)
	(1) 6/1/2016-5/31/2017	(2) 6/1/2017-5/31/2018	(3) 6/1/2019-5/31/2020	(4) 6/1/2019-5/31/2020		
a. Personnel	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00
b. Fringe Benefits	0.00	0.00	0.00	0.00	0.00	0.00
c. Travel	0.00	0.00	0.00	0.00	0.00	0.00
d. Equipment	142,069.00	142,246.00	142,427.00	142,613.00		569,355.00
e. Supplies	5,270.00	5,152.00	5,032.00	4,908.00		20,362.00
f. Contractual	0.00	0.00	0.00	0.00		0.00
g. Construction	0.00	0.00	0.00	0.00		0.00
h. Other	0.00	0.00	0.00	0.00		0.00
i. Total Direct Charges (sum of 6a-6h)	147,339.00	147,398.00	147,459.00	147,521.00		589,717.00
j. Indirect Charges	2,661.00	2,602.00	2,541.00	2,479.00		10,283.00
k. TOTALS (sum of 6i and 6j)	\$ 150,000.00	\$ 150,000.00	\$ 150,000.00	\$ 150,000.00	\$	\$ 600,000.00
7. Program Income	\$	\$	\$	\$	\$	0.00

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Prescribed by OMB Circular A-102

BUDGET INFORMATION - Non-Construction Programs

OMB Approval No. 0348-0044

SECTION A - BUDGET SUMMARY						
Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. AOOS- UAF Daniels	11.012	\$	\$	\$ 0.00	\$	\$ 0.00
2.						0.00
3.						0.00
4.						0.00
5. Totals		\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00

SECTION B - BUDGET CATEGORIES						
6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY				Total (5)	
	(1) 6/1/2016-5/31/2020	(2) 6/1/2020-5/31/2021	(3)	(4)		
a. Personnel	\$ 0.00	\$ 0.00	\$	\$	\$ 0.00	
b. Fringe Benefits	0.00	0.00			0.00	
c. Travel	0.00	0.00			0.00	
d. Equipment	569,355.00	142,803.00			712,158.00	
e. Supplies	20,362.00	4,782.00			25,144.00	
f. Contractual	0.00	0.00			0.00	
g. Construction	0.00	0.00			0.00	
h. Other	0.00	0.00			0.00	
i. Total Direct Charges (sum of 6a-6h)	589,717.00	147,585.00	0.00	0.00	737,302.00	
j. Indirect Charges	10,283.00	2,415.00			12,698.00	
k. TOTALS (sum of 6i and 6j)	\$ 600,000.00	\$ 150,000.00	\$ 0.00	\$ 0.00	\$ 750,000.00	
7. Program Income	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	

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Prescribed by OMB Circular A-102

SECTION C - NON-FEDERAL RESOURCES					
(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e) TOTALS	
8. AOOS - UAF Danielson	\$	\$	\$	\$ 0.00	
9.				0.00	
10.				0.00	
11.				0.00	
12. TOTAL (sum of lines 8-11)	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	
SECTION D - FORECASTED CASH NEEDS					
	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
13. Federal	\$ 150,000.00	\$ 37,500.00	\$ 37,500.00	\$ 37,500.00	\$ 37,500.00
14. Non-Federal	0.00				
15. TOTAL (sum of lines 13 and 14)	\$ 150,000.00	\$ 37,500.00	\$ 37,500.00	\$ 37,500.00	\$ 37,500.00
SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT					
(a) Grant Program	FUTURE FUNDING PERIODS (Years)				
	(b) First	(c) Second	(d) Third	(e) Fourth	
16. AOOS - UAF Danielson	\$ 150,000.00	\$ 150,000.00	\$ 150,000.00	\$ 150,000.00	
17.					
18.					
19.					
20. TOTAL (sum of lines 16-19)	\$ 150,000.00	\$ 150,000.00	\$ 150,000.00	\$ 150,000.00	
SECTION F - OTHER BUDGET INFORMATION					
21. Direct Charges: 737302		22. Indirect Charges: 12698			
23. Remarks: 50.5% indirect rate on MTDC					

BUDGET INFORMATION - Non-Construction Programs

OMB Approval No. 0348-0044

SECTION A - BUDGET SUMMARY						
Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. AOOS- WHOI Baumgardner	11.012	\$	\$	\$ 496,598.00	\$	\$ 496,598.00
2.						0.00
3.						0.00
4.						0.00
5. Totals		\$ 0.00	\$ 0.00	\$ 496,598.00	\$ 0.00	\$ 496,598.00
SECTION B - BUDGET CATEGORIES						
6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY					Total (5)
	(1) 6/1/2016-5/31/2017	(2) 6/1/2017-5/31/2018	(3) 6/1/2019-5/31/2020	(4) 6/1/2019-5/31/2020		
a. Personnel	\$ 0.00	\$ 6,328.00	\$ 6,550.00	\$ 6,777.00	\$ 19,655.00	
b. Fringe Benefits	0.00	2,232.00	2,310.00	2,391.00	6,933.00	
c. Travel	0.00	0.00	0.00	0.00	0.00	
d. Equipment	100,000.00	0.00	0.00	0.00	100,000.00	
e. Supplies	0.00	15,000.00	15,150.00	15,302.00	45,452.00	
f. Contractual	0.00	60,000.00	60,000.00	60,000.00	180,000.00	
g. Construction	0.00	0.00	0.00	0.00	0.00	
h. Other	0.00	6,750.00	6,750.00	6,750.00	20,250.00	
i. Total Direct Charges (sum of 6a-6h)	100,000.00	90,310.00	90,760.00	91,220.00	372,290.00	
j. Indirect Charges	0.00	7,737.00	8,009.00	8,287.00	24,033.00	
k. TOTALS (sum of 6i and 6j)	\$ 100,000.00	\$ 98,047.00	\$ 98,769.00	\$ 99,507.00	\$ 396,323.00	
7. Program Income	\$	\$	\$	\$	\$ 0.00	

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Prescribed by OMB Circular A-102

BUDGET INFORMATION - Non-Construction Programs

OMB Approval No. 0348-0044

SECTION A - BUDGET SUMMARY						
Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. AOOS- WHOI Baumr	11.012	\$	\$	\$ 0.00	\$	\$ 0.00
2.						0.00
3.						0.00
4.						0.00
5. Totals		\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00

SECTION B - BUDGET CATEGORIES							
6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY					Total (5)	
	(1)	6/1/2016-5/31/2020	(2)	6/1/2020-5/31/2021	(3)		(4)
a. Personnel	\$	19,655.00	\$	7,016.00	\$	\$	26,671.00
b. Fringe Benefits		6,933.00		2,475.00			9,408.00
c. Travel		0.00		0.00			0.00
d. Equipment		100,000.00		0.00			100,000.00
e. Supplies		45,452.00		15,455.00			60,907.00
f. Contractual		180,000.00		60,000.00			240,000.00
g. Construction		0.00		0.00			0.00
h. Other		20,250.00		6,750.00			27,000.00
i. Total Direct Charges (sum of 6a-6h)		372,290.00		91,696.00	0.00	0.00	463,986.00
j. Indirect Charges		24,033.00		8,579.00			32,612.00
k. TOTALS (sum of 6i and 6j)	\$	396,323.00	\$	100,275.00	\$ 0.00	\$ 0.00	\$ 496,598.00
7. Program Income	\$	0.00	\$	0.00	\$ 0.00	\$ 0.00	\$ 0.00

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Prescribed by OMB Circular A-102

SECTION C - NON-FEDERAL RESOURCES					
(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e) TOTALS	
8. AOOS - WHOI Baumgartner	\$	\$	\$	\$ 0.00	
9.				0.00	
10.				0.00	
11.				0.00	
12. TOTAL (sum of lines 8-11)	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	
SECTION D - FORECASTED CASH NEEDS					
	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
13. Federal	\$ 100,000.00	\$ 100,000.00	\$ 0.00	\$ 0.00	\$ 0.00
14. Non-Federal	0.00				
15. TOTAL (sum of lines 13 and 14)	\$ 100,000.00	\$ 100,000.00	\$ 0.00	\$ 0.00	\$ 0.00
SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT					
(a) Grant Program	FUTURE FUNDING PERIODS (Years)				
	(b) First	(c) Second	(d) Third	(e) Fourth	
16. AOOS - WHOI Baumgartner	\$ 98,047.00	\$ 98,769.00	\$ 99,507.00	\$ 100,275.00	
17.					
18.					
19.					
20. TOTAL (sum of lines 16-19)	\$ 98,047.00	\$ 98,769.00	\$ 99,507.00	\$ 100,275.00	
SECTION F - OTHER BUDGET INFORMATION					
21. Direct Charges: 463986			22. Indirect Charges: 32612		
23. Remarks:					

BUDGET INFORMATION - Non-Construction Programs

OMB Approval No. 0348-0044

SECTION A - BUDGET SUMMARY						
Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. AOOS- Axiom (suba)	11.012	\$	\$	\$ 535,000.00	\$	\$ 535,000.00
2.						0.00
3.						0.00
4.						0.00
5. Totals		\$ 0.00	\$ 0.00	\$ 535,000.00	\$ 0.00	\$ 535,000.00
SECTION B - BUDGET CATEGORIES						
6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY				Total (5)	
	(1) 6/1/2016-5/31/2017	(2) 6/1/2017-5/31/2018	(3) 6/1/2019-5/31/2020	(4) 6/1/2019-5/31/2020		
a. Personnel	\$ 87,962.00	\$ 69,046.00	\$ 60,357.00	\$ 59,369.00	\$ 276,734.00	
b. Fringe Benefits	26,389.00	20,713.00	18,107.00	17,811.00	83,020.00	
c. Travel	0.00	0.00	0.00	0.00	0.00	
d. Equipment	0.00	0.00	0.00	0.00	0.00	
e. Supplies	1,635.00	1,392.00	59.00	1,612.00	4,698.00	
f. Contractual	0.00	0.00	0.00	0.00	0.00	
g. Construction	0.00	0.00	0.00	0.00	0.00	
h. Other	24,014.00	18,849.00	16,477.00	16,208.00	75,548.00	
i. Total Direct Charges (sum of 6a-6h)	140,000.00	110,000.00	95,000.00	95,000.00	440,000.00	
j. Indirect Charges	0.00	0.00	0.00	0.00	0.00	
k. TOTALS (sum of 6i and 6j)	\$ 140,000.00	\$ 110,000.00	\$ 95,000.00	\$ 95,000.00	\$ 440,000.00	
7. Program Income	\$	\$	\$	\$	\$ 0.00	

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BUDGET INFORMATION - Non-Construction Programs

OMB Approval No. 0348-0044

SECTION A - BUDGET SUMMARY						
Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. AOOS- Axiom (sub)	11.012	\$	\$	0.00	\$	\$ 0.00
2.						0.00
3.						0.00
4.						0.00
5. Totals		\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00

SECTION B - BUDGET CATEGORIES						
6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY					Total (5)
	(1)	6/1/2016-5/31/2020	(2)	6/1/2020-5/31/2021	(3)	
a. Personnel	\$	276,734.00	\$	59,386.00	\$	\$ 336,120.00
b. Fringe Benefits		83,020.00		17,816.00		100,836.00
c. Travel		0.00		0.00		0.00
d. Equipment		0.00		0.00		0.00
e. Supplies		4,698.00		1,586.00		6,284.00
f. Contractual		0.00		0.00		0.00
g. Construction		0.00		0.00		0.00
h. Other		75,548.00		16,212.00		91,760.00
i. Total Direct Charges (sum of 6a-6h)		440,000.00		95,000.00	0.00	535,000.00
j. Indirect Charges		0.00		0.00		0.00
k. TOTALS (sum of 6i and 6j)	\$	440,000.00	\$	95,000.00	\$ 0.00	\$ 535,000.00
7. Program Income	\$	0.00	\$	0.00	\$ 0.00	\$ 0.00

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SECTION C - NON-FEDERAL RESOURCES					
(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e) TOTALS	
8. AOOS - Axiom (subaward)	\$	\$	\$	\$ 0.00	
9.				0.00	
10.				0.00	
11.				0.00	
12. TOTAL (sum of lines 8-11)	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	
SECTION D - FORECASTED CASH NEEDS					
	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
13. Federal	\$ 140,000.00	\$ 35,000.00	\$ 35,000.00	\$ 35,000.00	\$ 35,000.00
14. Non-Federal	0.00				
15. TOTAL (sum of lines 13 and 14)	\$ 140,000.00	\$ 35,000.00	\$ 35,000.00	\$ 35,000.00	\$ 35,000.00
SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT					
(a) Grant Program	FUTURE FUNDING PERIODS (Years)				
	(b) First	(c) Second	(d) Third	(e) Fourth	
16. AOOS - Axiom (subaward)	\$ 110,000.00	\$ 95,000.00	\$ 95,000.00	\$ 95,000.00	
17.					
18.					
19.					
20. TOTAL (sum of lines 16-19)	\$ 110,000.00	\$ 95,000.00	\$ 95,000.00	\$ 95,000.00	
SECTION F - OTHER BUDGET INFORMATION					
21. Direct Charges: 535000		22. Indirect Charges: 0			
23. Remarks: This will be a subaward agreement					

BUDGET INFORMATION - Non-Construction Programs

OMB Approval No. 0348-0044

SECTION A - BUDGET SUMMARY						
Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. AOOS- Axiom (cont)	11.012	\$	\$	\$ 3,000,000.00	\$	\$ 3,000,000.00
2.						0.00
3.						0.00
4.						0.00
5. Totals		\$ 0.00	\$ 0.00	\$ 3,000,000.00	\$ 0.00	\$ 3,000,000.00

SECTION B - BUDGET CATEGORIES						
6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY					Total (5)
	(1) 6/1/2016-5/31/2017	(2) 6/1/2017-5/31/2018	(3) 6/1/2019-5/31/2020	(4) 6/1/2019-5/31/2020		
a. Personnel	\$ 380,862.00	\$ 379,729.00	\$ 380,364.00	\$ 380,441.00	\$ 1,521,396.00	
b. Fringe Benefits	114,259.00	113,919.00	114,109.00	114,133.00	456,420.00	
c. Travel	0.00	0.00	0.00	0.00	0.00	
d. Equipment	0.00	0.00	0.00	0.00	0.00	
e. Supplies	904.00	2,686.00	1,688.00	1,565.00	6,843.00	
f. Contractual	0.00	0.00	0.00	0.00	0.00	
g. Construction	0.00	0.00	0.00	0.00	0.00	
h. Other	103,975.00	103,666.00	103,839.00	103,861.00	415,341.00	
i. Total Direct Charges (sum of 6a-6h)	600,000.00	600,000.00	600,000.00	600,000.00	2,400,000.00	
j. Indirect Charges	0.00	0.00	0.00	0.00	0.00	
k. TOTALS (sum of 6i and 6j)	\$ 600,000.00	\$ 600,000.00	\$ 600,000.00	\$ 600,000.00	\$ 2,400,000.00	
7. Program Income	\$	\$	\$	\$	\$ 0.00	

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BUDGET INFORMATION - Non-Construction Programs

OMB Approval No. 0348-0044

SECTION A - BUDGET SUMMARY						
Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. AOOS- Axiom	11.012	\$	\$	0.00	\$	\$ 0.00
2.						0.00
3.						0.00
4.						0.00
5. Totals		\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00

SECTION B - BUDGET CATEGORIES						
6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY				Total (5)	
	(1) 6/1/2016-5/31/2020	(2) 6/1/2020-5/31/2021	(3)	(4)		
a. Personnel	\$ 1,521,396.00	\$ 381,104.00	\$	\$	\$ 1,902,500.00	
b. Fringe Benefits	456,420.00	114,333.00			570,753.00	
c. Travel	0.00	0.00			0.00	
d. Equipment	0.00	0.00			0.00	
e. Supplies	6,843.00	521.00			7,364.00	
f. Contractual	0.00	0.00			0.00	
g. Construction	0.00	0.00			0.00	
h. Other	415,341.00	104,042.00			519,383.00	
i. Total Direct Charges (sum of 6a-6h)	2,400,000.00	600,000.00	0.00	0.00	3,000,000.00	
j. Indirect Charges	0.00	0.00			0.00	
k. TOTALS (sum of 6i and 6j)	\$ 2,400,000.00	\$ 600,000.00	\$ 0.00	\$ 0.00	\$ 3,000,000.00	
7. Program Income	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	

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SECTION C - NON-FEDERAL RESOURCES					
(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e) TOTALS	
8. AOOS - Axiom	\$	\$	\$	\$ 0.00	
9.				0.00	
10.				0.00	
11.				0.00	
12. TOTAL (sum of lines 8-11)	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	
SECTION D - FORECASTED CASH NEEDS					
	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
13. Federal	\$ 600,000.00	\$ 150,000.00	\$ 150,000.00	\$ 150,000.00	\$ 150,000.00
14. Non-Federal	0.00				
15. TOTAL (sum of lines 13 and 14)	\$ 600,000.00	\$ 150,000.00	\$ 150,000.00	\$ 150,000.00	\$ 150,000.00
SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT					
(a) Grant Program	FUTURE FUNDING PERIODS (Years)				
	(b) First	(c) Second	(d) Third	(e) Fourth	
16. AOOS - Axiom	\$ 600,000.00	\$ 600,000.00	\$ 600,000.00	\$ 600,000.00	
17.					
18.					
19.					
20. TOTAL (sum of lines 16-19)	\$ 600,000.00	\$ 600,000.00	\$ 600,000.00	\$ 600,000.00	
SECTION F - OTHER BUDGET INFORMATION					
21. Direct Charges: 600000		22. Indirect Charges: 0			
23. Remarks: This is a vendor services contract					

APPENDIX A: FY2016-2020 AOOS BUDGET NARRATIVE

Recipient Institutions in AOOS Proposed Budget

Alaska SeaLife Center on behalf of Alaska Ocean Observing System, PO Box 1329, Seward, AK 99664

Alaska Department of Natural Resources, 550 W 7th Ave #1260, Anchorage, AK 99501

Axiom Data Science, 1016 W. 6th Ave., Ste 105, Anchorage, AK 99501

Marine Exchange of Alaska, 1000 Harbor Way Suite 204, Juneau AK 99801

Prince William Sound Science Center, 300 Breakwater Ave, Cordova, AK 99574

Remote Sensing Solutions, 3179 Main St, Barnstable, MA 02630

Sitka Sound Science Center, 834 Lincoln St #200, Sitka AK 99835

University of Alaska Fairbanks, 505 S Chandlar Drive, Fairbanks, AK 99775

Woods Hole Oceanographic Institution, 86 Water St, Woods Hole, MA 02543

Holdback to NOAA: \$250,000 is requested to be held back from this proposal in Years 1-5 to NOAA's Kasitsna Bay Laboratory (Kris Holderied) for Cook Inlet oceanographic support. \$50,000 per year includes no personnel costs. In Years 1-5 travel funds are included for 2 trips for the PI from Homer to Anchorage for AOOS meetings (\$1800 airfare and per diem), 1 trip from Homer to Cordova to coordinate with the Prince William Sound Science Center (\$900 airfare and per diem), and 1 trip from Homer to a national ocean conference (\$2700 airfare and per diem). Funds for annual supplies are included for approximately \$9000 per year for boat/field supplies, fuel and shipping. Contractual funds (\$26,000-\$28,000 per year) are included for data analysis, vessel charter, and instrument calibrations. Indirect costs are reimbursed at 20%. Equipment purchases are described in Table 4 below.

a) Personnel (\$1,861,735) Salaries for the 60-month grant period are provided for three full-time employees (Executive Director, Operations Director, and Program Coordinator) and one half-time employee (Program Manager). A 3% annual salary increase is included.

b) Fringe Benefits (\$437,528) Fringe Benefits rate is 16% for the Executive Director and approximately 28% for the other three positions.

c) Travel and Per Diem (\$250,000 or \$50,000 per year) Travel costs in Alaska are extraordinarily high, especially for trips to the Bering Sea and Arctic communities, or for residents of those communities to participate in meetings in Anchorage. Trips to Washington D.C. can cost between \$2000 and \$3000 a trip, depending on airfare and hotel costs. Trips to Alaska communities outside Anchorage range from \$500 to Juneau to \$1000 to Dutch Harbor and Barrow. \$40,000 per year is requested for travel expenses for the three full-time and one half-time programmatic staff and the AOOS data team. This includes six trips to Washington DC or a similar national venue to participate in national IOOS and IOOS Association activities (\$15,000 total based on \$2500 per trip - \$1200 airfare, \$900 hotel, and per diem); 10 trips to Fairbanks, Juneau or other Alaska community to participate in user meetings and workshops and state and regional collaborations (\$12,000 total based on approximately \$1,200 per trip - \$500 air fare, \$500 hotel, and per diem); two trips to international Arctic meetings (\$7,000 total based on approximately \$3,500 per trip - \$1500 air fare, \$1200 hotel, and per diem); and three trips to national ocean observing related conferences and workshops (\$6,000 total based on

approximately \$2,000 per trip - \$1000 air fare, \$700 hotel, and per diem). These cost estimates assume a minimum four day trip with three nights hotel.

\$5,000 per year is requested for Board and Data Management Committee and data team travel. Board travel includes airfare for two board members for two one-day meetings per year since most other board members are either located in Anchorage, attend by teleconference, or cover their own costs (\$2,000 total based on \$500 per ticket, no hotel or per diem). Data Committee travel includes airfare, hotel and per diem for two committee members to attend two one-day meetings per year (\$2,000 based on \$500 per ticket, no hotel or per diem). Funds are included for data team staff to participate in two trips to attend user meetings in Alaska communities (\$1,000 total based on \$500 per trip).

\$5,000 per year is requested for stakeholder and user group travel for at least one meeting or workshop per year. Costs are based on travel for six to seven participants at an average cost of \$750 per trip (\$500 air fare, \$150 hotel, and per diem).

d) Equipment (\$2,153,755) All equipment purchases are detailed below. None is available for lease.

ASLC/AOOS/McCammon (\$2,153,755 years 1-5)

No new equipment will be purchased at the \$2.5M funding scenario. If full funding is received at the \$4M level, a pool of approximately \$425,000 a year would be available to purchase the following equipment under this grant: in Years 1-5: 2 new snotel weather stations at \$60,000 each, 1 CDIP wave buoy at \$80,000, 2 bottom-mounted pressure sensors at \$25,000 each; ocean acidification sensor packages to be deployed on moorings, ships or hatchery facilities at \$100,000 each; and additional biological sensors or acoustic recorders to be added to existing moorings in the Distributed Biological Observatory at \$75,000 each. Depending on leveraging, a fully-equipped Slocum webb glider could be substituted at \$140,000.

MXAK/Page (\$34,000/yr years 1-5)

Annual funding is requested to purchase the environmental sensors, off grid power (batteries, solar, wind and/or fuel cells), and radio transmission equipment (AIS transmitters and wireless modems) to support data collection and dissemination at 2 new AIS/weather sites per year.

UAF/Weingartner (\$150,000/yr, years 1-5)

Funding would be used to purchase Codar HFR packages at \$150,000 each in years 1, 3 and 5 to be deployed at new sites in the Bering Strait region. \$150,000 a year in years 2 and 4 would fund components of and fabricate a Remote Power Module (RPM) to power HFR field equipment when grid power is not available. These include the foundation, four wind turbines and load/diversion controllers, batteries, a housing structure, and photovoltaic panels, as well as electrical wiring, a meteorological station, a data logger and many additional small sensors, charge controllers, inverters, switches, relays, fuses and hardware components.

UAF/Danielson (\$135,000/yr, years 1-5)

Funds would be used to support a staff person (4 weeks per year) at \$24.45/hour, plus fringe and anticipated increases, to purchase equipment and fabricate the ecosystem moorings as part of the

AOOS ecosystem network. Equipment includes: two dual acoustic push-off release transponders sets (\$26,000) in years 1 and 5, which enable recovery of the mooring at the end of the deployment; an SBE-16 SeaCat datalogger with Eco-triplett, PAR, and DO (\$37,000) in years 1, 2, and 4 to measure temperature, salinity, pressure, photosynthetically available radiation, dissolved oxygen, chlorophyll a fluorescence, optical backscatter and colored dissolved organic matter; two Satlantic SUNA V2 instruments (\$56,000) in years 1 and 3 to measure nitrate; two Teledyne RDI WAVES ADCP instruments (\$54,000) in years 2 and 4 to measure ocean currents and significant wave height and direction; floatation (\$10,000/\$8,000) in years 1 and 3, respectively, to provide buoyancy to the moorings; a Sequoia LISST (\$44,000) in years 2, 4, and 5 to measure suspended sediment spectra and concentrations; an ASL AZFP (\$65,000) in years 3 and 5 to measure acoustic backscatter of fish and zooplankton at four frequencies; a recovery beacon (\$6,000) in years 1 and 3 assist in planned and emergency mooring recoveries.

UAF/Cross (\$15,000/yr)

Funds would be used to purchase a SAMI pCO₂ sensor as well as other ocean acidification sensors at \$15,000 each.

SSSC/Bell (\$32,207 in year 1)

Funds would be used to purchase an XYLEM EMM68 Buoy System with telemetry, water quality sonde and accessories, shipping container and mooring.

WHOI/ Baumgartner (\$100,000 in year 1)

Funds would be used to purchase one Slocum G2 glider from Teledyne Webb Research with a trade-in of an older WHOI Slocum G1 glider.

PWSSC/Pegau (\$22,000/ yr, years 1-5)

Funds would be used each year to purchase Acoustic Releases (2 @ \$5,500/ea for \$11,000) and one VR4 Acoustic Receiver (\$11,000) to support the acoustic array at the entrances to Prince William Sound.

NOAA Kasitsna Lab/Holderied (\$5,000 in year 2)

Purchase a CTD sensor replacement.

e) Supplies and Commodities (\$63,792) Supplies cover basic office, program and computer supplies and meeting expenses. A small increase is included each year for years 2-5.

f) Contracts/Services

Services (\$3,794,355)

Service costs include those for graphic design services (\$6,000 a year with 3% annual increase for newsletters, reports, other publications, etc), as well as an annual audit at \$16,500 in year 1 with annual increases. Funds at \$15,000 a year are also included to maintain the Cook Inlet and Norton Sound wave buoys. Additionally future service contracts totaling \$100,000 per year to deploy and maintain new wave buoys will be issued, but the actual recipients will depend on which entity is best suited to service the final choices for siting, and will likely be multiple institutions. The services contract for the water level sensors installation and maintenance

(\$100,000 per year) is also likely to be multiple institutions, depending on the final sites and types of sensors to be deployed. Funds are also included for the primary contract with Axiom Data Science for data management services (see Axiom budget in Table 1 below for details at \$600,000 a year).

Table 1. Data Management and Communications Year 1
Any differences in Years 2-5 will be described in summary below table.

Cost Category	Axiom Core Services
Salaries	\$380,862
Benefits	\$114,259
Supplies	\$904
Total Direct Costs	\$495,825
Indirect Costs	\$103,975
TOTAL	\$600,000

Axiom Data Science was selected as a directed subaward for all five years of the proposed project, following an open, competitive process. This project will maintain the core data management and communication services required to provide consistently available data storage, delivery and visualization tools integral to the AOOS program. Personnel costs include salary for several investigators working an average of 29% FTE with a fringe rate of 30% covering 401K, health insurance, and paid leave. Supplies include the purchase of replacement hard drives and server components. The indirect rate of 21% of salary costs is used to cover typical facilities costs. There is no significant variance of costs across the five-year project period.

Subawards (\$9,688,884)

Funds are included for directed contractual services to support observation projects with Prince William Sound Science Center, Marine Exchange of Alaska, University of Alaska Fairbanks, Sitka Sound Science Center, Woods Hole Oceanographic Institute, and Alaska Department of Natural Resources. Two additional contracts will be awarded depending on funding received, with the recipients to be determined. Funds are included for directed contractual services to support modeling, analysis and product services with Remote Sensing Solutions, University of Alaska Fairbanks and Axiom Data Science. Two additional contracts will be awarded depending on funding received, with the recipients to be determined. Additional details on these awards are included below and in Tables 2 and 3.

Table 2. Observing Year 1

Any differences in Years 2-5 will be described in summary below table.

Cost Category	University of Alaska Fairbanks				
	CBO Sea Ice	Ocean Acidification	Seward Line	High Frequency Radars	Ecosystem Mooring
Salaries	\$11,533	-----	-----	\$39,739	\$4,852
Benefits	\$5,270	-----	-----	\$15,504	\$2,217
Equipment	-----	\$15,000	-----	\$150,000	\$135,000
Travel	\$10,461	\$988	-----	\$16,936	-----
Supplies	\$10,000	\$1,268	-----	\$14,225	\$5,270
Contractual	\$28,500	\$50,900	\$100,000	\$17,250	-----
Total Direct Costs	\$65,764	\$68,156	\$100,000	\$253,654	\$147,339
Indirect Costs	\$33,211	\$26,844	-----	\$52,345	\$2,661
TOTAL	\$98,975	\$95,000	\$100,000	\$306,000	\$150,000

Cost Category	PWSSC Weather Stations	MXAK Weather Stations	SSSC SE Sentinel	ADNR Water Levels	WHOI Gliders Year 2
Salaries	\$11,096	\$25,300	\$6,160	\$17,700	\$6,550
Benefits	\$4,564	\$2,500	\$1,109	\$5,316	\$2,310
Equipment	\$22,000	\$34,000	\$32,207	-----	-----
Travel	-----	\$18,000	-----	\$11,340	-----
Supplies	\$10,000	\$3,500	-----	\$11,100	\$15,000
Contractual	-----		\$1,100	-----	\$60,000
Other	\$83,850		\$1,091	-----	\$7,600
Total Direct Costs	\$131,860	\$83,300	\$41,667	\$45,456	\$82,600
Indirect Costs	\$32,958	\$7,625	\$8,333	\$3,658	\$7,737
TOTAL	\$164,818	\$90,925	\$50,000	\$49,114	\$98,897

Cost Category	TBD Sentinel Sites	TBD Marine Debris			
TOTAL	\$40,000	\$20,000			

University of Alaska Fairbanks was selected for the following 5 direct subawards for all five years of the proposed project.

Community-Based Sea Ice Observations will build on existing networks and observing activities to implement and transition community-based sea ice observations from research into a sustained and operationally relevant mode. Personnel costs are included for one researcher working 348 hours on training observers and transferring observations into databases. Fringe benefits are charged at the university-negotiated rate of 45.7%. Travel will consist of three trips per year for the researcher to travel from Fairbanks Alaska to remote villages along the coast for field visits and one trip to Anchorage from Fairbanks for project coordination for a total of 21 days of travel at a per year total of \$3,575 in airfare, \$3,950 in lodging, \$5,870 in meals and \$330 for ground transportation. Supplies include the cost of components for sea ice mass balance stations, GPS and digital cameras, conductivity and thickness probes, and related gear. Contractual costs include the cost of printing observer handbooks and outreach products, stipends for local observers and logistical support. Indirect costs are included at a negotiated 50.5% MTDC rate.

Time Series Monitoring of Ocean Acidification will continue an eight-year time-series in the Gulf of Alaska along the Seward Line as well adjacent to the oceanographic sampling line supporting the statewide OA research monitoring program, and making data available to the public through the AOOS website. Travel costs cover one trip per year for the PI to travel from Fairbanks to Seward for sampling and mooring deployment at \$350 in airfare, \$100 in ground transportation, \$338 in lodging and \$200 in meals. A Supplies cost of \$1,268 will be used for general supplies. Contractual costs include \$1,900 for shipping, \$4,000 for nutrient analysis and \$45,000 for DIC/TA analysis. Indirect costs are included at a negotiated 50.5% MTDC rate.

The Seward Line Monitoring will continue the 18-year sentinel long-term monitoring of the Gulf of Alaska over the Alaskan shelf. A contractual cost of \$100,000 covers a ten-day vessel charter for the USFWS Tiglax.

High Frequency Radar Operations & Maintenance will install and maintain long-range CODAR HFR field sites on the northwest Alaska coast in Point Lay, Wainwright, Point Barrow, and Cape Simpson. Salaries include 87 hours (0.5 mo.) for the PI to supervise and 348 hours (2 mos.); for one staff performing HFR field logistics, deployments, maintenance, and reporting; and another staff member at 348 hours (2 mos.) for HFR operations and maintenance. Benefits are applied at a negotiated rate of 28.7% for faculty (PI) and 41% for staff. Travel will consist of 2 trips per year for 2 people to Barrow, Wainwright, and Point Lay, to conduct fieldwork. Supplies will include cables, conduit, fuses and housings, UPS component replacements/upgrades, guy line, tools, and Arctic field safety gear. Contractual costs include logistical support, data communications, air freight, honoraria for field guides, space or land use fees and permitting fees. Indirect costs are included at a negotiated 50.5% MTDC rate.

Chukchi Ecosystem Mooring will continue the incremental build-out of the Chukchi Sea Ecosystem Mooring, a multi-instrument physical/biological/chemical/geological oceanographic mooring that will be deployed in the NE Chukchi Sea. Personnel costs are included for fabrication of the mooring and include 160 hrs. (4 wks.) and a negotiated benefit rate of 45.7%. Supplies costs will be used to purchase batteries. Indirect costs are included at a negotiated 50.5% MTDC rate.

Prince William Sound Science Center – The PWSSC was selected as a directed subaward to support operation and maintenance of 8 snotel weather stations in Prince William Sound and Cook Inlet and an acoustic array at the entrances of the sound to track marine mammals and fish. Personnel costs are included for the lead investigator to supervise the project at 0.5 months/year, as well as a deployment technician at 0.8 months/year and a 0.3-month/year technician to assist with the acoustic receiver maintenance cruise. Fringe benefits are calculated at 13-53% rate depending on employee. There is no travel for the project. Supplies include those necessary to support the array maintenance. Vessel charter costs are included at \$18,000 for 6 days, and the sub-contract for Snotel station maintenance is included at \$23,000. Indirect costs are calculated at 30% on direct costs. There are no changes in years 2-5.

Marine Exchange of Alaska – The MXAK was selected as a directed subaward to enhance maritime safety in Alaska through providing real time, environmental information to vessels over the AIS (Automatic Identification System). Personnel costs include salaries of planning, support staff and technicians that assemble the integrated sensor/power/transmission packages and periodically service the equipment. Benefit costs include the standard applicable state and federal

taxes. Travel includes the costs incurred by technicians to travel to the sites to install the integrated sensor/power/transmission packages and service the equipment. Supplies include the purchase of environmental sensors, off grid power (batteries, solar, wind and/or fuel cells), radio transmission equipment (AIS transmitters and wireless modems) required to support data collection and dissemination. The indirect costs cover finance staff, office and shop space, admin staff and tools.

Sitka Sound Science Center – The SSSC was selected as a directed subaward for the Southeast Sentinel Observing project to strengthen and expand a pilot long term monitoring study looking at ocean conditions and kelp forest and pinto abalone populations in Sitka Sound as sentinels of climate change. Personnel costs are included for the lead researcher at 1.75 months/year at \$22/hour with 18% fringe benefits. In year 1 a buoy will be purchased and deployed, vessel charter costs of \$1,100 included for deployment and shipping costs estimated at \$1,091. Overhead rates are calculated at 20%. In year 2-5, personnel costs increase to 4 months a year for the lead researcher. Contractual costs increase to include a diver at \$200/day for 20 days, vessel charter costs at \$9,000 and data telemetry. Supplies include purchase of a data logger and current meter. Year 3-5 budgets are similar.

Alaska Department of Natural Resources, Division of Geological and Geophysical Survey – ADNDR DGGS was selected as a directed subaward to facilitate development of an integrated, interagency water level network for the Alaska coast. Personnel costs include 1 month at \$5,500 for the lead researcher, 2 months for a field scientist (\$8,700) and 1 month for a student field assistant (\$3,450). Fringe benefits are calculated at ADNDR rates of 33% for full staff and 18% for students. Airfare and ground transport for 2 DGGS employees to travel to at least 3 remote locations to install equipment is estimated at \$3,780 per trip (\$2,000 airfare for 2 people, 3 nights lodging at \$150/night, per diem at \$60/day/person for 4 days and ground transport at \$400), for a total of \$11,340. Supplies include 3 water level sensors at \$3,500 each. State of Alaska indirect rates are calculated at 16.95%.

Woods Hole Oceanographic Institution – WHOI was selected as a directed subaward to support the pilot glider project in the Chukchi Sea testing use of acoustic recorders and a call library to record and transmit marine mammal calls in near real-time. Funds for year 1 will be used to purchase equipment. Total labor and benefits costs in year 2 are \$8,560 and include .25 month/year for the lead researcher to prepare and pilot the glider and analyze data and an additional .50/month for a glider technician. Materials and supplies include \$15,000 a year to purchase expendable lithium glider batteries. Two subawards would go to University of Washington to refine the call libraries and assist with data analysis (\$35,000) and to a collaborator at University of Alaska Fairbanks to deploy and recover the glider and participate in data analysis (\$25,000). Funds are also included for Iridium satellite communications for 3 months/year (\$4,600 per year) and for shipping the AOOS glider from Woods Hole to Alaska each year (\$3,000). Indirect lab costs and general administrative costs are \$7,737 in year 2. The only changes in years 3-5 are small increases to personnel costs and the lab and general administrative indirect costs.

Subaward to be determined: Sentinel monitoring in other regions. If full funding is received, AOOS will seek to use \$40,000 per year to leverage with additional opportunistic funding to

develop and enhance sentinel monitoring in other regions of the state that have local science capacity and resources to support such operations. Contracts or other agreements could be developed with federal and state agencies in Kodiak, the Aleutian Pribilof Islands Association in the Pribilof Islands, the Northwest Arctic Borough in Kotzebue and the North Slope Borough in Barrow. These funds could also be used to add sensors to existing platforms around the state to enhance local observing capacity, such as adding conductivity sensors to tide stations (that already have temperature measurements) along the coast to better understand large-scale oceanographic changes in salinity.

Subaward to be determined: Support monitoring of marine debris. A small amount of funding - \$6,000 per year - will go to partner with Gulf of Alaska Keeper to pay for vessel fuel and disposal costs as part of a monitoring program of the annual accumulation of marine debris in Prince William Sound and the northern Gulf of Alaska shoreline, including debris from container spills and the 2011 Fukushima earthquake. At \$20,000 a year, AOOS will partner with the Alaska Department of Environmental Conservation (ADEC) to provide additional support for monitoring marine debris in other locations.

Table 3. Modeling, Analysis & Products Year 1
Any differences in Years 2-5 will be described in summary below table.

Cost Category	UAF/IARC Sea Ice Atlas	UAF/ACCAP Climatologies	RSS ROMS	Axiom	TBD Coast Report	TBD Modeling Testbed
Salaries	\$23,443	\$29,742	\$25,441	\$87,963	-----	-----
Benefits	\$5,762	\$7,572	\$12,977	\$26,389	-----	-----
Equipment	-----	-----	-----	-----	-----	-----
Travel	\$2,522	\$1,681	\$1,310	-----	-----	-----
Supplies	\$600	\$600	-----	\$1,635	-----	-----
Other	-----	-----	\$2,500	-----	-----	-----
Total Direct Costs	\$32,327	\$39,594	\$42,228	\$115,987	-----	-----
Indirect Costs	\$16,325	\$19,995	\$777	\$24,014	-----	-----
TOTAL	\$48,652	\$59,589	\$43,005	\$140,000	\$150,000	\$350,000

University of Alaska Fairbanks was selected for the following 2 direct subawards for all five years of the proposed project.

Expansion of gridded Alaskan sea ice atlas in high-interest regions will grid sea ice for Cook Inlet and Norton Sound and consolidate historical charts from the Beaufort and Chukchi Seas provided by Shell Oil Co. Personnel costs include 8.6% FTE for the PI, 16.7% FTE for the coordinator, 4.2% FTE for a website programmer and 89.3% FTE for a research assistant with benefits calculated at 10.7%, 45.7%, 41% and 9.2% respectively. Travel includes three trips from Fairbanks to Anchorage to meet with the National Weather Service with meals at \$60/day, lodging for \$99/night, ground transportation for \$110/trip and round trip airfare for \$412.50. Supplies are included at \$600. Indirect costs are included at a negotiated 50.5% MTDC rate.

Coastal Marine Climatology will inform planning, aid in the monitoring of changes, and serve as information for the ocean and marine ecosystem modeling by constructing monthly climatologies of key variables for the Beaufort, Chukchi, and Bering Seas, as well as the northern Gulf of Alaska. Personnel costs include salaries for 174 hours for the PI to oversee the

project and 348 hours for a research programmer. Benefit rates of 10.7% are applied for the PI and 41% for the programmer. Travel costs include two trips from Fairbanks to Anchorage to meet with AOOS staff with \$60/day for meals, \$99/night for lodging, \$110/trip for ground transportation and \$412.50 for round trip airfare. \$600 is included for project supplies. Indirect costs are included at a negotiated 50.5% MTDC rate.

Remote Sensing Solutions – RSS was selected for a directed subaward for the Prince William Sound ROMS Nowcast/Forecast project, which will continue the real-time operation of the Prince William Sound (PWS) nowcast/forecast using the Regional Ocean Modeling System (ROMS) with data assimilation. Personnel costs includes salary for the PI, one scientist and a project manager at 4%, 11% and 0.4% respectively. Benefits are included at a rate of 51.01%. Travel costs of \$1310 include one three-day trip for one person to Anchorage for meetings with the AOOS DMAC and staff and include airfare, lodging and meals. Other costs include computer system and disk storage space. Indirect costs are calculated at a rate of 14.23% and a budgeted fee rate of 6%.

Axiom Data Science – Axiom Data Science was selected for a directed subaward to maintain and operate existing and new special projects such as Arctic Assets Map, Yukon-Kuskokwim salmon run timing, AIS data integration and mobile applications. Personnel costs include the project PI at 5% FTE and four Axiom staff at 20% FTE. Benefits cover 401K, health insurance, and paid leave for staff salaries. Supplies include the cost of several replacement hard drives and server components. Indirect costs are calculated at 21% for facilities and ancillary operating costs.

Subaward to be determined: Develop a “State of Alaska’s Coasts and Oceans Report”. AOOS will solicit proposals from potential partners or contractors to produce a new product for AOOS – the Alaska Coasts and Oceans Status Report. Funds of up to \$150,000 a year would be used to develop an annual status report that is electronic and web accessible, but also includes a brief summary document in hard copy. AOOS will seek additional funding and co-sponsors for this product, especially in its earliest stages of development. The National Marine Fisheries Service is potentially a recipient of these funds, given their current initiatives in developing ecosystem report cards and Integrated Ecosystem Assessments.

Subaward to be determined: Initiate the Alaska Modeling Testbed. AOOS will solicit proposals from entities interested and qualified in organizing and running a new Alaska Modeling Testbed initiative for AOOS that could be funded up to \$300,000 a year. AOOS will assemble a modeling team to develop the program’s mission, objectives, and criteria for proposals (e.g., must solve a specific modeling problem, validate an existing model, add operational value to an existing model, etc.). The criteria will be used to select candidate projects, considering a number of factors, including the current status of model in question (e.g., existence and functionality of a model versus building a model from the ground up). Model status will be balanced with stakeholder-identified needs, model priorities and potential for leveraging. Preliminary discussions have been held between AOOS and NOAA National Weather Service on the new Arctic Testbed, and there is the potential for future collaborations on that effort. Two potential modeling needs have already been identified for Year 1 with potential funding partners.

Fiscal Sponsor Fee (\$1,128,570)

The fiscal sponsor services provided by the Alaska SeaLife Center, which include grant administration, legal, personnel and human resources, are charged based on estimated actual costs of approximately \$188,095 per year, increasing with inflation.

h) Other (\$559,476) Other costs include \$20,000 a year contributions to symposiums and conferences (e.g., annual Alaska Marine Science Symposium - \$5000 per year, Alaska Forum on the Environment - \$3000 per year, Week of the Arctic - \$5000 per year, Arctic Forum - \$3000 per year); rent at \$54,000 per year (office plus joint space including conference room plus parking); insurance for staff, officers and equipment at \$3000 per year; telephone and internet at \$6000 a year, which includes conference call costs; postage and publication printing (\$10,000 per year), memberships and dues at \$15,000 per year (\$10,000 for annual IOOS Association dues, \$1500 for Consortium for Ocean Leadership membership dues, and other conference registration fees). The budget reflects inflation increases for most items.

APPENDIX B: Linkages to Regional and National Plans

PLANNING DOCUMENT	Marine Operations	Coastal Hazards Inundation	Ecosystems Fisheries Climate	Water Quality
Alaska Plans				
ABSI LCC Strategic Science Plan (2013) & FY15-16 Science & Operations Plan	√		√	√
Alaska Arctic Policy Commission Report (2015)	√	√	√	√
AOOS: Preliminary 10-year Buildout Plan (2012)	√	√	√	√
AOOS Arctic Ocean Observing Buildout Plan (2013)	√	√	√	√
Arctic LCC Strategic Science Plan (2013)	√	√	√	√
National Climate Assessment - AK Chapter (2014)		√	√	√
Northern Waters Task Force Final Report (2012)	√	√	√	√
NPFMC Annual Priorities (2014)			√	√
USGS: Science Needs for Energy Eevelopment in Chukchi and Beaufort Seas (2011)	√		√	√
Western Alaska LCC Strategic Science Plan (2014)		√	√	√
Arctic Plans				
Arctic Marine Shipping Assessment (2009)	√	√	√	√
Arctic Observing Network Reports (2012)	√	√	√	√
Arctic Research Plan FY2013-2017, OSTP/IARPC	√	√	√	√
National Strategy for the Arctic Region & Implementation Plan (2013-14)	√	√	√	√
NOAA's Arctic Action Plan (2014)	√	√	√	√
Responding to Oil Spills in the U.S. Arctic Marine Environment (2014)	√	√	√	√
SEARCH 5-year Science Goals (2012)			√	√
Sustained Arctic Observing Network Reports	√	√	√	√
The Arctic in the Anthropocene: Emerging Research Questions (2014)	√	√	√	√
U.S. Arctic Research Commission Goals and Objectives (2015-2016)	√	√	√	√
U.S. Coast Guard Arctic Strategy (2013)	√	√	√	
USGS Arctic Science Strategy (2015)		√	√	
U.S. Navy Arctic Roadmap (2014)	√		√	√
National Plans				
Coastal Theme for the IGOS Partnership (2006)			√	√
First IOOS Development Plan (2006)	√	√	√	√
Implementation Strategy for Coastal Global Ocean Observing System (2005)	√	√	√	√
IOOS Modeling & Analysis Workshop Report (2008)	√	√	√	√
IOOS National Modeling Strategy		√	√	
National Ocean Policy Implementation Plan (2013)	√		√	√
National Operational Wave Observation Plan (2009)	√	√		
National Surface Current Mapping Plan (2009)	√		√	
Network Gaps Analysis for NWLON (2014)	√	√		
NIST Inundation Research Roadmap (2014)		√		
NOAA's Ecological Forecasting Roadmap: 2015-2019			√	√
NOAA's Storm Surge Roadmap (2009)	√	√		
Quality Assurance of Real Time Ocean Data (QARTOD) Manuals	√	√	√	√
Strategic Plan for a National Telemetry Network (2014)			√	
Strategic Plan for Research and Monitoring of Ocean Acidification (2014)				√
Toward a U.S. IOOS Underwater Glider Network Plan (2014)			√	√
U.S. Marine Biodiversity Observation Network (2014)			√	

APPENDIX C: AOOS Stakeholder Engagement Process

AOOS relies on a variety of avenues to engage stakeholders and solicit recommendations. This feedback allows AOOS to both identify gaps in ocean observing and enhance AOOS tools and products. Due to the enormous geographic size of Alaska and the diversity of coastal and marine issues, the AOOS board determined it would be more effective to use existing communication pathways and forums, as well as specific stakeholder engagement events, to provide input to AOOS rather than maintain a standing “stakeholder committee”. This method has allowed AOOS to effectively interact in a focused way with multiple interest groups and hear specific needs.



Figure 1. AOOS Organizational Structure

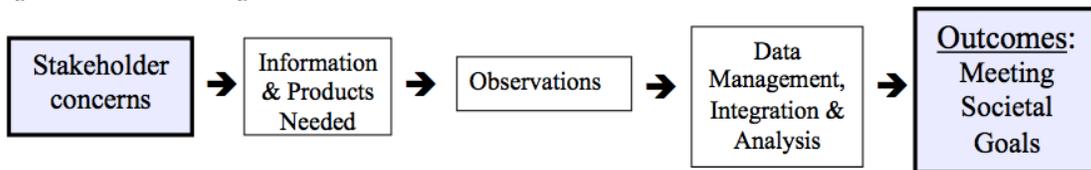


Figure 2. The AOOS prioritization process is user-driven

Facilitating Topic-based Groups

AOOS organizes and facilitates several topic-specific groups by convening relevant partners and discussing objectives, available resources, existing needs, and potential next steps to expand ocean monitoring and data access. These groups include ocean acidification, water level monitoring, impacts of the Blob (Pacific anomalies) in Alaska, and integration of long-term observing programs.

Hosting Regional meetings

In preparation for the 5-year proposal, AOOS held regionally-focused meetings with key stakeholders to identify gaps in ocean observing. Six meetings occurred in late 2014 and early 2015, focusing on Arctic observing, Arctic marine operations, Gulf of Alaska observing, Upper Cook Inlet observing, Prince William observing, and Southeast Alaska marine operations. Group sizes ranged from six to twenty people and discussion focused on specific local needs. While not all the recommendations could be incorporated into the proposal, documenting the needs will allow AOOS to continue to pursue and fill gaps through outside funding sources and collaborative partnerships.

Other Avenues for Ongoing Engagement

AOOS continues to maintain stakeholder engagement efforts in a number of other capacities. These include:

- **Presentations** – AOOS staff provide presentations and data portal demos to national, state, and local audiences on an ongoing basis. A comprehensive list of presentations, demos, and public appearances is located on the AOOS website.
- **Scoping groups** – AOOS organizes and runs ad-hoc scoping groups to assess and review new ideas and data tools. Examples have included the Research Assets Map, vessel track visualizations, hex-bin data techniques, and others.
- **User Surveys** – AOOS employs Survey Monkey several times a year to get feedback from broad audiences. Examples have included recommendations for locating Snotel sites, establishing the location and timing of seasonal wave buoy deployments, gathering feedback on workshops, and soliciting overall recommendations and ideas for the AOOS program.
- **Feedback tab** – Every page on the AOOS data portal includes a red feedback tab, allowing users to submit comments and recommendations regarding specific data and the user interface as a whole. AOOS/Axiom staff responds to each submission within 24 hours, and the feedback is documented, analyzed and assessed for implementation on a systematic basis.

Partner Organizations with stakeholder engagement processes

AOOS participates in the following organizations and relies on input from their stakeholder engagement processes:

- AK Ctr for Climate Assessment & Policy
- AK Climate Change Executive Roundtable
- Alaska Sea Grant
- Arctic LCC
- Bering Sea/Aleutian Island LCC
- Cook Inlet RCAC
- Kenai Watershed Fish Habitat Partnership
- North Pacific Fishery Management Council
- North Slope Science Initiative
- Oil Spill Recovery Institute
- Prince William Sound RCAC
- Scenarios Network for Alaska Planning
- Western Alaska LCC

Organizations to which AOOS has provided presentations or data portal demos

- AK Assoc. of Ports & Harbor Masters
- AK Center for Climate Assessment and Policy
- AK Climate Change Executive Roundtable
- AK Congressional Delegation
- AK Dept. of Environmental Conservation
- AK Dept. of Natural Resources
- AK Dept. of Transportation
- AK Marine Conservation Council
- AK Marine Science Symposium
- AK Sea Grant
- Arctic Animal Telemetry Network
- Arctic Council
- Arctic LCC
- Bering Sea/Aleutian Island LCC
- Bureau of Ocean Energy
- Canadian Beaufort Sea Partnership
- Cook Inlet RCAC
- Distributed Biological Observatory
- Geographic Information Network of Alaska
- Inuit Circumpolar Council
- Kenai Watershed Fish Habitat Partnership
- National Research Council Marine Board
- NOAA AK Fisheries Science Center
- NOAA headquarters, Juneau
- North Pacific Fisheries Management Council
- North Slope Borough
- North Slope Science Initiative
- Northern Oil and Gas Forum
- Northwest Arctic Borough Subsistence
- Ocean Research Advisory Panel
- Pacific Arctic Group
- Polar Research Board
- Prince William Sound RCAC
- R&M Engineering
- Scenarios Network for Alaska Planning
- ShoreZone Alaska Project
- U.S. Geological Survey
- UAA Institute for Social & Economic Research
- US Coast Guard
- US Fish & Wildlife Service
- Western Alaska LCC
- World Wildlife Fund Arctic Program

Appendix D: AOOS Data Management Technical Approach

Axiom Data Science has developed a framework for managing a variety of ocean data types (in-situ and remotely sensed data streams, multidimensional grids, GIS and other structured formats). This framework exposes managed data through interoperability systems and uses several user interface tools that allow the data to be discovered and explored by the broader community. Using this framework to power the AOOS DMAC system will enable the AOOS data team to rapidly ingest or connect to data sources relevant to AOOS and develop advanced user tools and data products efficiently.

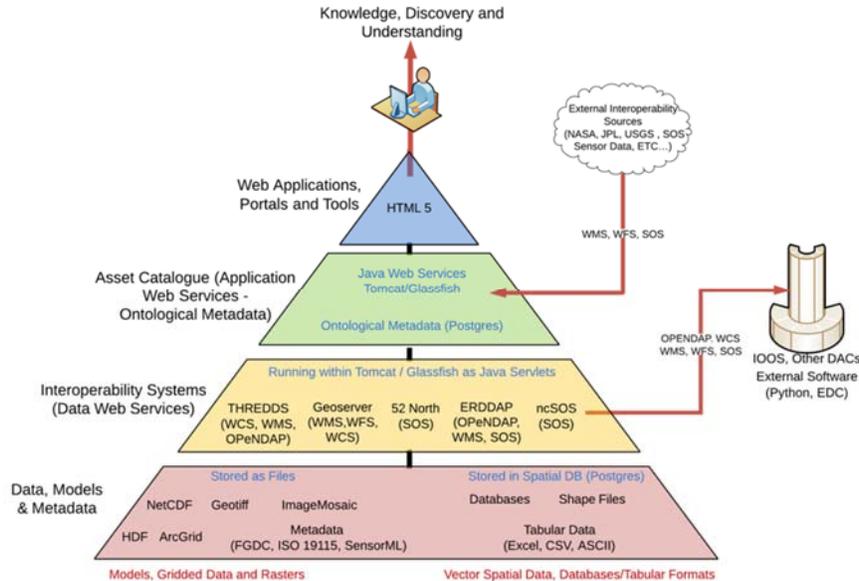


Figure 1. DMAC framework showing the flow of data through logical technology tiers, enabling discovery and understanding the ocean and coastal environments.

At the base (Tier 1) of the pyramid lie source data produced by numerical modeling centers, GIS analysts, instruments, CSW catalogs, models and remote sensing platforms. Many data sources can be ingested autonomously into the back-end data system through a series of harvesting mechanisms written in Java, Scala and Python that make use of lower-level interfaces (e.g., FTP, HTML and ad hoc service APIs). Data files are processed during the ingestion process and loaded into a clustered file storage and database system (GlusterFS and Postgres). A suite of interoperable systems (Tier 2) connect to the data storage, including 52 North SOS, GeoServer, THREDDS, ErDDAP, ncWMS and ncSOS, and they expose data feeds through SOS, WFS, WCS, WMS and OPeNDAP protocols. The asset catalog (Tier 3) is a database containing ontological information describing the dimensional characteristics (space, time, unit, measured parameter and taxonomy) of each known data resource and how these characteristics relate to each other across data sets. References to both internally- and externally-hosted data feeds are stored in the ontological database and provide the user with a harmonized set of interfaces for consistent access to data and visualizations. Sensors, numerical model output and remotely sensed observational grids are mapped to common characteristics (space, time, and climate forecast parameter) for comparison across sources. Data sets are further mapped across keywords and, if applicable, Integrated Taxonomic Information System (ITIS) records. The asset catalog also exposes web services providing external access to metadata in the database and

provides a method for indexing metadata across multiple formats and types using ElasticSearch, a scalable, Apache Lucene based, clustered search engine. The top level (Tier 4) is composed of the web-based applications and tools that provide users with access to data and products, which are developed in HTML5 and various web programming user interface frameworks. Users sit at the top of the pyramid with all underlying systems working together to create a powerful and intuitive way to rapidly discover, access and use data. This framework has enabled Axiom to support two other IOOS Regional Associations, several non-governmental research funders, and many state and federally funded research and data integration centers.

The Research Workspace is a cloud-based data management application designed for storing, documenting and sharing data among members of scientific communities. It also gives program managers, research coordinators, and other stakeholders a transparent and front-row view of how users have structured and described projects and how their programs are progressing through time. Some of the specific features of the Workspace are described below:

Secure group, user, and project profiles — Users of the Workspace have a password protected user profile that is associated with one or more research campaigns. To make login and authentication easy for users, the Workspace supports authentication through Google accounts; if a user is logged into a Google account, they can use the Workspace without creating a separate username and password. Transfer of data and information occur over Secure Socket Layer (SSL) encryption for all interactions with the Workspace.

Metadata authoring — The Workspace Metadata Editor provides metadata elements common to the Federal Geographic Data Committee (FGDC) designed Content Standard for Digital Geospatial Metadata (CSDGM) and the ISO 19115 standards for geospatial metadata, extended with biological profiles of those standards. Axiom also developed an integrated FGDC biological profile extension editor that allows users to search the Integrated Taxonomic Information System (ITIS) to rapidly add taxonomic information to metadata. As a cloud-based service, the Workspace allows researchers to move between computers during the metadata generation process in addition to allowing team members and administrators to simultaneously review and edit metadata in real-time.

Advanced and secure file management — The Workspace provides users with tools to bulk upload files, organize those documents into folders or collections, create projects with predefined and user-created context tags, and control read and write permissions on files within projects. The Workspace also provides simple version control.

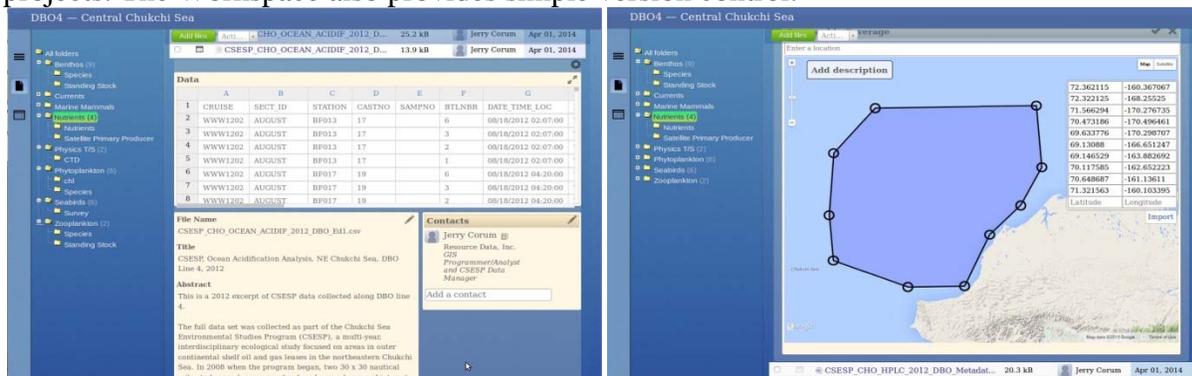


Figure 2. The first screenshot shows the Workspace metadata interface to author basic descriptive and citation information, add contacts, and edit attribute information for a Distributed Biological Observatory project data set. The second screenshot displays a tool that allows researchers to describe the geographic extent of the project.

APPENDIX E: Projects by Geographic Region, Funding Level and Programmatic Theme

Project	FUNDING LEVELS			PROGRAMMATIC THEMES			
	\$1.5M	\$2.5M	\$4M	Marine Operations	Coastal Hazards Inundation	Ecosystems Fisheries Climate	Water Quality
Statewide							
Program development, implementation, outreach	√	√	√	√	√	√	√
Data system, portal, website, products (<i>basic functions</i>)	√			√	√	√	√
<i>Current level of effort</i>		√	√				
<i>Additional data ingestion, models, sensors, products</i>			√				
Mobile apps		√	√+	√	√	√	√
AIS weather stations		√	√+	√	√		
State of Alaska coasts & oceans report		√	√	√	√	√	√
AIS vessel tracks visualizations		√	√	√			
AOOS modeling testbed		√	√+	√	√	√	√
Ocean climatologies			√			√	√
Particle trajectory tool			√	√	√	√	√
Model evaluation tool			√	√	√	√	√
Gulf of Alaska							
Ship survey:Seward line	√	√	√			√	√
Prince William Sound sentinel observations	√	√	√			√	√
Weather stations in PWS & CI	√	√	√+	√	√	√	
Wave buoys	√	√	√	√	√		
Cook Inlet sentinel observations	√	√	√			√	√
Ocean acidification monitoring	√	√	√+			√	√
Marine debris		√	√+				√
PWS ROMS		√	√	√	√	√	√
Southeast Alaska sentinel observations			√			√	√
Port of Anchorage Observations			√	√	√		
Sea ice atlas: Cook Inlet			√	√	√	√	
Bering Sea							
Fishery run timing products	√	√	√+			√	
Coastal inundation: water levels	√	√+	√+	√	√		
Wave buoys	√	√	√+	√	√		
Ocean acidification monitoring	√	√	√+			√	√
Arctic Marine Highway support tools			√	√			
Ecosystem moorings: Bering			√			√	√
Additional HF radars			√	√	√		
Sea ice atlas enhancements			√	√		√	
Community based monitoring			√		√	√	√
Arctic							
Sea ice atlas enhancement	√	√	√	√		√	
Arctic research assets map	√	√	√	√	√	√	√
HF radars	√	√	√+	√	√		
Coastal inundation: water levels	√	√+	√+	√	√	√	
Glider surveys: whale glider		√	√			√	
Ecosystem moorings: Chukchi & Beaufort		√	√			√	√
Ocean acidification monitoring		√	√			√	√
Arctic Marine Highway support tools			√	√			
Community based monitoring			√		√	√	√

The Aleutian and Bering Sea Islands
Landscape Conservation Cooperative
1011 East Tudor Road, MS 281
Anchorage, Alaska 99503



August 19, 2015

Molly McCammon
Director
Alaska Ocean Observing System
1007 West Third Avenue, Suite 100
Anchorage, Alaska 99501

Dear Molly:

Although the Aleutian and Bering Sea Islands Landscape Conservation Cooperative (ABSI) has only been in existence since 2012, we have collaborated with the Alaska Ocean Observing System (AOOS) on a number of important projects. One of our earliest joint efforts, the Aleutian and Bering Climate Vulnerability Assessment, has already produced valuable results that helped inform our 2015 Request for Proposals for further investigation on how climate change may impact natural and cultural resources in the Aleutian and Bering Sea Islands region. We have also collaborated on joint proposals for projects such as archiving and serving information about Arctic marine vessel traffic through the AOOS data portal.

With more coastline than the rest of the United States combined, the work that AOOS does to provide access to coastal and ocean information in Alaska is critically important. And given our strong focus on natural resources in the marine environment, the ABSI partnership looks forward to working with your organization on projects of mutual interest in the future. We hope the Integrated Ocean Observing Systems continues to support AOOS as the regional ocean observing system in Alaska.

Sincerely,

A handwritten signature in blue ink, appearing to read "Douglas M. Burn". The signature is fluid and cursive, with a long horizontal flourish extending to the right.

Douglas M. Burn
Coordinator, ABSI



University of Alaska Fairbanks
930 Koyukuk Drive
PO Box 757245
Fairbanks, AK 99775-7245
907-474-7812 • accap.uaf.edu

August 20, 2015

To Whom it May Concern,

The Alaska Center for Climate Assessment and Policy (ACCAP) fully supports the proposal - *Implementation of the U.S. Integrated Ocean Observing System: Alaska Ocean Observing System* submitted in response to Federal Funding Opportunity NOAA-NOS-IOOS-2016-2004378 by the Alaska Ocean Observing System (AOOS).

ACCAP is one of the Regional Integrated Science and Assessment (RISA) programs funded by the NOAA Climate Program Office, Climate and Societal Interactions Program. AOOS activities match and complement the overarching goals of ACCAP to improve the ability of Alaskans to respond to a changing climate. ACCAP partners with stakeholders to inform realistic community plans and climate adaptation strategies using the most scientifically accurate, reliable, and up-to-date information. Stakeholder interaction and outreach is integrated into every aspect of our work.

ACCAP has collaborated with AOOS on multiple projects over the past 5 years related to changing sea ice, ocean acidification, and climate change impacts in Alaska. For example, AOOS and ACCAP partnered to create and maintain the first digital Historical Sea Ice Atlas for Alaska—a web-based atlas is designed with user input to provide graphically represented historical sea ice extent from the mid-1800s to the present. We have also partnered on hosting workshops and information events such as an Ocean Acidification in Alaska workshop that included close to 100 in-person participants and over 70 online participants. Additionally AOOS Executive Director, Molly McCammon is a valued member of the ACCAP Steering Committee and her input on behalf of AOOS strengthens ACCAP organizationally as well as in the projects and products that we undertake and develop.

Collaborations in the past have supported and complimented the mission of ACCAP and we look forward to continued active and fruitful partnership with AOOS.

In addition, the work that AOOS does state-wide in partnership with state and federal agencies, non-governmental organizations and local communities provides benefits state-wide in building coastal resilience, supporting healthy marine ecosystem and making important scientific observations accessible to decision-makers and the general public.

I strongly encourage you to support the AOOS proposed work for the upcoming five years.

Sincerely,

Sarah F. Trainor
Director, Alaska Center for Climate Assessment and Policy (ACCAP)



THE STATE
of **ALASKA**
GOVERNOR BILL WALKER

Department of Transportation and Public Facilities

STATEWIDE DESIGN & ENGINEERING SERVICES
Coastal and Harbor Engineering Section

5800 East Tudor Road
Anchorage, Alaska 99507-1286
Main: 907.2696241
Fax: 907.2696478

August 24, 2015

Molly McCammon, Director
Alaska Ocean Observing System
1007 W. Third Avenue, Suite 100
Anchorage, AK 99501

Molly
Dear Ms. ~~McCammon~~:

I am writing this letter in support of the Alaska Ocean Observing System's (AOOS) proposal to NOAA for the next 5-year funding cycle, and in particular, the continued development of the Alaska Harbor Observation Network (AHON).

Alaska's coastal infrastructure may increasingly be subjected to changes associated with climate change: potential rising sea level, changes in sea ice cover and storm patterns, coastal storm surge, thermal degradation or permafrost melt; these conditions are not accurately measured, so engineering is often based on anecdotal information. Data collected to accurately reflect conditions along Alaska's 44,000 miles of coastline, particularly around the Bering and Chukchi Seas, and Arctic Ocean, would be invaluable, especially as the U.S. expands development throughout the arctic.

The Alaska Department of Transportation and Public Facilities, Coastal and Harbor Engineering Section, work with department personnel, other state and federal agencies and Alaska's coastal communities to develop harbor and related infrastructure to meet the needs of the community for shipping (barges and docks), transportation (ferries), tourism (cruise ships and commercial charters), and commercial, recreational and subsistence fishing. We would greatly benefit from, and use this information in the engineering of these facilities.

Additionally, the department lacks information about conditions for coastal infrastructure: harbors, highways and airports in our coastal communities; many are federally-funded through FHWA and FAA. Data from the AHON may be used in design of these multi-million dollar structures.

The AOOS proposal contains projects providing additional information on winds, waves, and near shore water levels. Easy access to this information would increase the efficiency and potentially lower the cost of our operations.

Sincerely,

A handwritten signature in blue ink, appearing to read "Ruth A Carter".

Ruth A Carter, P.E.
Coastal Engineer

cc: Harvey Smith, P.E., State Coastal Engineer



PO Box 101145 • Anchorage, AK 99501

T 907.277.5357

E fish@akmarine.org

W www.akmarine.org

August 19, 2015

To whom it concerns,

The Alaska Marine Conservation Council (AMCC) is a community-based organization dedicated to protecting the integrity of Alaska's marine ecosystems and promoting the health of ocean-dependent coastal communities. Our members include fishermen, subsistence harvesters, marine scientists, small business owners and families – Alaskans with a stake in the long-term success of our fisheries.

This is a letter of support for the proposal by the Alaska Ocean Observing System (AOOS) for funding from NOAA for the next five years. Monitoring key physical, chemical and biological parameters of the ocean – and understanding their significance to changing ecosystems and climate variability – is essential for the commercial fishing industry to maintain healthy fisheries.

We are fully in support of AOOS's efforts to fill gaps in ocean monitoring throughout the state, especially those in the Bering Sea and in the Gulf of Alaska. Fishermen are seeing changes in the ocean now, and want to know what to expect in the future in order to prepare both for challenges and opportunities. We are especially concerned about the potential impacts of ocean acidification on the food web and on commercial fisheries, and appreciate the efforts of AOOS to help network those doing monitoring, research and outreach on ocean acidification in Alaska.

We are also supportive of expanding weather and ocean condition forecasts to improve mariner safety. Forecasts now are operating with too little data; we need more real-time information.

Sincerely,

Kelly Harrell
Executive Director



August 25, 2015

Molly McCammon, Executive Director
Alaska Ocean Observing System
1007 W Third Ave., Suite 100
Anchorage, AK 99501

Dear Ms. McCammon:

We are writing in support of the Alaska Ocean Observing System (AOOS) proposal for federal FY16-20 funding as part of the national Integrated Ocean Observing System. We represent NGOs who strongly believe in the use of sound science—based on extensive monitoring data—to inform government decision-making on whether, when, and where offshore oil and gas development and other industrial activity (e.g., shipping and ports) is appropriate in the Arctic.

We have been impressed with AOOS' collaborations with stakeholder communities in the Arctic to facilitate increased planning and development of a robust research and monitoring program in the Beaufort, Chukchi and Bering seas. We have been especially pleased with AOOS efforts to integrate our arctic marine atlas data layers into their Arctic Data Portal and increase the usefulness of these data for decision making.

Since it is a consortium of state and federal agencies, academic institutions, and other organizations, and has a mission that is "policy neutral", we find that AOOS fairly facilitates information sharing among all the various players. In addition, AOOS has the ability to compile and integrate data and information from a variety of sources and then develop a plan for identifying gaps and developing strategies for filling them.

We strongly support fully funding this proposal at the maximum level, since these funds will be used to make existing data more accessible and to expand collection of biological information tied to physical and chemical observations. Full funding of this proposal will serve everyone's interests in the Arctic, regardless of one's perspective on industrial development in this region.

Sincerely,

A handwritten signature in black ink, appearing to read "Nils Warnock".

Nils Warnock, PhD
Executive Director
Audubon Alaska

A handwritten signature in blue ink, appearing to read "Andrew Hartsig".

Andrew Hartsig, Esq.
Arctic Program Manager
Ocean Conservancy



“The mission of the Council is to represent the citizens of Cook Inlet in promoting environmentally safe marine transportation and oil facility operations in Cook Inlet.”

22 August 2015

Members

*Alaska State
Chamber of
Commerce*

Molly McCammon, Director
Alaska Ocean Observing System
1007 W. Third Avenue, Suite 100
Anchorage, AK 99501

*Alaska Native
Groups*

Dear. Ms. McCammon,

*Environmental
Groups*

This letter is in support of your Alaska Ocean Observing System (AOOS) FY2016-2020 proposal under the NOAA Federal Funding Opportunity for the U.S. Integrated Ocean Observing System. Through the leadership of you and your team, AOOS is archiving and serving ocean observations and data that have historically been difficult to access, obtain, integrate, or visualize.

*Recreational
Groups*

AOOS has improved Cook Inlet Regional Citizens Advisory Council's (CIRCAC) ability to fulfil the mandates of our founding legislation, the Oil Pollution Act of 1990. As you know, we have worked closely with AOOS while developing long-term monitoring programs for Cook Inlet and the western Gulf of Alaska, and will continue to coordinate our activities as we gather data and develop tools to help ensure safe marine shipping and improve oil spill prevention and response capabilities.

*Aquaculture
Associations*

During the five years covered by your proposal, we are committed to continued partnerships with AOOS on ocean observing system issues. Specifically, we will continue to work with you on operating and maintaining observing platforms, such as the remote meteorological station in the Kamishak Bay area and the sensors and web-camera deployed at the mouth of the Kenai River as part of our Cook Inlet Ice Camera Network, all served via the AOOS Real Time Sensor Map.

*Fishing
Organizations*

City of Kodiak

We are also committed to working with AOOS to improve capabilities of the Cook Inlet Response Tool (CIRT), the data portal that is increasingly filling the needs of the oil spill planning and response community represented by industry and local, state, and federal organizations and agencies. As well, our participation on the steering committee for the new AOOS Beluga Ecosystem Portal will continue, and we'll provide any CIRCAC data and information needed by your data development team. Finally, we look forward to working with you in integrating oil spill trajectory modeling capabilities and results into AOOS data portals and visualization tools.

City of Kenai

City of Seldovia

City of Homer

We have benefited significantly from AOOS activities to date and we are particularly impressed with the responsiveness of your team to local concerns, especially in light of the fact that you are working with organizations that have ocean data needs throughout all of coastal Alaska.

*Kodiak Island
Borough*

Sincerely,

*Kenai Peninsula
Borough*

Michael Munger
Executive Director

*Municipality of
Anchorage*

North Slope Science Initiative

www.northslope.org

North Slope Borough
Bureau of Ocean Energy Management
Alaska Department of Natural Resources
Alaska Department of Fish and Game
National Marine Fisheries Service
National Weather Service Alaska
Bureau of Safety and Environmental
Enforcement



U.S. Arctic Research Commission
U.S. Fish and Wildlife Service
Bureau of Land Management
National Park Service
U.S. Geological Survey
Arctic Slope Regional Corporation
U.S. Department of Energy
U.S. Coast Guard

c/o Alaska State Office (910)
Bureau of Land Management
222 West Seventh Avenue, #13
Anchorage, Alaska 99513-7504

August 25, 2015

RE: In Response to Federal Funding Opportunity NOAA-IOOS-2016-2004378
Proposal for Fiscal Years 2016 – 2020
Implementation of the U.S. Integrated Ocean Observing System:
Alaska Ocean Observing System

Molly McCammon, Director
Alaska Ocean Observing System
1007 West Third Avenue, Suite 100
Anchorage, Alaska 99501

Dear Ms. ~~McCammon~~, *Molly*

Please accept this letter in support of your proposal for fiscal years 2016 through 2020 for funding as the Alaska Observing System (AOOS) component of the Integrated Ocean Observing System.

The North Slope Science Initiative (NSSI) was established by Congress pursuant to Section 348, Energy Policy Act of 2005 (Public Law 109-58). Congress directed the purpose of the NSSI is to implement efforts to coordinate the collection of scientific data that will provide for a better understanding of terrestrial, aquatic and marine ecosystems of the North Slope of Alaska. This includes efforts to work with other initiatives, such as AOOS, to collaborate on projects that provide access to coastal and ocean observing data and metadata to provide quality information to decision makers and researchers.

The NSSI continues to collaborate with AOOS on important information sharing opportunities and look forward to additional future opportunities through fiscal year 2020. If you have any questions, or need additional information, please contact me at (907) 271-3431.

Sincerely,

A handwritten signature in black ink that reads 'John'.

John F. Payne, PhD
Executive Director



NORTHWEST ARCTIC BOROUGH

Ambler Buckland Candle Deering Kiana Kivalina Kobuk
Kotzebue Noatak Noorvik Selawik Shungnak

August 24, 2015

Molly McCammon, Director
Alaska Ocean Observing System
1007 W Third Ave, Suite 100
Anchorage, AK 99501

Dear Ms. McCammon:

This letter indicates our support for your proposal for FY 2016 – 2020 funding, in response to the Federal Funding Opportunity NOAA-NOS-IOOS-2016-2004378.

The Northwest Arctic Borough was formed in June 1986 as a home rule borough. Geographically, the borough is roughly the size of the state of Indiana and our office in Kotzebue, is 33 miles above the Arctic Circle. Roughly 7,500 people in 11 communities call the NAB home. The Borough waters include the Kotzebue Sound and the Chukchi Sea, wedged between the Bering Straits South of us and the Beaufort Sea to the North.

The NAB believes in protecting/enhancing the traditional Inupiaq way of life. We are interested in collecting our traditional ecological knowledge and coupling it with the scientific assessments of “what’s makes the Kotzebue Sounds so important to our food security.” Our efforts to understand our environment directed us to develop a Science Division. This division is guided by our Science Steering Committee; whose Mission Statement is: To improve the science and research capacity of the NAB to better understand our environment.

We know that your proposal will satisfy the U.S. Integrated Ocean Observing Systems desire to develop national and regional partnerships to provide observations, data, and new tools to forecast to improve safety, enhance the economy, and protect our environment.

Like others in our region, we are looking to regional collaborations and partnerships to help us prepare for the potential opportunities and impacts of increased activity in our region. We look forward to working with you in the development of these tools.

Sincerely,

Reggie Joule
Mayor, Northwest Arctic Borough



2000 Anchorage Port Rd., Anchorage, AK 99501
Tel. 907-343-6200 | Fax. 907-277-5636
www.portofanc.com

August 17, 2015

Ms. Molly McCammon, Director
Alaska Ocean Observing System
1007 W. Third Avenue, Suite 100
Anchorage, Alaska 99501

Dear Ms. McCammon:

I am writing this letter in support of the Alaska Ocean Observing System's (AOOS) proposal to NOAA for Alaska Regional Coastal and Ocean Observing Systems.

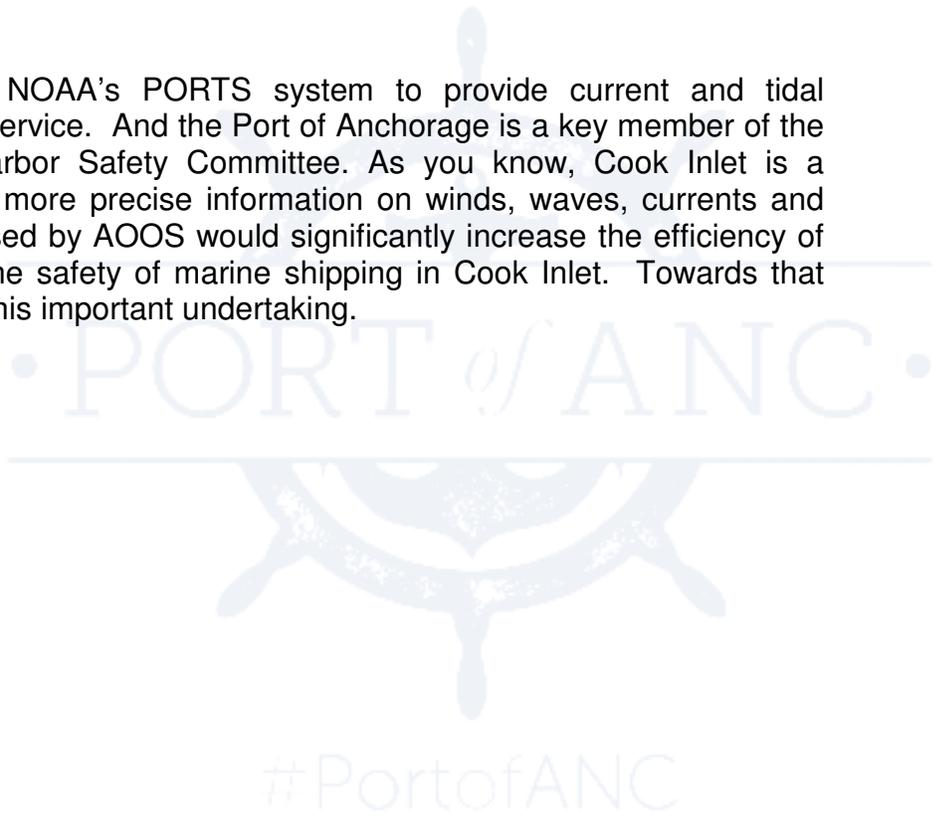
The Port of Anchorage is the major regional port serving 85% of Alaska's populated area, including the major military installations, from Homer to the North Slope by means of rail, road and air cargo connections. The Port handles 74% of all waterborne freight entering Southcentral Alaska, and 95% of all refined petroleum products.

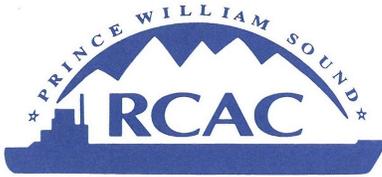
The Anchorage port is served regularly by two major ocean carriers that bring four ships weekly from the Pacific Northwest. Petroleum tankers and barges supply jet fuel for military and airport operations, unleaded and low-sulfur diesel fuel for service stations, aviation gasoline for civil aviators, and on-load petroleum products for western Alaska. Ships from Asia call frequently transporting construction and pipeline materials, refined petroleum, and cement. This traffic has been on the increase in 2015, and will continue to do so well into 2016.

The Port is already using NOAA's PORTS system to provide current and tidal information for the ships we service. And the Port of Anchorage is a key member of the newly-formed Cook Inlet Harbor Safety Committee. As you know, Cook Inlet is a complex body of water, and more precise information on winds, waves, currents and sediment transport as proposed by AOOS would significantly increase the efficiency of our operations and ensure the safety of marine shipping in Cook Inlet. Towards that end, we continue to support this important undertaking.

Sincerely,

Steve Ribuffo
Port Director





Regional Citizens' Advisory Council / "Citizens promoting environmentally safe operation of the Alyeska terminal and associated tankers."

In Anchorage: 3709 Spenard Road / Suite 100 / Anchorage, Alaska 99503 / (907) 277-7222 / FAX (907) 277-4523
In Valdez: P.O. Box 3089 / 130 South Meals / Suite 202 / Valdez, Alaska 99686 / (907) 834-5000 / FAX (907) 835-5926

MEMBERS

August 20, 2015

Alaska State
Chamber of Commerce

Molly McCammon
Alaska Ocean Observing System
1007 West Third Avenue, Suite 100
Anchorage, AK 99501

Chugach Alaska
Corporation

City of Cordova

SUBJECT: AOOS Federal Funding Opportunity NOAA-NOS-IOOS-2016-2004378

City of Homer

Dear Ms. McCammon:

City of Kodiak

I am writing this letter in support of the Alaska Ocean Observing System's proposal to NOAA for Alaska Regional Coastal and Ocean Observing Systems.

City of Seldovia

The Prince William Sound Regional Citizens' Advisory Council (PWSRCAC) is an independent non-profit corporation whose mission is to promote environmentally safe operation of the Valdez Marine Terminal and associated tankers. Our work is guided by the Oil Pollution Act of 1990, and our contract with Alyeska Pipeline Service Company. PWSRCAC's 19 member organizations are communities in the region affected by the 1989 Exxon Valdez oil spill, as well as commercial fishing, aquaculture, Native, recreation, tourism and environmental groups.

City of Seward

City of Valdez

City of Whittier

Community of
Chenega Bay

Community of
Tatitlek

Cordova District
Fishermen United

Kenai Peninsula
Borough

Kodiak Island
Borough

We have worked with the Alaska Ocean Observing System to enhance the safety of marine shipping, including that of oil tankers, in Prince William Sound. We are very supportive of AOOS' efforts to integrate existing ocean observing data in Alaska and to develop increased access to weather and sea state observations to improve navigation safety. We would like to see these efforts continue, especially for the oil tanker traffic routes through Prince William Sound and the Gulf of Alaska.

Kodiak Village Mayors
Association

We encourage NOAA to provide full funding for the AOOS proposal, not only to maintain the work currently underway and also additional work as proposed in future years.

Oil Spill Region
Environmental
Coalition

Sincerely,

Port Graham
Corporation

Mark A. Swanson
Executive Director

Prince William Sound
Aquaculture
Corporation

U.S. Department of
Homeland Security

United States
Coast Guard



Commander
Seventeenth Coast Guard District

PO Box 25517
Juneau, AK 99802-5517
Staff Symbol: (d)
Phone: (907) 463-2025
Fax: (907) 463-2037

16100

AUG 26 2015

Molly McCammon, Director
Alaska Ocean Observing System
1007 W Third Ave, Suite 100
Anchorage, AK 99501

Dear Ms. McCammon:

The U.S. Coast Guard Seventeenth District's Juneau Rescue Coordination Center frequently relies upon information from Alaska Ocean Observing System's vast collection to prosecute cases. Information like the products you will create through your proposal in response to NOAA Federal Funding Opportunity for Implementation of the U.S. Integrated Ocean Observing System (IOOS): NOAA-NOS-IOOS-2016-2004378.

The U.S. Coast Guard is the primary federal agency responsible for maritime operations in the Alaska region, responsible for Search and Rescue, Marine Safety, and Marine Environment Protection. Products from this proposal like observing platforms for monitoring winds, waves, currents and other ocean conditions to improve navigational safety, respond to coastal erosion, and track ecosystem and climate change trends and impacts support U.S. Coast Guard missions in Alaska.

I fully support the Alaska Ocean Observing System in its efforts to sustain and enhance the Alaska region's observing system and to validate the technologies that provide the U.S. Coast Guard with vital environmental information.

Sincerely,

A handwritten signature in black ink, appearing to read "D. B. Abel".

D. B. ABEL, RADM
Commander
Seventeenth Coast Guard District

Molly McCammon, Director
Alaska Ocean Observing System
1007 W. Third Ave, Suite 100
Anchorage, AK 99501

Western Alaska LCC



Dear Dr. McCammon,

19 August, 2015

I have recently become aware that the Alaska Ocean Observing System (AOOS) is submitting a proposal for continued funding through 2020 (NOAA-NOS-IOOS-2016-2004378). As the Coordinator for the Western Alaska Landscape Conservation Cooperative (LCC), I would like to encourage you to continue funding for this important program. The LCC is governed by a Steering Committee of 14 state, federal and tribal organization partners. The LCC Steering Committee makes decisions about the program of work for the LCC to support each year. Since the LCC began in 2011, we have partnered with AOOS on several projects and on shared planning activities. AOOS serves a very important role in Alaska. It is becoming the primary place for stakeholders to seek marine/ocean data and information and their staff is integral in providing services that make that information or data accessible to a wide range of user groups. From my standpoint within the LCC community our collaborations with AOOS on shared planning and science delivery activities have been crucial. Our collaborations have increased efficiencies of both the LCC and AOOS but more importantly the collaboration reduces confusion among partners and communities about priorities and the linkages between organizations. The Alaska Marine Science Symposium is the primary ocean/marine science conference in Alaska and it provides invaluable networking and education opportunities for its participants.

Please contact me if you would like any information about our collaborations with AOOS or about the activities of the Western Alaska LCC. I can be reached at Karen.A.Murphy@fws.gov or at 907-786-3501.

Sincerely,

A handwritten signature in black ink that reads "Karen A. Murphy". The signature is written in a cursive, flowing style.

Karen A. Murphy
Western Alaska LCC Coordinator

Molly (Mary Elizabeth) McCammon

mccammon@aoos.org

Work Telephone: (907) 644-6703 or Mobile Telephone: (907) 227-7634
1007 West Third Avenue, Suite 100, Anchorage, Alaska 99501

PROFESSIONAL EXPERIENCE

July 2003 – Present

Alaska Ocean Observing System (AOOS). Executive Director.

- Developing the Alaska regional component of the national Integrated Ocean Observation System (IOOS), guided by a board made up of federal and state resource agencies, marine research entities and marine industries.
- Represent Alaska interests in IOOS Association and further development of national IOOS.
- Work with Alaska members to establish an integrated system of ocean observations for Alaska to meet the needs of a wide variety of users.

Other current projects

Co-PI for COSEE Alaska, funded by NSF

Lead PI, Ocean planning tools project, funded by NOAA under Regional Ocean Partnership Program

Lead PI, Long-term monitoring program, funded by *Exxon Valdez* Oil Spill Trustee Council

Lead PI, Bering Strait wave monitoring, funded by Western AK Landscape Conservation Coop

Lead PI, Climate vulnerability assessment, funded by Aleutian Bering Sea Islands LCC

Co-PI, Marine Arctic Ecosystem Study, funded by Bureau of Ocean Energy Management

1993 - 2003

***Exxon Valdez* Oil Spill Trustee Council.** Executive Director.

- Implemented policies and direction of six-member, joint federal-state Trustee Council with requirement of unanimity for all decisions.
- Administered programs funded by \$900 million trust fund established by settlement of government claims against Exxon Corporation following 1989 oil spill, including annual research and monitoring work plans ranging in size from \$6 million - \$25 million a year.
- Developed oil spill restoration program now viewed as international model.
- Guided planning and successful review by National Academy of Sciences of groundbreaking long-term environmental monitoring program.
- Negotiated and implemented one of largest habitat acquisition programs in nation.

Recent Professional Activities

- 2013 – 2014, member, National Academy of Sciences Gulf Program Advisory Group.
- 2003- present, Alaska representative to IOOS Association, treasurer and member, Executive Committee; 2005-2011, national chair.
- 2011 – present and 2006-2009, member national Ocean Research Advisory Panel.

- 2004 - present, Board member representing city of Anchorage and past President, Cook Inlet Regional Citizens' Advisory Council.
- 2004 – present, Alaska Sea Grant, Advisory Group member.
- 2005 – present, Fellow, Cooperative Institute for Arctic Research, University of Alaska Fairbanks.
- 2008 – 2013, member, National Academy of Sciences Polar Research Board.
- 2011-2012, writing team Alaska Regional Climate Assessment and Alaska chapter of national Climate Assessment.
- 2004 – 2006, member, National Research Council Committee to Establish an Arctic Observing Network.

Past Experience 1984-1993

Ten years experience in Alaska public policy, specializing in natural resources, fisheries and Alaska Native issues, working for Alaska Governor Bill Sheffield, the Alaska Department of Fish and Game, Chief of Staff for Senate Finance Committee Chair John Binkley, and Senate Fisheries Committee aide.

Education

B.A. in Journalism, University of California, Berkeley, 1973. Phi Beta Kappa.

Publications

- Calder, J., McCammon, M. et al., Observations for climate: an Integrated International Approach to Arctic Ocean Observatories for Society: A Legacy of the International Polar Year; white paper, Proceedings of OceanObs09. 2010.
- Colt, S.; Fay, G.; and McCammon, M.; A Simple Effective Project Selection System for the Alaska Ocean Observing System, Marine Technology Society Journal, Volume 45, No. 1, p 68-74.
- Markon, C.J., Trainor, S.F., and Chapin, F.S., III, eds., 2012. The United States National Climate Assessment – Alaska Technical Regional Report: U.S. Geological Survey Circular 1379, 148 p.
- McCammon, M. co-author “Bering Strait chapter”: Arctic Marine Shipping Assessment 2009 Report, Arctic Council, April 2009.
- Schoch, G.C., McCammon, M., Demonstrating the Alaska Ocean Observing System in Prince William Sound, Continental Shelf Research – Volume 63, Supplement, July 2013.
- Schoch, G. C., McCammon, M., et al., Integrated Observing and Forecasting for Prince William Sound, Bulletin of the American Meteorological Society – Volume 92, Number 8, Aug 2011.

Carol D. Janzen, Ph.D.
Curriculum Vitae

Education

- 2000 Ph.D. Marine Studies/Physical Oceanography**, University of Delaware, USA
NSF Coastal Oceanography Graduate Fellowship Award (1996-2000)
- 1996 M.S. Marine Studies/Oceanography**, University of Delaware, USA
- 1986 B.S. Oceanography**, University of Washington, USA

Professional Summary

- 06/2015 - * **Director of Operations**, Alaska Ocean Observing System, Anchorage, AK, USA
- 07/2006-06/2015 **Senior Oceanographer**, Sea-Bird Electronics, Inc, Bellevue, WA, USA
- 11/2002-08/2006 **Research Scientist-Physical Oceanographer**,
School of Marine Sciences, University of Maine, Orono, ME, USA
- 09/2000-10/2002 **Physical Oceanographer (Post-Doctoral Researcher)**,
School of Ocean Sciences, University of Wales (Bangor), Menai Bridge, Anglesey, UK
- 06/1993-08/2000 **Research Assistant-Graduate Student (M.S. 1996, Ph.D. 2000)**,
Graduate College of Marine Studies, University of Delaware, Newark, DE, USA
- 01/1989-06/1993 **Ecology Supervisor-Oceanographer**,
Washington State Department of Ecology, Olympia, WA, USA
- 05/1985-12/1988 **Assistant Scientist-Oceanographer**, Envirosphere Company, Bellevue, WA, USA

Professional Activities:

- 2007 - 2015 Industry Representative, NANOOS Regional Association Governing Council for IOOS
- 2006 - 2014 External Graduate Faculty Member, University of Maine
- 2011 - * Marine Technology Society Oceanographic Instrumentation Committee Chair
- 2004-2006 Alliance for Coastal Technologies Technical Coordinator, GOMOOS, NE Region

Select Relevant Publications

- Murphy, D.J., **C. D. Janzen**, 2015. Designing CTDs to meet the challenges of monitoring climate change in the ocean, Marine Technology Society Journal, May/June 2015 Vol 49, No. 3, pp. 50-55.
- **Janzen, C.**, and E. Creed, 2011. Physical oceanographic data from Seaglider trials in stratified coastal waters using a new pumped payload CTD. Proceedings of OCEANS 2011 MTS/IEEE, Kona, Hawaii, USA, September 19-23, 2011.
- Edwards, B., **C. Janzen**, D. Murphy, N. Larson, 2010. Calibration response and hysteresis in deep sea dissolved oxygen measurements. Journal of Atmospheric and Oceanic Technology, 27(5). DOI:10.1175/2009JTECHO693.1
- **Janzen, C.**, 2009. Considerations for CTD spatial and temporal resolution on moving platforms. In: Ocean News and Technology, Vol. 15, Issue 6, pp. 54-55.
- **Janzen, C.D.**, Jim Churchill, Neal Pettigrew, 2005. Observations of bay/shelf exchange between eastern Casco Bay and the western Gulf of Maine. Deep-Sea Research Part II: Special Issue: The Ecology and Oceanography of Toxic Alexandriumfunyense Blooms in the Gulf of Maine, Ed. D.M Anderson, D.W. Townsend, D.J. McGillicuddy, and J.T. Turner, Vol. 52, Issue 19-21 September-October 2005, pp. 2411-2429. DOI 10.1016/j.dsr2.2005.06.032
- **Janzen, C.D.**, J.H. Simpson, M.E. Inall, F. Cottier, 2005. Across-sill circulation near a tidal mixing front in a broad fjord. Continental Shelf Research, 25, pp. 1805-1824.
- **Janzen, C.D.**, K.-C. Wong, 2002. Wind forced dynamics at the estuary-shelf interface of a large coastal plain estuary. Journal of Geophysical Research, Vol. 107, No. C10.
- **Janzen, C.D.**, 1992. Marine Water Column Ambient Monitoring Plan, Final Report. Prepared for the Washington State Department of Ecology and the Puget Sound Water Quality Authority, Pub.No. 92-23, Olympia, WA.
- **Janzen, C. D.**, K. S. Short, L. E. Hachmeister, 1991. Long-term marine water quality and climatological trends in the Pacific Northwest. Oral presentation and Paper, Oceans' 91 Conference, Oceanic Engineering Society, Institute of Electrical and Electronics Engineers, Honolulu, HI. 1991 IEEE Oceans Proceedings, Vol. 2, No. 91CH3063-5, pp. 1044-1048.
- Short, K.S., **C.D. Janzen**, C.J. Van Zee, and D.J. Hanzlick, 1991. Oceanography. In: 1987 Final Report for the Endicott Environmental Monitoring Program, Volume 3, Part II, Chapter 3. Prepared by Envirosphere Company for the U.S. Army Corps of Engineers, Alaska District, Anchorage, AK.

MARK F. BAUMGARTNER

Biology Department
Woods Hole Oceanographic Institution
Woods Hole, MA 02543

Phone: (508) 289-2678
Fax: (508) 457-2134
Email: mbaumgartner@whoi.edu

PROFESSIONAL PREPARATION

Oregon State University, 2002, Ph.D. in Biological Oceanography with Statistics minor.

University of Southern Mississippi, 1995, M.S. in Oceanography.

University of Notre Dame, 1990, B.S. in Mathematics and Computer Science.

APPOINTMENTS

Woods Hole Oceanographic Institution, Biology Department, Woods Hole, Massachusetts. Associate Scientist with Tenure (2014-Present), Associate Scientist (2009-2014), Assistant Scientist (2005-2009), Postdoctoral Investigator (2004-2005), Ocean Life Institute Postdoctoral Scholar (2002-2004).

Oregon State University, College of Oceanic and Atmospheric Sciences, Corvallis, Oregon. NASA Earth System Science Fellow (1999-2002), NASA Space Grant Fellow (1998-1999).

Woods Hole Oceanographic Institution, Physical Oceanography Department, Woods Hole, Massachusetts. Research Associate (1996-1998); Research Assistant (1995-1996).

National Marine Fisheries Service, Stennis Space Center, Bay St. Louis, Mississippi. Computer Specialist (1992-1995).

TEN PUBLICATIONS RELATED TO PROPOSED PROJECT

Baumgartner, M.F., K.M. Stafford, P. Winsor, H. Statscewich, and D.M. Fratantoni. 2014. Glider-based passive acoustic monitoring in the Arctic. *Marine Technology Society Journal* 40(5):40-51.

Baumgartner, M.F., D.M. Fratantoni, T.P. Hurst, M.W. Brown, T.V.N. Cole, S.M. Van Parijs, and M. Johnson. 2013. Real-time reporting of baleen whale passive acoustic detections from ocean gliders. *Journal of the Acoustical Society of America* 134:1814-1823.

Baumgartner, M.F., N.S.J. Lysiak, H.C. Esch, A.N. Zerbini, C.L. Berchok, and P.J. Clapham. 2013. Associations between North Pacific right whales and their zooplanktonic prey in the southeastern Bering Sea. *Marine Ecology Progress Series* 490:267-284.

Baumgartner, M.F. and S.E. Mussoline. 2011. A generalized baleen whale call detection and classification system. *Journal of the Acoustical Society of America* 129:2889-2902.

Baumgartner, M.F., N.S.J. Lysiak, C. Schuman, J. Urban-Rich, and F.W. Wenzel. 2011. Diel vertical migration behavior of *Calanus finmarchicus* and its influence on right and sei whale occurrence. *Marine Ecology Progress Series* 423:167-184.

Baumgartner, M.F. and D.M. Fratantoni. 2008. Diel periodicity in both sei whale vocalization rates and the vertical migration of their copepod prey observed from ocean gliders. *Limnology and Oceanography* 53: 2197-2209.

Baumgartner, M.F., L. Freitag, J. Partan, K. Ball and K. Prada. 2008. Tracking large marine predators in three dimensions: the Real-time Acoustic Tracking System. *IEEE Journal of Oceanic Engineering* 33:146-157.

Baumgartner, M.F., S.M. Van Parijs, F.W. Wenzel, C.J. Tremblay, H.C. Esch, and A.M. Warde. 2008. Low frequency vocalizations attributed to sei whales (*Balaenoptera borealis*). *Journal of the Acoustical Society of America* 124:1339-1349.

Baumgartner, M.F. and B.R. Mate. 2005. Summer and fall habitat of North Atlantic right whales inferred from satellite telemetry. *Canadian Journal of Fisheries and Aquatic Sciences* 62:527-543.

Baumgartner, M.F. and B.R. Mate. 2003. Summertime foraging ecology of North Atlantic right whales. *Marine Ecology Progress Series* 264:123-135.

Lauren E. Bell

Sitka Sound Science Center
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Sitka, AK 99835
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EDUCATION

University of Alaska Fairbanks, School of Fisheries and Ocean Sciences, Fairbanks, AK M.S. Marine Biology	8/12 - 5/15
Stanford University, Stanford, CA B.S. Biology. Honors in Marine Biology, with distinction	9/07 - 6/11
Stanford's Hopkins Marine Station, Monterey, CA	3/09 - 9/10
University of Queensland, Brisbane, QLD, Australia	9/09 - 12/09

RESEARCH/ANALYTICAL EXPERIENCE

Research Technician , contractor with the Sitka Sound Science Center Field Coordinator for AK Electronic Monitoring Study, in association with Archipelago Marine Research <ul style="list-style-type: none">• Installed, maintained electronic monitoring systems on longline fishing vessels across coastal AK• Oversaw dockside monitoring at delivery, including species identification of rockfish bycatch• Preliminary analysis of all video and sensor data to ensure data quality and program compliance Biologist and Mentor, Coastal Resilience Abalone and Kelp Project, in association with ADF&G and USCGA <ul style="list-style-type: none">• Co-authored study and field methods for pinto abalone population status surveys• Established permanent kelp bed and subtidal monitoring sites, conducted underwater surveys• Mentored two USCGA cadets on scientific method, field practices and data quality and analysis	3/15 - present
Research Assistant , School of Fisheries and Ocean Sciences, University of Alaska Fairbanks, Iken lab Fieldwork in the Chukchi and Beaufort Seas as part of two major, multi-year Arctic biological surveys <ul style="list-style-type: none">• Collected, processed, identified and analyzed water and POM samples from CTD deployments, surface sediments and infaunal invertebrates from bottom grabs, and zooplankton, epifaunal invertebrates and fish from pelagic and benthic trawls for isotopic signatures and food web analysis• Assisted in winter nearshore habitat and faunal surveys under thick landfast ice using SCUBA	8/12 - 5/15
Research Technician , GulfWatch Alaska Project. PIs: Katrin Iken, Brenda Konar Fieldwork out of the Kasitsna Bay Laboratory in Kachemak Bay, Alaska <ul style="list-style-type: none">• Assisted in long-term monitoring surveys of intertidal rocky shores and eelgrass beds• Documented field effort and created a promotional video for the GulfWatch project	4/14 - 7/14
Research Assistant , Hopkins Marine Station, Stanford University, Gilly lab Fieldwork in the Gulf of California, Mexico on the <i>R/V New Horizon</i> (Scripps Institute) <ul style="list-style-type: none">• Captured Humboldt squid and performed behavioral and physiological analyses of escape responses• Programmed and deployed National Geographic's CRITTERCAM on Humboldt squid• Cataloged and analyzed video footage and data acquired from CRITTERCAM deployments	1/10 - 5/11

PUBLICATIONS

- Bell LE, Iken K, Bluhm BB (in review) The influence of terrestrial matter in marine food webs of the Beaufort Sea shelf and slope. *Mar Ecol Prog Ser*
- Bell LE, Iken K, Norcross BL (2014) Under-ice sampling through thick landfast ice in the eastern Beaufort Sea. In: Eckert G, Keller S, Tamone S (eds), *Diving for Science 2014. Proceedings of the American Academy of Underwater Sciences 33rd Symposium (72-75)*. Dauphin Island, AL: American Academy of Underwater Sciences.
- Rosen H, Gilly W, Bell L, Abernathy K, Marshall G (2015) Chromogenic behaviors of the Humboldt Squid, (*Dosidicus gigas*), studied *in situ* with an animal-borne video package. *J Exp Biol* 218: 265-275
- Gilly WF, Zeidberg LD, Booth JAT, Stewart JS, Marshall G, Abernathy K, Bell LE (2012) Locomotion and behavior of Humboldt squid, *Dosidicus gigas*, in relation to natural hypoxia in the Gulf of California, Mexico. *J Exp Biol* 215:3175-3190

Robert Bochenek
Information Architect
Axiom Data Science LLC, 1016 W. 6th Ave Suite 105, Anchorage, AK 99501, USA

Experience Summary: Extensive background and experience developing cyberinfrastructure tools for marine science data. Currently involved in the DMAC support of AOOS, CeNCOOS and SECOORA, all regional associations of the national IOOS Program. Key architectural role in several IOOS funded projects including the development of the 52 North IOOS SOS stack, IOOS scalability experiment and the IOOS Systems Integration Test. Expertise in data management and the development of cyberinfrastructure for large scale federal and regional scientific marine research efforts for the last 15 years. Founder of Axiom Data Science to focus on broader multi-agency efforts to manage scientific data via an end-to-end systems approach.

Education 2001, University of Michigan, Aerospace Engineering, B.S.E.

Appointments

2013 – Present Co-Lead, Central and Northern California Ocean Observing System (CeNCOOS), Moss Landing, CA
2010 – Present Technical Lead, Alaska Ocean Observing System (AOOS), Anchorage, AK
2006 – Present Information Architect, Axiom Data Science, Anchorage, AK
2003 – 2006 Data Systems Manager, Exxon Valdez Oil Spill Trustee Council (EVOSTC), Anchorage AK, 99504
2001 – 2002 Analyst Programmer, Alaska Department of Fish & Game, Anchorage, AK

Products

Bochenek, R.B., S. StClaire, B.Stone (2012), AOOS Arctic Portal . Accessible from http://portal.aaos.org/?v=rand&portal_id=3.

Bochenek, R.B., S. StClaire, D. Snowden, L. Finfrock (2013), IOOS Sensor Observation Service. Accessible from <http://ioossos.axiomalaska.com/>.

Bochenek, R.B., S. StClaire, Lance Finfrock (2013), Central and Northern California Data System. Accessible from <http://data.cencoos.org/>.

Bochenek, R.B., S. StClaire ,B.Stone, Lance Finfrock (2013), Gulf Watch Data Portal . Accessible from <http://www.gulfwatch.org/>.

Bochenek, R.B., S. StClaire, B.Stone (2012), Alaska Ocean Observing System Data Management System. Accessible from <http://data.aaos.org>.

Synergistic Activities

2015 – Present Core member of IOOS coordinated Marine Biodiversity Observation Network DMAC team. Leading the Arctic MBON and co-leading the Monterey Bay/Florida Marine Sanctuaries DMAC efforts.
2012 – 2014 Funded under the NOAA High Performance Computing program for exploratory research in applying HPC concepts to serving and visualizing gridded multidimensional models and observational data sets
2011 – Present Member of the IOOS Sensor Observation Service standardization Committee
2010 – Present Member of the Alaska Data integration Working Group (ADIWG) focused on developing frameworks for interchange of scientific information across Alaskan Agencies.

CURRICULUM VITAE

Yi Chao

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Education

Ph.D. 1988-1990, Atmospheric and Oceanic Sciences Program, Princeton University

M.A. 1985-1987, Geophysical Fluid Dynamics Program, Princeton University

B.Sc. 1980-1985, Atmospheric Physics, University of Science and Technology of China

Employment

2012-present, Principal Scientist, Remote Sensing Solutions, Inc.

2007-present, Adjunct Professor, Department of Atmospheric and Oceanic Sciences and Joint Institute for Regional Earth System Science and Engineering (JIFRESSE), UCLA

1993-2011, Scientist, Research Scientist, Principal Scientist, Aquarius Project Scientist, JPL

Five publications most closely related to the proposed project

Chao, Y., Z. Li, J. D. Farrara, and P. Huang: Blended sea surface temperatures from multiple satellites and in-situ observations for coastal oceans. *Journal of Atmospheric and Oceanic Technology*, 26 (7), 1435-1446, 10.1175/2009JTECHO592.1, 2009.

Chao, Y., Z. Li, J. Farrara, J. C. McWilliams, J. Bellingham, X. Capet, F. Chavez, J.-K. Choi, R. Davis, J. Doyle, D. Frantaoni, P. P. Li, P. Marchesiello, M. A. Moline, J. Paduan, S. Ramp: Development, implementation and evaluation of a data-assimilative ocean forecasting system off the central California coast. *Deep-Sea Research II*, 56, 100-126, 2009.

Chao, Yi, Zhijin Li, John D. Farrara, Mark A. Moline, Oscar M. E. Schofield, and Sharanya J. Majumdar: Synergistic applications of autonomous underwater vehicles and the regional ocean modeling system in coastal ocean forecasting. *Limnology and Oceanography*, 53, 2251-2263, 2008.

Li, Z., Y. Chao, J.C. McWilliams, and K. Ide (2009) A Three-Dimensional Variational Data Assimilation Scheme for the Regional Ocean Modeling System. *Journal of Atmospheric and Oceanic Technology*, 25, 2074-2090.

Li, Z., Y. Chao, J. C. McWilliams, and K. Ide (2008) A three-dimensional variational data assimilation scheme for the Regional Ocean Modeling System: Implementation and basic experiments. *Journal of Geophysical Research (Oceans)*, 113, C05002, doi:10.1029/2006JC004042.

Five other significant publications

Farrara, J.D., Yi Chao, Z. Li, X. Wang, X. Jin, H. Zhang, P.P. Li, Q. Vu, P.Q. Olsson, G.C. Schoch, M. Halverson, M.A. Moline, C. Ohlmann, M. Johnson, J.C. McWilliams, F.A. Colas (2013) A data-assimilative ocean forecasting system for the Prince William sound and an evaluation of its performance during sound Predictions 2009, *Continental Shelf Research*, Vol. 63, Supplement 15, S193-S208.

Li, Z., Yi Chao, J.D. Farrara, J.C. McWilliams (2013) Impacts of distinct observations during the 2009 Prince William Sound field experiment: A data assimilation study, *Continental Shelf Research*, Vol. 63, Supplement 15, S209-S222.

Wang, X., Yi Chao, D.R. Thompson, S.A. Chien, J. Farrara, P. Li, Q. Vu, H. Zhang, J.C. Levin, A. Gangopadhyay (2013) Multi-model ensemble forecasting and glider path planning in the Mid-Atlantic Bight, *Continental Shelf Research*, Vol. 63, Supplement 15, S223-S234.

Wang, X., Yi Chao, H. Zhang, J. Farrara, Z. Li, X. Jin, K. Park, F. Colas, J.C. McWilliams, C. Paternostro, C.K. Shum, Y. Yi, C. Schoch, P. Olsson (2013) Modeling tides and their influence on the circulation in Prince William Sound, Alaska, *Continental Shelf Research*, Vol. 63, Supplement 15, S126-S137.

Colas, F., X. Wang, X. Capet, Yi Chao, J.C. McWilliams (2013) Untangling the roles of wind, run-off and tides in Prince William Sound, *Continental Shelf Research*, Vol. 63, Supplement 15, S79-S89.

Jessica Cross

Postdoctoral Research Associate

Cooperative Institute for Alaska Research

University of Alaska, Fairbanks

7600 Sand Point Way NE, Seattle, WA 98115

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Jessica.Cross@NOAA.gov

Curriculum Vitae

EDUCATION

University of Alaska-Fairbanks, School of Fisheries and Ocean Sciences

- **Ph.D., Chemical Oceanography** **2008-2013**
- Dissertation: "Carbon Biogeochemistry of the Eastern Bering Sea Shelf."
- Major Advisor: Dr. Jeremy Mathis
- GPA: 3.72 of 4.0

Rhodes College

- **B.S., Chemistry** **2004-2008**
 - Research: Computational modeling of quantum mechanical systems
 - GPA: 3.2 of 4.0
-

RESEARCH

Research focuses on carbon biogeochemistry and ocean acidification in Arctic regions, and especially along the Alaskan coast. Focus is on understanding how acidification processes interact with natural biogeochemical cycles, and how to detect geochemical and biological impacts of OA.

SELECT PUBLICATIONS AND PRESENTATIONS

- **Cross, J.N.**, Mordy, C.W., Tabisola, H.M., Meinig, C., Cokelet, E.D., and Stabeno, P.J., 2015. Innovative Technology Development for Arctic Exploration. *Oceans 2015 MTS/IEEE Washington, D.C., Sea Change: Dive into Opportunity*, accepted.
- Mathis, J.T., Monacci, N.M., **Cross, J.N.**, Hopcroft, R.A., and Stockwell, D.A., 2015. The physical and biological influences on Ocean Acidification in the northern Gulf of Alaska. *Journal of Geophysical Research – Oceans*, submitted.
- Evans, W., Mathis, J.T., **Cross, J.N.**, Bates, N.R., Frey, K.E., and Else, B.G.T., et al., 2015. Sea-air CO₂ exchange in the western Arctic coastal ocean. *Global Biogeochemical Cycles*, 29, doi: 10.1002/2015GB005153.
- Mathis, J.T., and **Cross, J.N.**, Evans, W., and Doney, S.C., 2015. Ocean acidification in the Pacific-Arctic Region. *Oceanography Magazine*, 28(2), 122-135.
- Mathis, J.T., Cooley, S.R., Lucey, N., Hauri, C., Ekstrom, J., Hurst, T., Colt, S., Evans, W., **Cross, J.N.**, and Feely, R.A., 2014. Ocean Acidification Risk Assessment for Alaska's Fisheries Sector. *Progress in Oceanography*, 136, 71-91, doi: 10.1016/j.pocean.2014.07.001.
- **Cross, J.N.**, Mathis, J.T., Frey, K.E., Cosca, C., Danielson, S.L., Bates, N.R., Feely, R.A., Takahashi, T., and Evans, W., 2014. Annual sea-air CO₂ fluxes in the Bering Sea: Insights from new autumn and winter observations of a seasonally ice-covered continental shelf. *Journal of Geophysical Research – Oceans*, 119, doi: 10.1002/2013JC009579
- **Cross, J.N.**, Mathis, J.T., Lomas, M.W., Moran, S.B., Grebmeier, J., Shull, D., Mordy, C.W., Stabeno, P.J., Sambrotto, R., Gradinger, R., Juranek, L., Prokopenko, M., and Baumann, M.S., 2014. Integrated assessment of the carbon budget in the Southeastern Bering Sea. *Deep Sea Research II*, 109, 112-124, doi: 10.1016/j.desr2.2014.03.003.

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Professional Preparation:

University of Alaska Fairbanks, Ph.D. Oceanography, 2012
University of Alaska Fairbanks; M.S. Oceanography, 1996
Lehigh University; B.S. Electrical Engineering, 1990, with honors

Appointments:

Research Assistant Professor of Oceanography, IMS-UAF, Fairbanks, AK, 2013-present
Research Professional, Institute of Marine Science, UAF, Fairbanks, AK, 1997–2013
Driller, Polar Ice Coring Office, IMS-UAF, Fairbanks AK, 1993-1994 and UNL, Lincoln, NB, 1996-1997
Research Assistant, Institute of Marine Science, UAF, Fairbanks, AK, 1994-1996
Junior Engineer, Allen Organ Company, Macungie, PA, 1990-1992

Selected Peer-Reviewed Publications:

Danielson, S. L., L. Eisner, C. Ladd, C. Mordy, L. de Sousa, and T. J. Weingartner (submitted), A comparison between late summer 2012 and 2013 water masses, macronutrients, and phytoplankton standing crops in the northern Bering and Chukchi Seas, Arctic Eis DSR-II Special Issue

Danielson, S. L., T. W. Weingartner, K. Hedstrom, K. Aagaard, R. Woodgate, E. Curchitser, and P. Stabeno, (2014), Coupled wind-forced controls of the Bering–Chukchi shelf circulation and the Bering Strait through- flow: Ekman transport, continental shelf waves, and variations of the Pacific–Arctic sea surface height gradient. *Prog. Oceanogr.* <http://dx.doi.org/10.1016/j.pocean.2014.04.006>

Pickart, R.S., L.M. Schulze, G.W.K. Moore, M.A. Charette, K. R. Arrigo, G. van Dijken, **S. L. Danielson**, (2013), Long-term trends of upwelling and impacts on primary productivity in the Alaskan Beaufort Sea, *Deep Sea Res. Part I: Oceanographic Research Papers*, Volume 79, September 2013, <http://dx.doi.org/10.1016/j.dsr.2013.05.003>.

Weingartner, T. E. Dobbins, **S. Danielson**, P. Winsor, R. Potter, H. Statscewich (2013), Hydrographic variability over the northeastern Chukchi Sea shelf in summer-fall 2008–2010, *Cont. Shelf Res.* ISSN 0278-4343, <http://dx.doi.org/10.1016/j.csr.2013.03.012>

Danielson, S., T. Weingartner, K. Aagaard, J. Zhang, and R. Woodgate (2012), Circulation on the central Bering Sea shelf, July 2008 to July 2010, *JGR*, 117, C10003, doi:10.1029/2012JC008303.

Weingartner, T.J., **S. L. Danielson**, Y. Sasaki, V. Pavlov and M. Kulakov (1999), The Siberian Coastal Current: A wind- and buoyancy-forced Arctic coastal current, *JGR*; 104; C12; 29,697-29,713

Related activities:

1997-present: Monitoring at oceanographic station GAK1 in the Gulf of Alaska (NSF/EVOS/NPRB)
2007-2014: Bering Sea Ecosystem Study (BEST) moorings and larval transport modeling (NSF)
2008-2014: Chukchi Sea Environmental Studies Program (CSESP, Shell/Conoco Phillips/Statoil)
2010-2013: co-PI, Adaptation of an Arctic Circulation Model (BOEM)
2012-present: co-PI, Arctic Ecosystem Integrated Survey (CIAP; BOEM)
2013-present: PI, Bering-Chukchi transport pathways (NPRB #1302)
2014-present: co-PI, Coastal Community Ocean Observations (NPRB #1415)
2014-present: PI, Ecosystem monitoring and detection of wind and ice-mediated changes through a year-round physical and biogeochemical mooring in the Northeast Chukchi Sea (NPRB #1426, AOOS, Olgoonik-Fairweather, UAF)
2015-present: co-PI, Arctic Marine Biodiversity Observing Network (AMBON; NOPP/Shell)

HAJO EICKEN

**International Arctic Research Center, University of Alaska Fairbanks, P.O. Box 757340,
Fairbanks, AK 99775-7340 phone: 907-474-7280, e-mail: heicken@alaska.edu**

EDUCATION

December 1990 Ph. D. degree (Natural Sciences) from the University of Bremen, Germany
January 1988 Diploma Degree in Mineralogy, Technical University of Clausthal, Germany

EMPLOYMENT

April 2015 - present: Interim Director, International Arctic Research Center, UAF
September 2014 - March 2015: Deputy Director, International Arctic Research Center,
University of Alaska Fairbanks (UAF)
March 2009 - present: Joint appointment as Professor of Geophysics at the Geophysical
Institute, Dept. of Geology and Geophysics and International Arctic Research Center,
UAF
July 2007 - present: Professor of Geophysics / Sea-ice geophysicist at the Dept. of Geology
and Geophysics and the Geophysical Institute, UAF
March 1998 - June 2007: Associate Professor of Geophysics / Sea-ice geophysicist at the
Dept. of Geology and Geophysics and the Geophysical Institute, UAF
October 1995 - February 1998: Senior scientist at the Alfred Wegener Institute for Polar and
Marine Research in Bremerhaven, Germany (Department of Oceanic and Atmospheric
Physics, head of research group "Sea ice physics and remote sensing")
August 1992 - September 1995: Employment as staff scientist at the Alfred Wegener
Institute (Department of Oceanic and Atmospheric Physics)
February 1991 - July 1992: Employment as Postdoctoral scientist at the Alfred Wegener
Institute (Department of Geophysics and Glaciology)
May 1988 - January 1991: Employment as Ph. D. student at the Alfred Wegener Institute
(Department of Geophysics and Glaciology)
January - April 1988: Visiting Scientist at the Cold Regions Research and Engineering
Laboratory, Hanover, N. H.

SELECT PUBLICATIONS

Select Books, Chapters, and Journal Articles

Eicken, H., Mahoney, A.R. (2015) Sea ice: Hazards, risks and implications for disasters. In:
Ellis, J., Sherman, D. (Eds.), Sea and ocean hazards, risks and disasters. Elsevier, Oxford.
Lovecraft, A. L., and H. Eicken (eds., 2011) North by 2020: Perspectives on Alaska's
changing social-ecological systems. University of Alaska Press, 736pp. (author or co-
author of six chapters in the book)
Eicken, H., J. Jones, Rohith MV, C. Kambhamettu, F. Meyer, A. Mahoney, M. L.
Druckenmiller (2011) Environmental security in Arctic ice-covered seas: From strategy
to tactics of hazard identification and emergency response. *Marine Technol. Soc. J.*, 45(3), 37-48.
Krembs, C., H. Eicken, J. W. Deming (2011) Exopolymer alteration of physical properties
of sea ice and implications for ice habitability and biogeochemistry in a warmer Arctic. *PNAS*,
108(9), 3653-3658.
Eicken, H. (2010) Indigenous knowledge and sea ice science: What can we learn from
indigenous ice users? In: SIKU - Knowing our ice - Documenting Inuit sea ice
knowledge and use; edited by I. Krupnik, C. Aporta, S. Gearheard, L. Kielsen Holm, G.Laidler.
Springer, Berlin, pp. 357-376.
Eicken, H., A. L. Lovecraft, and M. L. Druckenmiller (2009) Sea-ice system services: A
framework to help identify and meet information needs relevant for Arctic observing
networks. *Arctic*, 62(2), 119-136

Synergistic Activities

Co-Chair (2009) and member (2010-), Steering Committee of World Climate Research
Program Climate and the Cryosphere (CliC) Arctic Sea Ice Working Group
Member, Science Steering Committee of Scientific Committee on Antarctic Research
(SCAR) Program "Antarctic Sea Ice Processes and Climate" (ASPeCt), 1997-2004

Resume

Kristine (Kris) Holderied

National Oceanic and Atmospheric Administration (NOAA) Kasitsna Bay Laboratory
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WORK EXPERIENCE

- NOAA, National Ocean Service, National Centers for Coastal Ocean Science,
Kasitsna Bay Laboratory. Homer, AK 09/2005- present
Director/Supervisory Oceanographer: NOAA Director for the Kasitsna Bay Laboratory, a subarctic coastal marine ecosystem laboratory operated in partnership with the University of Alaska Fairbanks (UAF). Develop and implement science and operations plans for the lab. Manage facility operations and construction. Coordinate research and education activities with regional partners, including local, state, and federal agencies, Alaska Native organizations, universities, public schools and non-profit education and conservation groups. Mentor NOAA graduate students and interns. Science lead for "Gulf Watch Alaska", a 5-year, \$12 million, multiagency ecosystem monitoring and synthesis program to support management of resources injured by the Exxon Valdez oil spill.
- NOAA, National Ocean Service, National Centers for Coastal Ocean Science,
Center for Coastal Monitoring and Assessment. Silver Spring, MD 06/2000-09/2005
Physical Scientist: Developed innovative technical solutions to address internal NOAA and external customer needs for remote sensing products and services in U.S. coastal regions. Used satellite data to map benthic habitats in support of NOAA's Coral Reef Program and developed applications of satellite-derived information to address issues with harmful algal blooms, estuarine and coastal eutrophication and climate change. Served as technical representative on remote sensing, habitat mapping and water quality sensor development contracts.
- Old Dominion University, Center for Coastal Physical Oceanography. Norfolk, VA 11/1996-06/2000
Graduate Research Assistant: Planned and conducted observational studies of density and circulation in the Chesapeake Bay, Inland Sea of southern Chile, and Gulf of California, Mexico.
- U.S. Army Corps of Engineers, Norfolk District. Norfolk, VA 01/1992-11/1996
Oceanographer: Project manager for environmental compliance projects, a navigation study, and a three-year water quality sampling program. Led development and technical management of multi-year, multi-million dollar delivery order contracts for Army training area management and general environmental compliance support for Federal facilities across the U.S.
- GE Government Services. Norfolk, VA 11/1991-01/1992
Systems Engineer (acoustics): Developed a training course in ocean acoustics.
- U.S. Navy active duty - Rota, Spain; Cambridge, MA; Norfolk, VA; Bay St Louis, MS 05/1984-09/1991
Naval Officer (Oceanographer): Provided meteorological, acoustic and tactical environmental forecasts to naval and merchant marine ships and aircraft in the North Atlantic Ocean and Mediterranean, Red and Black Seas. Provided local meteorological forecasts for Rota, Spain and Norfolk, VA. Managed divisions of up to 12 people, with responsibility for personnel supervision, training and administration.

EDUCATION

- Massachusetts Institute of Technology/Woods Hole Oceanographic Institute, M.S. 1988,
Physical Oceanography, Cambridge MA.
U.S. Naval Academy, B.S. 1984, Oceanography, Annapolis MD. Valedictorian.

Russell Ross Hopcroft
Institute of Marine Science, University of Alaska Fairbanks
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PROFESSIONAL PREPARATION:

University of Guelph, Ontario, Canada	Marine Biology	B.Sc. 1983
University of Guelph	Marine Ecology	M.Sc. 1988
University of Guelph	Marine Biology	Ph.D. 1997
Monterey Bay Aquarium Research Institute (MBARI)	Zooplankton Ecology	1997-1999
University of Massachusetts Dartmouth	Zooplankton Ecology	1999-2000

APPOINTMENTS:

Professor, Institute of Marine Science, University of Alaska Fairbanks, 2010-present
Associate Professor, Institute of Marine Science, University of Alaska Fairbanks, 2005-2010
Assistant Professor, Institute of Marine Science, University of Alaska Fairbanks, 2000-2005

MOST RELEVANT PUBLICATIONS: (out of 88)

Sousa, L., K.O. Coyle, R.P. Barry, T.J. Weingartner, **R.R. Hopcroft**, *accepted*. Climate-related variability in abundance of mesozooplankton in the northern Gulf of Alaska 1998-2009. *Deep-Sea Res. II*.

Coyle, K.O., G.A. Gibson, K. Hedstrom, A. Hermann, & **R.R. Hopcroft**. 2013. Zooplankton biomass, advection and production on the northern Gulf of Alaska shelf from simulations and field observations. *J. Mar. Sys.* **128**: 185-207.

Mundy, P., D. Allen, J.L. Boldt, N.A. Bond, S. Dressel, E. Farley Jr., D. Hanselman, J. Heifetz, **R.R. Hopcroft**, M.A. Janout, C. Ladd, R. Lam, P. Livingston, C. Lunsford, J.T. Mathis, F. Mueter, C. Rooper, N. Sarkar, K. Shotwell, M. Sturdevant, A.C. Thomas, T.J. Weingartner & D. Woodby. 2010. Status and trends of the Gulf of Alaska Coastal region, 2003-2008. pp. 142-195. *In*: S.M. McKinnell & M. Dagg (ed.) *Marine Ecosystems of the North Pacific Ocean; 2003-2008. PICES Spec. Pub. 4. 393p.*

Pinchuk, A.I., K.O. Coyle & **R.R. Hopcroft**. 2008. Climate-related variability in abundance and reproduction of euphausiids in the northern Gulf of Alaska in 1998-2003. *Prog. Oceanogr.* **77**: 203-216.

Liu, H. & **R.R. Hopcroft**. 2007. A comparison of seasonal growth and development of the copepods *Calanus marshallae* and *C. pacificus* in the northern Gulf of Alaska. *J. Plankton Res.* **29**: 569-581.

Educational web-pages:

<http://www.arcodiv.org/index.html>

<http://www.sfos.uaf.edu/sewardline/>

<http://www.oceanexplorer.noaa.gov/explorations/05arctic/welcome.html>,

<http://www.oceanexplorer.noaa.gov/explorations/02arctic/welcome.html>,

<http://oceanexplorer.noaa.gov/explorations/09arctic/welcome.html>

Graduate Students: Imme Rutzen, Jennifer Questel, Heather Oleson, Elizaveta Ershova (all Ph.D. *in progress*); Caitlin Smoot (M.Sc. *in progress*); Ayla Doubleday (M.Sc.2013), Jenefer Bell (M.Sc.2009), Laura Slater (M.Sc. 2004), Hui Liu (Ph.D. 2006), Alexei Pinchuk (Ph.D. 2006)

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Education

MARCH 2011 PhD in Earth & Planetary Sciences • University of California, Santa Cruz
MAY 2006 B.A. with Honors in Geology • Colgate University • Hamilton, New York

Work & Research Experience

2010 - Present Division of Geological & Geophysical Surveys • Alaska Department of Natural Resources • Fairbanks, Alaska
Geologist IV, Coastal Hazards

2009 - 2011 U.S. Geological Survey • Western Coastal & Marine Geology • Santa Cruz, California
Graduate Student Contractor

2006 - 2010 Department of Earth & Planetary Sciences • University of California, Santa Cruz
Teaching Assistant and Graduate Researcher

2005 - 2006 Department of Geology • Colgate University • Hamilton, New York
Teaching Assistant and Undergraduate Researcher

Recent Publications and Products

DeRaps, M.R., **N.E.M. Kinsman**, D.S.P. Stevens and J.R. Smith (*submitted for peer review*), Surficial-geologic Map of Shaktoolik, Norton Bay Quadrangle, Alaska: Alaska Division of Geological & Geophysical Surveys Report of Investigation, 1 sheet.

Kinsman, N. and G.B. Griggs, 2015 (*accepted for publication*), Beach Users' Perceptions and Knowledge of Engineered Retention Structures in California, USA: ICM Coastal Management.

Kinsman, N.E.M., Gibbs, A. and Nolan, M. (*accepted for publication*), Positional uncertainty of coastline features estimated with 'structure from motion'-derived elevation data: Proceedings of Coastal Sediments 2015.

Kinsman, N.E.M., and Gould, A.R., 2014, Contemporary Shoreline Retreat Rates at Old Meshik in Port Heiden, Alaska: Alaska Division of Geological & Geophysical Surveys Preliminary Interpretive Report 2014.

Kinsman, N.E.M., and Gould, A.I., 2015 (*accepted for publication*), Collaborative, Real-Time Water Level Monitoring in Unalakleet and Tununak, Alaska: Alaska Division of Geological & Geophysical Surveys Preliminary Interpretive Report, 18 p.

Tschetter, T.J., **Kinsman, N.E.M.**, and Fish, A.M., 2014, Color-indexed elevation maps for flood-vulnerable coastal communities in western Alaska: Alaska Division of Geological & Geophysical Surveys Miscellaneous Publication 154, 20 p., 20 sheets, scale 1 inch = 500 feet. doi:10.14509/29129

Southerland, L.E., and **Kinsman, N.E.M.**, 2014, Lidar data for Unalakleet, Alaska, collected in October 27, 2005: Alaska Division of Geological & Geophysical Surveys Raw Data File 2014-2, 12 p. doi:10.14509/27121

Kinsman, N.E.M., and Gould, A.I., 2014, Coastal vulnerability mapping in Alaska: strategies for small populations in data-sparse regions (poster): Ocean Sciences Meeting, Honolulu, Hawaii, February 23-28, 2014: Alaska Division of Geological & Geophysical Surveys, 1 sheet. doi:10.14509/27202

Synergistic Activities

2015 - PRESENT State of Alaska Silver Jackets Flood Risk Management Team
Alaska Department of Natural Resources Representative

2014 - PRESENT Weather-Ready Nation Initiative • National Weather Service
State of Alaska Ambassador

2012 - PRESENT Department of Geology & Geophysics • University of Alaska, Fairbanks
Affiliated Faculty Member; Guest Lecturer in Erosion Mechanics, Environmental Decision Making

2011 - PRESENT Alaska ShoreZone
Alaska Department of Natural Resources Partnership Representative

Captain Ed Page, U.S. Coast Guard (Ret)
Executive Director, Marine Exchange of Alaska

Captain Ed Page, U.S. Coast Guard (Ret) is the Executive Director of the Marine Exchange of Alaska located in Juneau, Alaska having established the non-profit maritime organization in April 2001 after serving 29 years as a commissioned officer in the U.S. Coast Guard. The Marine Exchange provides information, communications and services to aid safe, secure, efficient and environmentally sound maritime operations.

A 1972 graduate of the U.S. Coast Guard Academy, Captain Page sailed on Coast Guard vessels sailing Atlantic, Pacific and Alaska waters followed by assignments in marine safety, environmental protection and search and rescue in the Pacific, including postings in Anchorage, Ketchikan and Juneau Alaska. Later in his career he served as Chief of Environmental Protection during the Exxon Valdez oil spill, as Captain of the Port and Group Commander for Los Angeles-Long Beach and Chief of Marine Safety and Environmental Protection for Coast Guard Pacific Area.

He is the founding Executive Director of the Marine Exchange and over the past fifteen years has developed the largest Vessel Compliance Monitoring and Response System in the world through the build out and operation of an extensive satellite and terrestrial AIS (Automatic Identification System) vessel tracking system. This real time 7x24 vessel tracking system encompasses over 1.5 million square miles of U.S. waters and is used by the Coast Guard, State of Alaska and the marine industry to locate and track vessels in Alaska and North America to aid safe, efficient and environmentally sound maritime operations. With assistance from the Alaska Ocean Observing System (AOOS) he has incorporated environmental stations at over 30 locations in Alaska that transmit weather data to mariners over the AIS network. He has also led the Marine Exchange's engagement with the Coast Guard R&D Center via a Cooperative Research and Development Agreement in developing an Arctic Next Generation Navigational Safety Information System.

Examples of innovative projects Captain Page has led the Marine Exchange's implementation of include the automated transmission of alerts to the Glacier Bay Park Service when vessels exceed the speed limits established to protect whales and the monitoring of oil exploration vessels' compliance with environmental protection measures in the Arctic. Captain Page has been responsible for the application of emerging technologies to implement several maritime safety and environmental protection initiatives in the U.S. and abroad and is presently leading several Arctic and Aleutians' marine safety initiatives.

BIOGRAPHICAL SKETCH

W. Scott Pegau

Oil Spill Recovery Institute

Box 705

Cordova, AK 99574

ph: 907-424-5800 x222

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Education:

1990 B.S., Physics, University of Alaska, Fairbanks

1996 Ph.D, Oceanography, Oregon State University

Professional Experience:

1987-1990 Research Assistant, University of Alaska, Fairbanks

1990-1996 Graduate Research Assistant, Oregon State University

1996-1997 Research Associate (Post Doc), Oregon State University

1997-1999 Faculty Research Associate, Oregon State University

1999-2010 Assistant Professor, Oregon State University

2002-2003 Senior Scientist, Kachemak Bay Research Reserve

2003-2007 Research Coordinator, Kachemak Bay Research Reserve

2007-present Research Program Manager, Oil Spill Recovery Institute

Research:

Develop novel oil spill detection and tracking approaches to understand the fate and behavior of oil spilled in cold water environments. Circulation in Prince William Sound, Cook Inlet and the Gulf of Alaska and the associated larval transport. Relationship between oceanographic conditions and fisheries. Application of remote sensing for understanding coastal processes.

Select Publications

Pegau, W. Scott, Inherent optical properties of the central Arctic surface waters, *J. Geophys Res.*, **107**, doi. 10.1029/2000JC000382, 2002.

Montes-Hugo, M. A., K. Carder, R. J. Foy, J. Cannizzaro, E. Brown, and S. Pegau, Estimating phytoplankton biomass in coastal waters of Alaska using airborne remote sensing, *Remote Sens. Environ.* **98**, 481-493, 2005.

Streever, B., R. Suydam, J.F. Payne, R. Shuchman, R.P. Angliss, G. Balogh, J. Brown, J. Grunblatt, S. Guyer, D.L. Kane, J.J. Kelley, G. Kofinas, D.R. Lassuy, W. Loya, P. Martin, S.E. Moore, W.S. Pegau, C. Rea, D.J. Reed, T. Sformo, M. Sturm, J.J. Taylor, T. Viavant, D. Williams, and D. Yokel, Environmental Change and Potential Impacts: Applied Research Priorities for Alaska's North Slope, *Arctic*, **64**, 390-397, 2011.

Moline, M.A., I. Robbins, B. Zelenke, W.S. Pegau, and H. Wijesekera, Evaluation of bio-optical inversion of spectral irradiance measured from an autonomous underwater vehicle, *J. Geophys. Res.*, **117**, 12pp., doi:10.1029/2001JC007352, 2012.

Musgrave, D.L., M.J. Halverson, and W.S. Pegau, Seasonal Surface Circulation, Temperature, and Salinity in Prince William Sound, Alaska, *Cont. Shelf Res.*, doi:10.1016/j.csr.2012.12.001, 2012

JOHN E. WALSH

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Professional Preparation:

Dartmouth College <i>Hanover, NH</i>	Mathematics and Computer Sci.	B.A. 1970
Massachusetts Institute of Technology <i>Cambridge, MA</i>	Meteorology	Ph.D. 1974

Appointments:

2003- Present	President's Professor of Global Change Chief Scientist, International Arctic Research Center
1974- Present	University of Illinois, Department of Atmospheric Sciences Professor Emeritus (2003-pres.); Professor of Meteorology (1985–2003); Associate Professor (1979–85); Assistant Professor (1974–79)
1986-1987	Naval Postgraduate School, Department of Oceanography, Monterey, CA ONR Chair in Arctic Marine Science, Visiting Professor
1977, 1983	National Center for Atmospheric Research, Boulder, CO Visiting Scientist: polar meteorology and climatology

Publications

Walsh, J.E., D. Wuebbles, K. Hayhoe, J. Kossin, K. Kunkel, G. Stephens, P. Thorne, R. Vose, M. Wehner and J. Willis, 2014: Our Changing Climate. Ch. 2 in *The Third National Climate Assessment, Climate Change Impacts in the United States* (J. M. Melillo, T.C. Richmond and G.W. Yohe (Eds.)), U.S. Global Change Research Program.

Walsh, J.E., 2014: Intensified warming of the Arctic: Causes and *impacts* on middle latitudes. *Global and Planetary Change* 117, 52-63.

Walsh, J. E., and L. D. Hinzman, 2015: Challenges, opportunities and responsibilities. Where will the USA take the Arctic Council? *The Circle*. 1, 28-29.

Walsh, J.E., 2013: Melting ice: What is happening to Arctic sea ice and what does it mean for us? *Oceanography*, 26(2), 171-181, <http://dx.doi.org/10.5670.2013.19>.

Overland, J.E., M. Wang, **J.E. Walsh** and J.C. Stroeve, 2014: Future Arctic climate changes: Adaptation and mitigation timescales. *Earth's Future*, 2, 68074, DOI: 10.1002/2013EF000162.

Wallace, J.M., I.M. Held, D.W. Thompson, K.E. Trenberth and **J.E. Walsh**, 2014: Global warming and winter weather. *Science*, 343, 729-730, doi:10.1126/science.343.6172.729.

Rauber, R. M., **J.E. Walsh**, D.J. Charlevoix (2008). *Severe and Hazardous Weather: An Introduction to High-Impact Meteorology* (3rd Edition). Kendall-Hunt, Dubuque, IA, 642 pp.

Synergistic Activities:

Editor, Journal of Climate, 2014-present
Committee on Extreme Weather Events and Climate Change Attribution, Nat. Acad. Sci., 2015-
Coordinating Lead Author, Adaptation Actions for a Changing Arctic (AMAP), 2014-
Coordinating Lead Author, Climate Science, U.S. National Climate Assessment, 2012-14
Roger Revelle Lecturer, American Geophysical Union, 2013
Graduate students advised and postdoctoral scholars sponsored: 35

THOMAS J. WEINGARTNER

EDUCATION

- Ph.D. Physical Oceanography, 1990, North Carolina State University
M.S. Physical Oceanography, 1980, University of Alaska
B.S. Biology, 1974, Cornell University

PROFESSIONAL EXPERIENCE

Institute of Marine Science, School of Fisheries and Ocean Sciences, U. of Alaska Fairbanks, Alaska

- Professor; 6/07 – present
- Associate Professor; 6/99 – 6/07
- Assistant Professor; 11/93 - 1999
- Research Associate; 9/91 - 10/93

Postdoctoral Student; Institute of Marine Science, School of Fisheries and Ocean Sciences, U. of Alaska Fairbanks, Alaska; 7/88 - 8/91

Graduate Research Assistant; Department of Marine, Earth & Atmospheric Sciences, North Carolina State U.; Raleigh, North Carolina & Dept. of Marine Science, U. S. Florida; St. Petersburg, Florida; 8/84 - 10/88

SYNERGISTIC ACTIVITIES

Workshop Organizer, Physical Oceanography Studies Needs for the Alaskan Beaufort Sea (sponsored by MMS, 2004)

Member, Science Advisory Committee, Synthesis of Arctic Research, BOEM-NOAA (2012-2015)

Member, National Research Council Committee on “Emerging Research Questions in the Arctic” (2013- present)

Member, Science Advisory Council, Alaska Sea Life Center,

Member, Science Advisory Committee, Shell-North Slope Borough Baseline Studies Program, Barrow, Alaska (2011-2015).

AWARDS

Emil Usibelli Distinguished Research Award at University of Alaska, Fairbanks

2014 Alaska Ocean Leadership Award in Marine Research

SELECT PUBLICATIONS

- Lu, K., T. Weingartner, S. Danielson, P. Winsor, E. Dobbins, K. Martini, and H. Statscewich. Lateral mixing across meltwater fronts of the Chukchi Sea shelf. (in press, *Geophysical Research Letters*)
- Kasper, J. and T. Weingartner. 2015. The spreading of a buoyant plume beneath a landfast ice cover. *Journal of Physical Oceanography* 45: 478 – 494.
- Fang, Y-C., T. J. Weingartner, R. A. Potter, H. Statscewich, P. R. Winsor. Quality Assessment of HF Radar Derived Surface Currents Using Optimal Interpolation. *Journal of Atmospheric and Oceanic Technology*, 32: 282 – 296.
- Weingartner, T., E. Dobbins, S. Danielson, R. Potter, H. Statscewich, and P. Winsor. 2013 Hydrographic variability over the northeastern Chukchi Sea shelf in summer-fall 2008–2010, *Continental Shelf Research*, 67:5 – 22. <http://dx.doi.org/10.1016/j.csr.2013.03.012>.
- Danielson, S., T. Weingartner, K. Aagaard, J. Zhang, R. Woodgate, 2012. Circulation on the central Bering Sea shelf, July 2008 to July 2010. *Journal of Geophysical Research*, 117, C10003, doi:10.1029/2012JC008303.
- Statscewich, H., T. Weingartner, S. Danielsen, B. Grunau, G. Egan, and J. Timm, 2011. A High-Latitude Modular Autonomous Power, Control, and Communication System for Application to High-Frequency Surface Current Mapping Radars. *Marine Technology Society*, 45(3): 59 – 68.

APPENDIX H: NATIONAL ENVIRONMENTAL POLICY ACT (NEPA)

NOAA Administrative Order 216-6, Environmental Review Procedures, requires all proposed projects to be reviewed with respect to environmental consequences on the human environment.

Question C1. Is the proposed activity going to be conducted in partnership with NOAA or would the proposed activity require NOAA's direct involvement, activity or oversight? If yes, describe NOAA's involvement, activity or oversight, including the name of the office or program that is involved.

1. Developing a regional management system. *Yes, NOAA has two members on the AOOS Board. Doug Demaster represents NOAA research in Alaska; Amy Holman, NOAA's Alaska Regional Collaboration Team, represents all the NOAA offices in Alaska.*
2. Developing observing systems and products to address Marine Operations needs. *Yes, NOAA is a partner with AOOS in its weather and wave enhancement projects, and will be doing the observations in Cook Inlet.*
3. Developing observing systems and products to address Coastal Hazard needs. *Yes, we are partnering with NOAA CO-OPS to develop more water level monitoring sites.*
4. Developing observing systems and products to address Ecosystem and Climate Trends needs. *Yes, we are partnering with NOAA/OAR to support the Bering Sea moorings, and to provide data support for the Distributed Biological Observatory.*
5. Developing statewide capacity in data management, website and products. *Yes, NOAA Auke Bay Lab director Phil Mundy serves as chair of the AOOS Data Management Advisory Committee. AOOS partners with NOAA to provide increased access to NOAA datasets.*
6. Developing modeling capacity. *Yes, AOOS will be partnering with NOAA to develop an AOOS modeling testbed and to add value to circulation models to create HABS products.*
7. Developing stakeholder engagement, education and outreach activities to increase ocean observing capacity in Alaska. *Yes, AOOS collaborates for its outreach activities with the NOAA regional collaboration team and the NOAA RISA – ACCAP.*

Question C2. Would the proposed activity involve any other federal agency(ies) partnership, direct involvement, activity, or oversight? If yes, provide the name(s) of the agency(ies) and describe its involvement, activity or oversight.

1. Developing a regional management system. *Yes, other federal agencies serve on the AOOS Board including USCG, USGS and BOEM.*
2. Developing observing systems and products to address Marine Operations needs. *Yes, the Dept of Agriculture is a collaborator on the Snotel weather stations. The Army Corps is a partner on the wave buoys. The Coast Guard will assist with deployment and retrieval of buoys as available as well as enhancements to the AIS system and development of Arctic shipping decision support tools.*
3. Developing observing systems and products to address Coastal Hazard needs. *Yes, Army Corps, USGS and USFWS Alaska Landscape Conservation Cooperatives are collaborators on the water level projects.*
4. Developing observing systems and products to address Ecosystem and Climate Trends needs. *Yes, NSF is a partner in many of the monitoring programs. The Coast Guard provides ship time on the Healy for the Bering Sea mooring project. USGS provides biological data.*
5. Developing statewide capacity in data management, website and products. *Yes, other agencies provide data to the AOOS data system, including USGS, NASA, NSF.*
6. Developing modeling capacity. *Yes, NASA is a partner on some of the ocean circulation modeling projects and other agencies may be involved with the testbed.*

7. Developing stakeholder engagement, education and outreach activities to increase ocean observing capacity in Alaska. *Yes, we work with all the agency outreach programs.*

Question D1. Provide a brief description of the location of the proposed activity.

1. Developing a regional management system. *Anchorage AOOS Office.*
2. Developing observing systems and products to address Marine Operations needs. *Snotel stations are in Prince William Sound and Cook Inlet. AIS and weather stations will be added in locations TBD. Wave buoys will be deployed in Cook Inlet and in Norton Sound.*
3. Developing observing systems and products to address Coastal Hazard needs. *Water level sensors will be deployed in Bristol Bay, Norton Sound and Chukchi communities*
4. Developing observing systems and products to address Ecosystem and Climate Trends needs. *Ocean acidification monitoring to occur in Resurrection Bay, PWS, Southeast AK. Seward Line in Gulf of Alaska. Bering Sea moorings along 70m isobath in Bering Sea. Oceanographic measurements in lower Cook Inlet. Many activities occur in PWS including the Ocean Tracking Network's acoustic array.*
5. Developing statewide capacity in data management, website and products. *Anchorage office of Axiom Data Science.*
6. Developing modeling capacity. *Various offices at University of Alaska Fairbanks and Anchorage, Remote Sensing Solutions.*
7. Developing stakeholder engagement, education and outreach activities to increase ocean observing capacity in Alaska. *Anchorage AOOS office.*

Question E1. List any federal, state, or local permits, authorizations, or waivers that would be required to complete the proposed activity. Provide the date the permit, authorization, or waiver was obtained or will be obtained. Provide copies of the permit, authorization, or waiver as appropriate. Was a NEPA analysis prepared for the permit, authorization, or waiver? If yes, state the title of the NEPA analysis and provide copies of the NEPA analysis.

1. Developing a regional management system. *None.*
2. Developing observing systems and products to address Marine Operations needs. *All necessary reports to the US Coast Guard Aids to Navigation office in USCG District 17 will occur.*
3. Developing observing systems and products to address Coastal Hazard needs. *Rights-of-way, access permits and real estate-related arrangements may be necessary for shore-based platforms, but no environmental permits will be required since the stations are erected on existing infrastructure.*
4. Developing observing systems and products to address Ecosystem and Climate Trends needs. *No permits required for Bering Sea moorings, Seward Line, OA moorings, and wave buoys. PWS OTN array requires state permit which will be renewed in January 2016. All necessary reports to the US Coast Guard Aids to Navigation office in USCG District 17 will occur.*
5. Developing statewide capacity in data management, website and products. *None.*
6. Developing modeling capacity. *None.*
7. Developing education and outreach activities. *None.*

Question F1. Is there the potential for the proposed activity to cause changes that would be different from normal ambient conditions (e.g., temperature, light, turbidity, noise,, other human activity levels, etc.)? If yes, describe the changes and the circumstances that would cause these changes. No impacts anticipated from any activities.