



AOS FY 2016-2020

STRATEGIC OPERATIONS PLAN

September 21, 2016

Minor clarifications added February 27 2017 for AOS Certification Application

I. ABOUT AOS

The Alaska Ocean Observing System (AOS) is one of 11 federal, regional and private-sector partnerships or Regional Associations (RAs) that are part of the national Integrated Ocean Observing System (IOOS), working to enhance our ability to collect, deliver and use ocean information. IOOS RAs cover the entire U.S. Exclusive Economic Zone connecting the people of the United States with their oceans.

AOS facilitates a statewide observing system as well as three distinct coastal and ocean observing systems for the Gulf of Alaska, Bering Sea and Arctic, covering nearly 44,000 miles of Alaska coastline and offshore environments. AOS is unique not only for its size, but also because it is the only RA in the United States that includes an Arctic boundary.

Developing an integrated ocean observing system at high latitudes creates unique challenges. In addition to the harsh environment, the region encompassed by AOS is 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 without road access or power, 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. There is no state more maritime than Alaska.

A Board of Directors, currently made up of 19 members representing federal and state agencies, research entities, and private sector organizations, governs AOS. The Board has one standing committee, the Data Management Advisory Committee (DMAC), which is composed of experts, including both data users and providers, providing technical advice to the AOS Data Team and program staff. An additional Nominations Committee is convened when needed to identify candidates for officer positions. Ad hoc advisory groups and working groups are topic or regionally specific and convened as needed.

The Alaska SeaLife Center, an incorporated nonprofit, is the fiscal sponsor for AOS, and performs legal, financial and administrative functions on its behalf.

II. INTRODUCTION

AOS uses its core, five-year cooperative agreement with the NOAA IOOS Program as the framework for its Strategic Operations Plan, hereafter referred to as the

“Plan”. The FY 2016-2020 cooperative agreement begins June 1, 2016 and runs through May 31, 2021.

The Plan also draws upon the 2011 [AOOS Preliminary Build Out Plan](#) and the 2013 [AOOS Arctic Ocean Observing Build Out Plan](#) as guidance (both under revision in 2017), as well as relevant regional and national plans, especially those for the U.S. Arctic.

The AOOS Plan is organized first to describe the overarching goals, objectives and activities for each of the four thematic focus areas for the organization, and second to provide the reader with the overall approach to planning for and implementing the operational subsystems of AOOS. Inclusion of an activity in the Plan does not necessarily mean a final decision to implement that activity has been made, or that funding is available.

Strategic planning and stakeholder engagement are ongoing processes within the AOOS program. However, establishing priorities to be included in the five-year funding request to the IOOS Program Office formally begins a year prior to submission. The Stakeholder Engagement Policy adopted by the AOOS Board in 2015 and included in the AOOS Standard Operating Procedures guides the initial steps in determining key elements to be addressed in this Strategic Operations Plan. The Plan is, therefore, closely linked to the five-year funding proposal. It is the intention of AOOS to update this Plan at least every five years prior to submittal of the IOOS Program funding request.

PRIORITY GOALS

The AOOS Board adopted these goals as identified through stakeholder engagement:

- 1) To increase access to existing coastal and ocean data;
- 2) To package information and data in useful ways to meet the needs of stakeholders; and
- 3) To increase observing and forecasting capacity in all regions of the state, with a priority on the Arctic and the northern Gulf of Alaska.

III. FOCUS AREAS

The AOOS Board adopted these four programmatic focus areas: marine operations; coastal hazards and inundation; ecosystems, fisheries and climate trends; and water quality. These are consistent with the key focus areas of the national IOOS Program.

A. Marine Operations

Alaska’s marine operations stakeholders are diverse, including but not limited to the operators of oil tankers, cruise ships and ferries, container ships, bulk cargo ships, tugs and barges, fishing vessels and recreational vessels. 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 percent of Alaska's consumable goods are transported through the Port of Anchorage, arriving on container ships and barges that navigate the dynamic sea ice and extreme tides of Cook Inlet. Nearly all trade with U.S. and Canadian ports in the Pacific transits through the Aleutian Islands to and from Far East ports. Over 7,000 deep draft vessels a year sail via the Great Circle route to the Far East through Alaska waters. As Arctic sea ice retreats and the Northwest and Northern Route passages stay ice-free for longer periods, more vessels are transiting Alaska's Arctic waters, transporting raw materials to international destinations and bringing more tourists to the Arctic. In addition to the operators of vessels, maritime stakeholders include 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. AOOs provides direct and easy access to a variety of real time environmental information to mariners to help ensure safe, efficient and environmentally sound maritime operations.

Alaska's marine operations 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 conditions, 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 Alaska waters, carrying shipments to international destinations or passengers to 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.

1. Five Year Goal: To improve safety of marine operations (including search and rescue and oil spill response).

2. Objectives: AOOs will focus on sustaining weather and sea state observations and more effective dissemination of weather information to users, as well as developing related information and decision support tools for stakeholders, including the emerging Arctic Marine Highway, subsistence activities, and offshore energy.

3. Activities:

- Sustain critical weather and other environmental observations in the Gulf of Alaska (GOA).

- Increase access to weather observations statewide and especially in the Arctic by co-locating weather stations with AIS (Automatic Identification System) vessel tracking stations and using AIS communications to provide localized information to mariners.
- Sustain critical wave buoys for navigation safety in Cook Inlet, the Bering Strait and other regions.
- Map surface currents using high frequency radars (HFRs) in the Chukchi and Beaufort Seas, as well as other key transportation choke points.
- Pilot use of freeze-up detection moorings for real-time ice forecasting.
- Collaborate with key partners to enhance observations at the Port of Anchorage, Alaska’s largest port.
- Respond to emerging needs.

Existing and planned activities for the Marine Operations focus area are listed by subsystem in the following table.

Subsystem	Maintain Existing Efforts	Planned
Observations	<ul style="list-style-type: none"> • Co-located weather/AIS stations • 8 SnoTel weather stations in Prince William Sound (PWS) and Cook Inlet • Cook Inlet Wave Buoy (Gulf of AK) • King Island Wave Buoy (Bering Sea) • 4 HF Radars in Chukchi and Beaufort Seas 	<ul style="list-style-type: none"> • 2 or more weather/AIS stations • 2 more SnoTel stations in PWS • 3 land-based wind anemometers in PWS • 2 or more wave buoys • 2 or more HFR stations • Additional sensors at Port of Anchorage • Transition pilot freeze-up detection mooring to operational status
Products, Modeling & Analysis	<ul style="list-style-type: none"> • AIS Vessel Tracking Database & Visualizations • Cook Inlet Response Tool • Arctic Marine Highway Integrated Visualization & Planning Tool • Climatologies & syntheses 	<ul style="list-style-type: none"> • Enhanced AIS Tools • Enhanced Arctic Marine Hwy tools • Wave models & forecasts • Enhanced climatologies
Coordination/ Facilitation	<ul style="list-style-type: none"> • Emergency Response Management for Alaska (ERMA)(quarterly meetings) • Coordination with Department of Homeland Security (DHS) Arctic Intelligence Fusion Capability 	
Outreach Activities	<ul style="list-style-type: none"> • Briefings to Coast Guard & Regional Citizens Advisory Councils, Pilots and other mariners • Support for Arctic Waterways Safety Committee & Cook Inlet Harbor Safety Committee • Presentations to Alaska Harbormasters 	
Data Management	<ul style="list-style-type: none"> • Environmental data for PARS (Arctic Port Access Route study) • Real-time observations and dissemination of data on website 	

B. Coastal Hazards and Inundation

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 concentration and extent, increased storm surge, thawing coastal permafrost, and subsequent 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 Accountability 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 coastal residents 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. National water level systems are expensive and difficult to reach, operate and maintain in remote, ice-covered waters. Stakeholders include coastal subsistence communities in 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.

1. Five Year Goal: To improve the ability to forecast and plan for changing storm and sea ice conditions and their impacts on coastal communities and habitats.

2. Objectives: AOOs will focus on increasing water level and wave observations and related products for stakeholder decision-making.

3. Activities:

- Increase water level observations in western and northern Alaska by facilitating the development and implementation of an integrated Water Level Observing Network.
- Increase wave observations using novel approaches to improve water level forecasting and develop plans to fill existing gaps.
- Pilot a new program using remote water level sensors for coastal vessel traffic.
- Pilot use of crowd-sourced non-NOAA hydrographic (water depth) survey data to improve navigation safety.
- Develop long-term plan for water level observations based on results of pilot projects.
- Respond to emerging needs.

Existing and planned efforts for the Coastal Hazards and Inundation focus area are listed by subsystem in the following table.

Subsystem	Maintain Existing Efforts	Planned
Observations	<ul style="list-style-type: none"> • Pilot alternative Water Level Sensors • Support 2 wave buoys (Cook Inlet and Bering Strait) • Bridge installations of iGages with AK Dept. of Natural Resources in remote villages • Support Western AK LLC with Lidar Surveys over Yukon 	<ul style="list-style-type: none"> • Install alternative water level technologies • Pilot new methodologies for land-based water level observations • Support 2 or more additional wave buoys
Products, Modeling & Analysis	<ul style="list-style-type: none"> • Maintain community flood maps • Maintain shoreline profile database tool 	<ul style="list-style-type: none"> • Implement Integrated Water Levels Observation Network • Pilot storm surge remote water level sensor program at river mouths • Pilot crowd-sourcing hydrographic data & observation • Develop tidal prediction web tool • Improve forecasts for sea ice & extreme weather events
Coordination/ Facilitation	<ul style="list-style-type: none"> • Water Levels Working Group 	<ul style="list-style-type: none"> • Collaborate with NOAA and industry on hydrographic survey data
Outreach Activities	<ul style="list-style-type: none"> • Support Alaska Sea Grant Coastal Resiliency Coordinator position 	
Data Management	<ul style="list-style-type: none"> • Provide access to existing resiliency tools & products 	
Related Activities & Projects	<ul style="list-style-type: none"> • Denali Commission erosion project • State of AK emergency managers 	

C. Ecosystems, Fisheries and Climate Trends

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 a changing climate. Representative stakeholders include the fishing industry (commercial and recreational), coastal communities, federal and state management entities, subsistence-based communities, tourism and academic and agency researchers.

1. Five Year Goal: To better 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.

2. Objectives: AOOs will build upon and leverage existing programs to support an integrated network of physical, chemical, biological and community-based ocean observations and develop a synthesized State of Alaska’s Coasts and Oceans Report, envisioned as a living web-based resource that is updated at least annually.

3. Activities:

- Sustain ship-based water sampling for biological, chemical and physical parameters along the long term “Seward Line” transect, augmented with glider observations.
- Provide year-round observations to the Distributed Biological Observatory (DBO) by supporting ecosystem moorings in the Chukchi, Beaufort and Bering Seas and the Gulf of Alaska. Enhance existing moorings.
- Pilot the use of glider surveys to monitor ocean conditions and marine mammals.
- Support community based monitoring initiatives.
- Continue to incorporate data from telemetered animals and add additional feeds to the AOS Data System.
- Sustain intensive sentinel monitoring in Prince William Sound (PWS) through SnoTel weather stations and the PWS Ocean Tracking Network .
- Sustain long-term sentinel monitoring in Cook Inlet based on monthly transect surveys of oceanographic conditions.
- Partner with organizations to provide sentinel level monitoring in Southeast Alaska and other regions.
- Respond to emerging needs.

Existing and planned efforts for the Ecosystem, Fisheries and Climate Trends focus area are listed by subsystem in the following table.

Subsystem	Maintain Existing Efforts	Planned
Observations	<ul style="list-style-type: none"> • Seward Line • Chukchi Ecosystem Mooring • Marine mammal/Glider in Chukchi • PWS Ocean Tracking Network • Cook Inlet sentinel observations 	<ul style="list-style-type: none"> • Add glider observations to Seward Line • Add sensors to Chukchi Mooring & develop moorings in Beaufort & Bering Seas & GOA • Support additional flights for Chukchi glider • Increase collection of community-based coastal ice and oceanographic observations • Incorporate additional animal telemetry • Enhance sentinel observations in Cook Inlet & PWS • Support sentinel observations in Southeast & other regions
Products, Modeling & Analysis	<ul style="list-style-type: none"> • Pilot a “State of Alaska’s Coasts & Oceans Report” • Support Gulf of Alaska hydrological model 	<ul style="list-style-type: none"> • Enhance Oceans Report • Contribute to regional ecosystem assessments
Coordination/ Facilitation	<ul style="list-style-type: none"> • Coordinate AK Animal Tracking Network (ATN) efforts 	
Outreach Activities	<ul style="list-style-type: none"> • Participate in Gulf Watch outreach • Conduct Arctic ATN workshop 	
Data Management	<ul style="list-style-type: none"> • Increase access to environmental datasets via AOS data portal 	Coordinate access to Shell data

	<ul style="list-style-type: none"> • Provide data management services to integrated programs • Develop ATN data node • Maintain Beluga Ecosystem Portal
Related Activities & Projects	<ul style="list-style-type: none"> • Gulf Watch AK & Herring Programs (EVOSTC) • Integrated research programs (DBO, AMBON, RUSALCA, MARES)

D. Water Quality

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, largely from passive atmospheric deposition. In Southeast Alaska, neighboring Canadian mining activities have raised worries about the impacts of mineral development, and other potential development, on the water quality of transboundary waters that pass through Alaska. Lastly, harmful algal blooms continue to concern stakeholders from both the mariculture industry and the subsistence/recreational communities. Representative stakeholders include the fishing industry, federal and state management entities, policy makers, emergency responders, academic and agency researchers, subsistence users, and local residents.

1. Five Year Goal: To understand, document and respond to current and future changes to the quality of Alaska’s marine waters.

2. Objectives: AOOs will support monitoring of ocean acidification and marine debris, organize and facilitate a working group focused on harmful algal blooms and explore opportunities for providing data products and decision-support tools for contaminants and watershed/ocean linkages.

3. Activities:

- Maintain ocean acidification (OA) monitoring through ship-based observations along the long term “Seward Line” transect and along Alaska Marine Highway routes, moorings in the Bering Sea and Gulf of Alaska and instruments at hatcheries in Seward and Ketchikan.
- Identify preferred technologies and methodologies for making accurate and meaningful OA measurements, and develop a coordinated OA network.
- Increase OA observations by adding capability including instrumentation at hatcheries, on ships of opportunity such as state ferries, on planned and existing moorings, and on oceanographic cruises.

- Support monitoring of marine debris in Prince William Sound, at the Kenai Peninsula, and in other areas of the state.
- Support contaminants monitoring by state agencies through data integration or data support.
- Support a harmful algal bloom (HAB) working group focused on assessing the risk to local marine resources and integrating local observations.
- Respond to emerging needs.

Existing and planned efforts for the Water Quality focus area are listed by subsystem in the following table.

Subsystem	Maintain Existing Efforts	Planned
Observations	<ul style="list-style-type: none"> • OA sampling along Seward Line • Support OA moorings in Bering Sea & Gulf of Alaska • Maintain support for OA instrumentation at Alutiiq Pride (Seward, AK) and Oceans Alaska (Ketchikan, AK) hatcheries 	<ul style="list-style-type: none"> • Additional Burkolators at hatcheries • OA measurements on cruises • OA sensor installation on intersate AK Marine HWY Ferry • Water Quality observations on mooring in Southeast AK • Support marine debris monitoring
Products, Modeling & Analysis	<ul style="list-style-type: none"> • Pilot HAB risk assessment 	<ul style="list-style-type: none"> • Support GOA OA forecast • Support HAB monitoring
Coordination/ Facilitation	<ul style="list-style-type: none"> • Develop Alaska OA Network • Develop products from OA Technology Workshop • Coordinate HAB workshop w/AK Sea Grant 	
Outreach Activities	<ul style="list-style-type: none"> • Use OA Network for OA Outreach • Participate in Coastal Resiliency workshops 	
Data Management	<ul style="list-style-type: none"> • Develop Alaska OA data portal 	<ul style="list-style-type: none"> • Support State contaminant monitoring • Coordinate HAB data collection
Related Activities & Projects	<ul style="list-style-type: none"> • UAF OA Research Center • NOAA's OA Program & Ecological Forecasting Roadmap Working Group 	

IV. THE SYSTEM

AOOS continues to build upon existing efforts, taking into account the challenges of providing real-time observations in Alaska, placing a premium on access to and integration and synthesis of existing data and data sources, and relying extensively on collaborations. AOOS leverages funding with other programs and provides coordination and synthesis services to better integrate and add value to existing research and monitoring activities. The program also draws upon the 2011 AOOS Preliminary Build Out Plan and the 2013 AOOS Arctic Ocean Observing Build Out

Plan as guidance, as well as the plethora of relevant regional and national plans, especially those for the U.S. Arctic.

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 (PWS) 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: AOS used 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, AOS also completed an Arctic Ocean Observing Build Out Plan in 2013 to map out an approach to accomplish collective Arctic observing goals that increase the environmental intelligence and infrastructure needed for Arctic Marine Domain Awareness. This plan is being updated in 2017 to reflect recent activities, including accelerating initiatives in the Arctic and more recent national program relevancies from NOAA to the Department of Homeland Security (e.g., Arctic Domain Awareness activities).

AOS is organized into four subsystems: Outreach, Coordination and Facilitation; Observations; Modeling, Analysis and Products; and Data Management. Our general approach to these subsystems, as well as to Research and Development, is described below.

A. Outreach, Coordination and Facilitation Subsystem

The AOS Board has made stakeholder outreach, facilitation, coordination, and partnership building one of the cornerstones of the AOS program. AOS is one of the few multi-agency, multi-disciplinary organizations in Alaska whose mission includes facilitating and coordinating marine-related efforts.

The AOS Stakeholder Engagement Policy guides all stakeholder engagement activities. 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. Activities include:

- AOS website, Facebook and publications
- Participation in professional conferences
- Stakeholder interaction
- Stakeholder working groups
- Education activities
- AOS Short Film Contest
- Alaska Marine Policy Forum
- Participation in IOOS Outreach Committee

- Participation in regional programs with stakeholder engagement (e.g., Alaska Sea Grant Advisory Committee, Alaska Center for Climate Assessment and Policy steering committee, U.S. Department of Interior’s Landscape Conservation Cooperatives)

Coordination and facilitation activities include such activities as

- Support for Alaska ad hoc group tracking the Pacific Anomalies (“The Blob”), including an “Alaska Blob Tracker” Blog on the AOOS website
- Informal working group to establish an Integrated Water Levels Observation Network in Alaska to facilitate increasing water level observations and piloting alternative technologies
- Development of an Alaska Ocean and Coastal Acidification Network aimed at increasing Alaska awareness of ocean acidification
- Participation in a working group to develop a Harmful Algal Bloom Forecasting Program in Alaska

AOOS staff will compile stakeholder input and feedback at least annually and provide a summary to the AOOS Board for its review prior to Board approval of annual work plans and the five-year cooperative agreement proposal with NOAA. The input and feedback will also be used to modify the priorities and activities described in the AOOS Strategic Operations Plan as needed, but at least annually.

B. Observation Subsystem

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 (or anticipated) 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. During the next five years AOOS will continue to support key observational assets while identifying gaps and working collaboratively to fill those gaps. This includes supporting alternative technology trials that can ultimately increase observing capacity by providing less expensive alternatives to more traditional methods (e.g., expensive NDBC moorings) that are difficult to maintain and operate in Alaska.

A variety of platforms are used in the AOOS observing subsystem. These include moorings, some with real-time capability, wave buoys, ship-based surveys, autonomous underway shipboard systems, autonomous vehicles such as gliders, and community-based observations.

C. Modeling, Analysis & Products Subsystem

A long-term goal of all the regional IOOS programs is to develop models and forecasts for the ocean, comparable to those for the atmosphere developed by the

National Weather Service. AOS initiated pilot wind, wave, and ocean circulation models for the Prince William Sound region between 2005 and 2010. However, without substantial new funding, we have only been able to continue support for the ocean circulation model and current use and future support for that is still under review. A major limitation in Alaska is the lack of observations for data assimilation and model validation.

Given limited resources AOS will focus on these objectives for our Modeling, Analysis & Products Subsystem:

- Support existing models and data products previously developed
- Develop a State of the Coasts and Oceans Report that builds on existing efforts such as the PICES State of the Pacific Report, the North Pacific Fishery Management Council's ecosystem status report and indicators, and the annual Arctic Report Card
- Develop new products prioritized by stakeholders such as a harmful algal bloom risk assessments, vessel tracking and planning tools and climatologies
- Develop new web-based model evaluation tools
- Initiate an Alaska Modeling Testbed in conjunction with the national IOOS Modeling Testbed

D. Data Management Subsystem

The goals of the AOS Data Management Subsystem are to serve as the Alaska regional Data Assembly Center (DAC) for Alaska coastal and ocean data collected by AOS 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.

AOS 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 AOS with AOS staff and other partners, contractor Axiom Data Science has developed the AOS 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. The AOS DAC is currently the largest data management service in this region. The [AOS Data Assembly Center and Data Management Subsystem Plan](#) describes in more detail how the Data System is operated and managed.

All IOOS regional associations must meet IOOS Data Management and Communications requirements, and each regional association must support the local needs of their constituents. The AOS data system is now able to directly leverage and benefit from the AOS-developed systems, capabilities and lessons learned through Axiom's contractual support for data management at two other IOOS regional associations (Southeast Coastal Ocean Observing System Regional Association and Central and Northern California Ocean Observing System) as well as

the national IOOS Program Office. 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 across IOOS regions, and reduce costs for all the programs while improving overall performance.

E. Approach to Research and Development

AOOS is not a large enough organization to have its own formal Research and Development Subsystem. However, given the logistical and technical challenges of operating observing assets in Alaska's remote ocean waters, many of which are covered by sea ice for a majority of the year, many of AOOS' observing assets could be considered under some form of research and development. AOOS investigators are consistently looking towards ways to improve buoy, glider and sensor technology under harsh environmental (e.g., Arctic) conditions. Three significant AOOS programs are research-and-development (RnD) pilot efforts: the freeze-up detection mooring funded by the IOOS Technology Transfer program, the marine mammal detection glider, and several alternative technology and application projects that are testing novel alternative water level methodologies. Given the tremendous costs for operation and maintenance in Alaska and the Arctic, AOOS reviews all of its projects with an eye towards reducing future costs, improving transmission efficiencies, all the while increasing observational capacity in the form of data collection.

V. OPERATIONS AND MAINTENANCE

A. Personnel

AOOS staff include four primary positions: an Executive Director, a Director of Operations and Development, a Director of Administration and Outreach, and a Data Manager. The Executive Director reports directly to the AOOS Board of Directors under a three-year contractual agreement with mutually agreed upon annual performance objectives and subsequent reviews by the AOOS Executive Committee. The Operations Director and the Administration and Outreach Director are hired by the Executive Director and report directly to him/her with annual evaluations. All other staff, such as Program Managers and interns, are hired by the Executive Director as needed. Continued employment of all staff is dependent upon responsible execution of the duties incumbent to the position they hold.

The AOOS Board chose to hold an open competition for a contract to run the AOOS Data Management Subsystem and following an extensive competitive process in 2010, the Anchorage firm Axiom Data Science was selected. The AOOS Data Manager position is held by the technical lead of that firm. The 5-year Axiom contract was extended by the AOOS Board in 2014 for 3 additional years (now through August 31, 2018). An external review of the AOOS Data Subsystem is planned for winter/spring 2017.

Administrative staff for AOS are provided by its fiscal sponsor, the Alaska SeaLife Center (ASLC). These include grant and contract specialists, accountants and human resources.

B. Equipment

The AOS guidelines for managing equipment are included in the 2015 AOS Operating Procedures and call for AOS to manage and operate its system at the highest level in accordance with those policies.

AOS staff maintain the AOS equipment asset inventory. All AOS equipment assets owned, funded and/or operated by AOS are required to be calibrated, operated and maintained in accordance with manufacturing guidelines and /or national IOOS program guidelines and best practices, when available. Maintenance and inventory logs must be made available upon request. This requirement will be included in all AOS contracts and subawards.

C. Asset Inventories and Gap Analyses

AOS is committed to establishing and maintaining an ocean observing asset inventory for the Alaska region to assist with identifying gaps for the IOOS program as well as other state, federal, local and private activities. AOS is actively engaged with developing specific regional observing asset inventories for IOOS Program Office efforts to fill nationwide observing gaps for such platforms and themes as High Frequency Radars, moorings/buoy observations, gliders/autonomous vehicles, wave observations, ocean acidification monitoring, and harmful algal bloom monitoring. These inventories will be used in the revisions of the 2011 Statewide and 2013 Arctic Build-out Plans, to be completed in 2017, and incorporated into a region wide platform inventory in response to regional and national IOOS informational needs. AOS will make these inventories available on the website and update them regularly.

VI. FUNDING AND BUDGETS

A. NOAA Core Funding

AOS receives core funding as part of the U.S. IOOS enterprise through five-year cooperative agreements with NOAA established following a competitive process. Per the Federal Funding Opportunity (FFO) requirements, AOS in August 2015 submitted a proposal for FY 2016-20 for \$4 million a year, with priorities identified for three different funding levels: \$1.5 million, \$2.5 million and the full \$4 million. These were determined by the AOS Board following its review of stakeholder engagement and staff input.

Under all three funding scenarios, program staff and the data management system would stay roughly the same since these were established by the AOS Board as top priorities and staffing levels are already at the limit of the lowest funding level. The primary difference between the three scenarios is in the extent of proposed

observations, equipment purchases, and resources devoted to modeling. A \$1.5 million a year scenario would sustain core staff coordination, outreach and facilitation activities, basic data assembly center functions, and those observing activities for which AOS support is essential. A \$4 million a year scenario would fill additional priority observation gaps especially for waves, water levels and ecosystems; enhance the proposed regional modeling testbed to add value to existing models; and develop additional derived data and information products identified by stakeholders.

The \$2.5 million request is the closest to the 2015 funding award. It provides for core staff support; basic data assembly center functions as well as enhanced data ingestion and data product development; a suite of observations for marine operations, coastal hazards, ecosystem trends and water quality (including ocean acidification); and development of a modeling testbed and prototype decision-support tools.

B. Process for Descoping

Once Congress approves NOAA's annual budget and NOAA internally determines final budget numbers for each of its programs, the IOOS Program Office notifies AOS of the expected funding amount for that particular fiscal year. Since annual appropriations have not increased significantly over the past five years, that amount has been significantly less than the \$4 million requested, thus requiring a "descoping" process. This provides the AOS board an additional opportunity to look at priorities determined in the initial proposal, review any additional stakeholder input and priorities received during the prior year, and make any adjustments based on new information or alternative funding sources. Typically, the final request is very similar to what has been funded in past years, with some minor adjustments.

The Executive Director, based on the priorities in the original proposal with additional input from stakeholder engagement over the previous year, develops a recommendation for the annual AOS Work Plan that is presented to the AOS Board for their review and approval. The AOS Data Management Advisory Committee also provides input, although most of their recommendations concern how funding for the AOS DAC is used to implement the annual work plan.

C. Other Funding Sources

AOS seeks additional funding from other partners throughout the year, usually in the form of proposals submitted to various federal agencies and private foundations to implement components of our key focus areas and objectives. In the past, additional funding has been obtained from other NOAA programs including the Ocean Acidification Program, Office of Coast Survey, National Weather Service and National Marine Fisheries Service. AOS has also contracted with other federal agencies including Bureau of Ocean and Energy Management, US Geological Survey, US Fish and Wildlife Service, and the National Fish and Wildlife Foundation. The IOOS Program Office has also contracted with AOS to develop data management software and tools for application across all the regions, including AOS. The AOS

data team at Axiom Data Science is sometimes contracted directly by other programs to develop products or services that then can in turn, be used by AOOS.

D. Developing Priorities

AOOS has undertaken numerous prioritization processes over the years since its formation in 2004, using a variety of ad hoc scientific and stakeholder working groups and workshops. A formal Stakeholder Engagement Policy was adopted by the AOOS Board in November 2015 and is included in the AOOS Standard Operating Procedures.

Informal prioritization processes have included:

- 2011 AOOS Preliminary Build Out Plan
- 2013 AOOS Arctic Ocean Observing Build Out Plan
- Relevance to regional and national plans such as national Wave, Glider and Water Level Plans as well as national Arctic priority plans
- Analyses using socio-economic criteria including costs, benefits and risks
- Scientific-technical criteria including performance and relevance

Based on input from stakeholders, including agency staff, AOOS staff provides a summary of the input to the AOOS Board prior to its annual review and approval of descope budgets and work plans.

E. Assessing Future Funding Constraints

Since most AOOS projects rely on leveraged funding, AOOS staff assesses the costs of each proposed project to identify the benefits to the AOOS mission, to determine whether in-kind resources can be used, assess the risks to the project of losing leveraged funding, and predict the potential for sustainability of funding. After these considerations, a final assessment is made whether a project still has value, even if shorter-term. If a new component is added to an existing project, AOOS usually commits to a minimum of three years of funding, assuming sustained annual funding levels.