

Semi-annual Program Performance Report for NA16NOS0120027
FY 2016-20 Implementation and Development of a Regional Coastal Ocean Observing System: Alaska
Ocean Observing System
For reporting period December 1, 2017 – May 31, 2018
Prepared by Molly McCammon, Project PI on June 28, 2018

1.0 PROGRESS AND ACCOMPLISHMENTS

1.1 Regional Governance & Management Subsystem

1.1.1 Support ongoing board and committee activities.

- The AOOS Board met January 11, 2018 to address recommendations from the November external review of the AOOS Data System. The Board also approved Katrina Hoffman as board chair and Ed Page as vice-chair to serve until the fall elections. Hilcorp was approved as the oil and gas board member, with Bill Britt as its board representative. The Board's Executive Committee met April 23 to conduct Executive Director Molly McCammon's annual performance review and discuss performance objectives for the coming year. The Board met again May 11 and approved the 2018 budget. The AOOS Data Management Advisory Committee met December 18, 2017 to review the draft recommendations from the External Data Management Review Committee.

1.1.2 Provide ongoing fiscal and administrative oversight for program.

- McCammon conducted the annual evaluation for Administration and Outreach Director, Holly Kent.
- AOOS continues to seek additional external funding, and in this reporting period, submitted six proposals. A NOAA coastal resiliency proposal from 2017 is being reconsidered for funding in 2018-19. A NOAA-OAP proposal with Lead partner, the University of Wyoming, was accepted for funding, with an AOOS subaward for \$17,657. AOOS partnered the AECOM's submission to NOAA for a Pro-Tech contract for NOAA's Ocean Services Domain, which is still pending. Two IOOS-COMPT proposals with AOOS partnership were rejected. Additional funding is being provided from NOAA OAP through AOOS to support OA work on the DBO cruises and to help support two long-term OA mooring operations (GAKOA and M2) in Alaska.
- McCammon and Janzen worked with the External Review Committee to finalize their report and recommendations regarding the AOOS data system.

1.1.3 Support national and international partnerships and collaborations.

- Janzen presented at the AGU/TOS/ASLO Ocean Sciences international meeting in Portland, OR in February 2018 on the trial ASTRA GPS reflectometry water level results from Seward during a session on emerging technologies in ocean sciences.
- McCammon attended a Consortium for Ocean Leadership public policy forum and spring trustee meeting in March. McCammon serves on the COL board.
- Janzen and AOOS PI Seth Danielson participated in the National Ecosystem Mooring Workshop hosted by IOOS and the Alliance for Coastal Technologies (ACT) during April in Seattle, WA. The workshop was a meeting of subject matter experts for establishing recommendations of a backbone ecosystem mooring infrastructure for the US, as a follow-up to the National Mooring Strategy plan released in 2017.
- McCammon participated in numerous meetings with the IOOS program office and the IOOS Association (IA). These included monthly meetings with other Regional Association directors, the IA Executive Committee and the IA Finance Committee, as well as the spring IOOS meeting in Washington, DC.
- AOOS hosted an Animal Telemetry Network (ATN) workshop with the ATN coordinator Bill Woodward December 5-6, 2017 with over 50 participants both in person and online.

1.1.4 Support Alaska and regional partnerships and collaborations.

- McCammon was appointed by Alaska Governor Bill Walker to the Climate Change for Alaska Leadership Team and has been working with the team in drafting a new state climate action policy.
- Kent attended the Alaska ShoreZone annual meeting in December and the following Steering Committee meeting to discuss an expanded role for AOOS in the program.
- McCammon and Kent participated on the organizing committee for the Alaska Marine Science Symposium in January attended by nearly 700 marine scientists, educators and resource managers.
- Molly met with PIs of the Arctic Marine Biodiversity Observing Network (AMBON) project in January to discuss ways to better integrate that project into the goals and work plan of AOOS.
- McCammon is a new co-team leader for the Interagency Arctic Research Policy Committee's Environmental Intelligence Collaboration Team and has been participating in the team's monthly meetings .

- Janzen presented on January 26 at the Arctic Domain Awareness Center (ADAC) Quarterly Review for the joint AOOS/AXIOM/Marine Exchange of Alaska project on using AIS vessel tracking data to help prioritize NOAA bathymetric survey efforts in the Arctic.
- Janzen and AOOS Data Manager Bochenek presented on their ADAC project using AIS vessel tracking data to prioritize bathymetry at the ADAC Customers and Partners Roundtable webinars held quarterly on February 22, 2018.
- Janzen facilitated working groups for a workshop held 26-27 March 2018 by the ADAC in Nome titled “Arctic in the distant future-gaining Alaskan Native Insights to challenges anticipated across Maritime and Coastal Regions.”
- Janzen participated in the Western Alaska Interdisciplinary Science Conference at Nome, AK during March, hosted by Alaska Sea Grant and the University of Alaska, Fairbanks (UAF), Northwest Campus.
- AOOS provided support to the Kachemak Bay Regional Science Conference in March.
- AOOS and Axiom began working with the AK Fisheries Development Foundation and The Nature Conservancy on developing a data tool that can assist mariculture permit applicants with siting for potential shellfish, seaweed, or other farms.
- AOOS is collaborating with the Port of Nome, the CDIP Buoy Program, and the Marine Exchange of Alaska to deploy a CDIP buoy off the port of Nome in July 2018. The NOAA ship Fairweather is delivering the buoy for this effort.
- McCammon participated in the Cook Inlet Regional Citizens Advisory Council’s (CIRCAC) annual meeting in April as the Municipality of Anchorage representative and also chairs the CIRCAC Environmental Monitoring Committee.
- Janzen participated in the IARPC webinar in April 2018 on tracking of anthropogenic noise in marine ecosystems and discussed the 300 TB of Shell Ambient Noise acoustic data from the US Arctic region.
- McCammon met with the steering committee of the Exchange for Local Observations and Knowledge of the Arctic during their meeting in Anchorage in April.
- McCammon gave a talk on observations for Arctic navigation safety on one of the Arctic Encounters Symposium’s panels in Seattle, WA in April with 40 people attending the session.
- McCammon joined a group of scientists visiting Alaska from the Nansen Legacy program, a project researching the Barents Sea.
- McCammon gave a talk on Arctic observations and technologies at the Arctic Research day as a part of the North by North celebration in April at the Anchorage Museum.
- AOOS and the Alaska Department of Natural Resources hosted the 2018 Alaska Coastal Water Level Observations Meetings in May focused on technologies and user needs for water level observations in Alaska.
- McCammon and Dugan began working with NOAA, IARPC, and Alaska Sea Grant to facilitate a more coordinated response to increased concerns about the potential for increasing harmful algal blooms (HABS) by Bering Strait residents. Warmer ocean waters and reduced sea ice have sparked the concern and AOOS is facilitating potential sampling opportunities for the 2018 field season in the Arctic.
- Janzen and McCammon coordinated and lead steering committee meetings for multiple AIS vessel tracking projects in March and May 2018, to solicit feedback on what data attributes are important in the AIS records. They received guidance for data products being developed by Axiom Data Science for a web-based user tool.

1.2 Outreach, Stakeholder Engagement & Education Subsystem

1.2.1 Support website, Facebook and printed publications as key AOOS communication tools.

- Kent and staff began working on refreshing the AOOS website.
- Kent and staff developed a Communication Plan for the coming year.
- Kent continued to add content to the AOOS website and Facebook page, including news, featured stories, and descriptions of new data tools.
- Staff produced monthly updates and started a monthly proposal update for board members.
- Staff circulated a quarterly e-newsletter in June to a list-serve of over 400 recipients and produced a hard copy winter newsletter.

1.2.2 Support ongoing stakeholder interactions.

- AOOS hosted a survey from November 2017 through January 2018 gather feedback on the data portal from end users.
- McCammon gave an update on AOOS programs and projects for the Alaska Climate Change Assessment and Policy webinar series in April.

- Janzen presented to the Indigenous Peoples Committee on Marine Mammals in April on two AOOS projects that use AIS vessel tracking data.

1.2.3 *Support stakeholder working groups including the Alaska Ocean Acidification Network, Harmful Algal Bloom Network, integrated water level observation network, Alaska Pacific Anomalies Working Group, and long-term observing system coordination and integration.*

Alaska Ocean Acidification Network

- The Network completed a statewide survey to better understand the information needs of Alaskans to help inform future monitoring.
- The Network launched a new monthly series where scientists from the network answer real questions from Alaskans in less than 5 minutes.
- The Network launched a new page for educators that includes a chart categorizing curriculum by concept, grade level, and resource type.
- The network launched a page for fishermen which includes frequently asked questions about ocean acidification and helpful links.
- An in-person steering committee meeting was held in Anchorage in January to review network progress and scope next steps. AOOS continued to coordinate the 6 topic-specific working groups.
- Community sampling programs were expanded to Barrow, Kotzebue and Nome in collaboration with the US Arctic Research Commission and the Alutiiq Pride Shellfish Hatchery.

Alaska Harmful Algal Bloom Network

- AOOS received funds from the US Arctic Research Commission to implement some water and animal tissue sampling for harmful algal blooms in the Nome/Kawerak region, Kotzebue and Barrow.
- AOOS and Alaska Sea Grant partnered to secure a half-time Sea Grant Fellow to help coordinate the network starting in September 2018.

Alaska Water Level Watch

- McCammon and Janzen continue to work with partners to implement pilot projects for alternative water level observation technologies. AOOS, NOAA and the Alaska Department of Natural Resources hosted two days of workshops May 22-23 focusing on technologies and user needs for water level observations in Alaska. The input will be used to update the joint Water Level Observing Network report that was published in 2016.

1.2.4 *Support partnerships with marine education and outreach programs.*

- Staff supported the Shorezone project as a partner.
- Kent maintained a web page with resources for educators on AOOS.org.
- Staff provided support to Alaska Sea Grant's marine education programs.

1.2.5 *Support Alaska Marine Policy Forum*

- AOOS partnered with Alaska Sea Grant to host sessions of the Alaska Marine Policy Forum (AMPF) in December 2017, February 2018, April 2018, and June 2018.

1.2.6 *Continue AOOS short film contest.*

- AOOS decided not to hold a Short Film Contest in 2018.

1.2.7 *Continue to co-sponsor the Alaska Marine Science Symposium.*

- AOOS staff participated on the steering committee for the January event.
- AOOS staff coordinated workshops and keynote addresses for symposium week, and hosted an information table during the poster sessions.
- Kent participated on the organizing committee for the 2018 Communicating Ocean Sciences Workshop (COSW) featuring scientist/photographer Chris Linder in conjunction with the AMSS. This committee also organized a one-day science communication workshop prior to the AMSS led by the American Geophysical Union's Sharing Sciences group.

1.2.8 *Participate in IOOS Outreach Committee*

- Kent attended monthly meetings of the committee and responded to various requests for materials from the IOOS office for inclusion into IOOS publications and website.
- Kent updated the IOOS Education and Outreach Inventory.

1.3 Observing Subsystem

1.3.1 Marine Operations

1.3.1.1 Sustain weather observations in the GOA.

- **Subaward to Prince William Sound Science Center to service 8 SnoTel stations in Prince William Sound and Cook Inlet; Original Completion Date: May 2018.**

Status: Completed May 2018.

1.3.1.2 Increase access to weather observations using AIS.

- **Subaward to the Marine Exchange of Alaska to install and maintain joint weather/AIS stations in at least two new remote locations; Original Completion Date: June 2018.**

Status: On Track. Gull Island weather sensor repaired in March 2018, Point Arden weather sensor installed in June 2018, Captain's Bay weather sensor to be installed in July 2018. Inspection, maintenance, upgrade and/or repair conducted at seven stations from March to June 2018.

1.3.1.3 Support sea ice radar in Barrow

- **Subaward to University of Alaska Fairbanks (UAF), Geophysical Institute;**
 - Finalize plan for transitioning data processing and management tasks to Axiom/AOOS.

Original Completion Date: August 2018.

Status: Complete. Data is now being streamed to Axiom.

1.3.1.4 Sustain critical wave buoys for navigation safety.

- **Operate and maintain Cook Inlet buoy; Original Completion Date: May 2018.**

Status: On Track. The buoy was recovered and replaced in December 2016 and has been operational through April 2018, after which the battery expired. A replacement buoy was procured, and arrived in Homer, AK June 4, 2018. AOOS PI Kris Holderied is coordinating a buoy recovery and redeployment effort for late-June/early July.

- **Operate and maintain Bering Strait/Norton Sound Buoy; Original Completion Date: May 2018.**

Status: Complete. Buoy no longer in service. The buoy was shipped back to Seward in 2017, and due to the expense and uncertainties of deployment and retrieval with operating in the Bering Strait region, this asset is not being planned for any further deployment at this time. Instead, a CDIP buoy is going to be deployed in the region, but closer to the Port of Nome entrance, to provide waves and currents for vessels operating in the region and using the Port. AOOS is partnering with the Port of Nome, the Marine Exchange of Alaska, and CDIP to accomplish this effort, and the buoy is scheduled to be deployed July 2018.

1.3.1.5 Map surface currents with high frequency radars (HFRs).

- **Subaward to University of Alaska Fairbanks to support operation and maintenance of three HFR sites on the Chukchi and Beaufort Seas as part of a consortium;**

- Demobilize HFR field sites for Arctic winter; Original Completion Date: November – December 2017.

Status: Complete. Successfully demobilized HFR field sites for Arctic winter.

- All collected data will be made available in real-time to the IOOS HFR national data server, as well as to AOOS and Axiom and archived at the University of Alaska Fairbanks in the standard CODAR software formats for spectra, diagnostic, radial, and totals files.; Original Completion Date: May 2018.

Status: Complete. Data were available to and served on the IOOS HFR national data server, from which AOOS and Axiom could download the files in real-time. All spectra, diagnostic, radial, and totals files are archived at the University of Alaska Fairbanks in duplicate.

1.3.2 Coastal Hazards & Inundation

1.3.2.6 Increase water level observations in western & northern Alaska

- **Subaward to the Alaska Department of Natural Resources.**

- Complete flood communication mapping for 5 communities on the west coast of Alaska; Original Completion Date: December 2018.

Status: On Track. Developing a new tidal datum conversion tool was not successful and not all communities have sufficient data for maps. Maps will be created for five communities that have the necessary baseline information.

- Install at least 4 tide staffs opportunistically (Deering, Quinhagak, Nunapitchuk, and White Mountain) with survey report; Original Completion Date: July 2018

Status: On Track.

- Complete maintenance of current operational water level sensors that have experienced gaps in data or are no longer transmitting; Original Completion Date: May 2019.
Status: Delayed. Tununak and Wales igages are being evaluated. New igages are to be installed in Dillingham, Chignik, and Kotzebue. Will be completed by August 2018.
- Assist the Alaska-based weather forecasting offices of the NWS with storm forecasting and post-storm cataloging of storm conditions. Original Completion Date: May 2018.
Status: Complete.
- Establish collaboratively developed content for online information for the Water Level Network of Alaska website; Original Completion Date: May 2018.
Status: Complete.

- **Subaward to UNAVCO to install one GPS telemetered water level station in St. Michael; Original Completion Date: May 2018.**

Status: Delayed. Completed the onsite assessment at St Michael and verified viable station communications and logistics. Permitting delayed installation until spring 2018. The installation is underway and expected to be completed in June. Raw data will be operational soon after installation is complete. AOOS is looking for options to process the data to produce water level information, as there is no standard processing algorithm commercially or publicly available.

1.3.2.7 Increase wave observations for forecasting and planning

- A CDIP wave/current buoy was obtained and is being shipped to Nome by NOAA's Fairweather for deployment outside the Port of Nome in July 2018.

1.3.2.8 Initiate statewide geospatial mapping coordination

- Marta Kumle was hired for a short-term AOOS position to develop a statewide coastal mapping strategy and implementation plan with support from NOAA and the state of Alaska. She was the primary organizer of the Alaska Coastal Mapping Summit held February 9 in Anchorage. She authored the summit report and began work on a statewide strategy and plan. She is currently on family leave and will return to work in August.

1.3.3 Ecosystems, Fisheries & Climate Trends

1.3.3.1 Sustain ship-based sampling along the Seward Line.

- **Subaward to University of Alaska Fairbanks to support two sampling cruises along the Seward Line; Original Completion Date: May 2018.**

Status: Complete. The spring cruise was completed April 30-May 5.

1.3.3.2 Support ecosystem moorings in Alaska's Large Marine Ecosystems.

- **Subaward to University of Alaska Fairbanks to begin the incremental build-out of a moored Gulf of Alaska Ecosystem Observatory (GEO) by providing funding for equipment purchases.**

- Complete design of real-time surface buoy and data transmitting features; Original Completion Date: May 2018.

Status: Complete. Equipment purchases have begun.

- Construct project website; Original Completion Date: August 2018.

Status: On Track.

- Assemble first mooring for deployment; Original Completion Date: July 2019.

Status: On Track.

- **Continue support to UAF for Chukchi Sea Ecosystem Mooring.**

- 2017 mooring turnaround was successful using ship of opportunity. Cleaning, download, and calibration of instruments was conducted following the 2017 deployment and instruments are being prepared for a summer 2018 deployment.

1.3.3.3 Pilot use of gliders to monitor ocean conditions and marine mammals

- **Subawards to Woods Hole Oceanographic Institute, University of Alaska Fairbanks and University of Washington to conduct a simultaneous marine mammal and oceanographic survey of the Chukchi Sea using a Slocum autonomous underwater glider during the summer of 2017.**

- Data QA/QC'd and delivered to Axiom; Original Completion Date: June 2018.

Status: On Track.

- Complete a comparative assessment of noise levels of a pumped CTD versus an unpumped CTD to ensure that changing to a pumped CTD would not negatively impact marine mammal detections; Original Completion Date: March 2018.

Status: Complete. March 2018.

- Update marine mammal call library, prepare DMON, prepare glider. This includes installing a new science bay and a pumped Seabird CTD; Original Completion Date: April 2018.
Status: Complete. April 2018.
 - At-sea test of glider near Seward, Alaska; Original Completion Date: May 2018.
Status: Complete. May 2018.
- 1.3.3.4 Host regional ATN workshop
AOOS hosted a regional ATN workshop December 5-6, 2017 with more than 50 participants in person and on line. Original Completion Date: December 2017.
Status: Complete. Working with Bill Woodward on final report.
- 1.3.3.5 Regional Sentinel Observations
- **Subaward to Prince William Sound Science Center to support partnership to operate and maintain acoustic arrays across major PWS entrances and maintain conductivity sensor.**
 - Clean conductivity sensor. Original Completion Date: December 2017.
Status: Complete.
 - Upload data from OTN array. Original Completion Date: February 2018.
Status: Complete.
 - Submit data to OTN. Original Completion Date: March 2018.
Status: Complete.
 - Upload PWSSC OTN data to PWSSC historical data workspace. Original Completion Date: March 2018.
Status: Complete May 2018.
 - Swap and calibrate conductivity sensor: Original Completion Date: May 2018. Status: Delayed. Calibration completed May 2018. Swap delayed until June 2018 due to weather.
 - **Funding set aside to NOAA/UAF's Kasitsna Bay Laboratory and other partners to collect oceanographic data along repeated transects in Kachemak Bay and lower Cook Inlet.**
 - Conduct monthly CTD surveys at mid-Kachemak Bay transect; Original Completion Date: May 2018.
Status: Complete. Monthly mid-Kachemak Bay oceanographic surveys were completed on 14 December 2017, 17 January 2018, 2 March 2018, 27 March 2018, 23 April 2018 and 24 May 2018.
 - Conduct three seasonal surveys at outer Kachemak Bay transect (spring, summer, fall); Original Completion Date: May 2018.
Status: Complete. One seasonal outer bay survey was on 23 April 2018.
 - Conduct two seasonal oceanographic surveys on an along-Kachemak Bay transect (spring, summer). Original Completion Date: May 2018.
Status: Complete. Six along-Kachemak Bay oceanographic surveys (4 more than milestone) were completed for the reporting period, on same dates as mid-Kachemak Bay surveys (see first bullet). We are leveraging support from NCCOS and EVOSTC to increase the frequency of along-estuary sampling.
 - Deliver quality assured/quality controlled oceanographic data to AOOS data contractor Axiom. Original Completion Date: May 2018
Status: Complete. QA/QC'd oceanographic data from the Kachemak Bay surveys through 24 May 2018 was provided to Axiom via the Research Workspace.
 - Present oceanographic and nutrient monitoring results at one or more science conferences annually (Alaska Marine Science Symposium or other); Original Completion Date: May 2018.
Status: Complete. Kachemak Bay oceanographic sampling results were presented by Kris Holderied at:
 - 1) Alaska Marine Science Symposium in Anchorage, AK in January 2018 in a poster entitled "Variability in estuarine salinity and stratification in Kachemak Bay, Alaska from 2012-2017";
 - 2) Ocean Sciences meeting in Portland OR in February 2018 in a poster entitled "Variability in Nearshore and Estuarine Oceanographic Conditions in the Northern Gulf of Alaska: 2004-2016"; and
 - 3) Kachemak Bay Science Conference in Homer AK in March 2018 in talk entitled "Heating up and cooling off in Kachemak Bay Alaska – what does it mean for the marine ecosystem?"

- Participate in one or more science outreach events, using graphic products developed from Kachemak Bay oceanography data (e.g., Kachemak Bay NERRS Discovery Labs); Original Completion Date: May 2018.
Status: Complete. Project data visualizations were used by Kris Holderied in a training for Center for Alaskan Coastal Studies (CACS) seasonal education staff in April 2018. CACS staff provide marine science education for K-12 students in Kachemak Bay.

1.3.4 *Water Quality*

1.3.4.1 Sustain Ocean acidification (OA) monitoring including moorings, sampling along the Seward Line, Burkolators and an instrumented ferry.

- **Subaward to University of Alaska Fairbanks to continue a ten-year time-series in the Gulf of Alaska along the Seward Line as well as support the deployment of OA moorings adjacent to the oceanographic sampling line.**

- Support equipment maintenance and turnaround for OA surface mooring sites; Original Completion Date: Spring 2018.

Status: Complete. The GAKOA surface mooring was turned around in late February 2018. The GAK 1 subsurface mooring was turned around in May 2018. The M2 surface mooring was deployed in May 2018. The M2 subsurface mooring was turned around in May 2018. Supporting water sample collection at the GAKOA mooring to facilitate in-situ sensor validation.

- **Subaward to Alutiiq Pride Shellfish Hatchery to maintain continuous ocean acidification monitoring using a permanently installed Burke-o-Lator; Original Completion Date: June 2018.**

Status: Complete. Installed Burke-o-Lator has been continuously monitoring seawater during this project period.

1.3.4.2 Support Alaska OA Network

- **AOOS received funding from the national OA Program to support the Alaska OA Network.**

- Support travel for OA Q&A sessions, roundtables, and presentations in coastal communities. Original Completion Date: May 2018.

Status: Delayed. Funding has supported five trips with the remaining travel funding expected to be used for researcher presentations in Yakutat in July 2018, and in Bering Sea communities in August 2018.

- Update and develop outreach materials. Original Completion Date: May 2018. Status: Delayed. Some materials still in progress. Existing outreach materials updated and reprinted, and new card for fishermen produced. OA Network pop-up in development, to be completed in July.

- Purchase OA kits for science classes. Original Completion Date: May 2018.

Status: Delayed. Kit components have been researched; purchases to be made in July 2018.

1.4 Data Management & Communications Subsystem, subaward to Axiom Data Sciences

1.4.1 *Provide Core Data Management Support*

1.4.1.1 Provide technical support for AOOS cyber infrastructure.

- Throughout this performance period project, Axiom ensured that the AOOS Data System was healthy, secure and monitored; provided technical support to system problems; and mapped out future upgrade strategies.
- A prototype version of new sensor and model system is actively being developed to monitor and display current status. This system will make adding new sensor datasets and maintaining existing sensor datasets much less cumbersome.

Status: On Track.

1.4.1.2 Continue development of AOOS Data Portal.

- During this performance period, three versions of the beta AOOS Data Portal were released from the AOOS home page in a test environment. These portal functionality enhancements were informed by earlier feedback from the AOOS and greater IOOS user communities. Additionally, some of these iterations included feature enhancements that were a direct result of AOOS testing and feedback of the beta capabilities. A summary of the version releases is below and full release notes can be found at: <https://axiomdatascience.com/portal-updates/>
 - Version 2.5: In February 2018 the opt-in 2.5 beta version was released, which featured the integration of biological vector data layers with physical and environmental data. Enhancements were made to Data Views to include the stations or spatial areas of interest in a map; individual

stations or spatial areas were uniquely numbered for easier identification in data charts; and improved the ability for users to download data and add individual charts to a data comparison.

- Version 2.6: In March 2018, the opt-in 2.6 beta version was released, which optimized the portal search engine and reworks the catalog and metadata views. The catalog now includes icons for quick, visual identification of data types (e.g. layers, sensors, and mobile platforms). Enhancements were made to more easily manage layers and download or add interactive data to a map.
- Version 2.7: Enhancements were made to partition real-time from historical data feeds to quicken load speeds. Additionally, real-time conditions are available on a mouse hover and persist to selected data views.
Status: Complete.

1.4.1.3 Implement QARTOD QA/QC checks for AOOS real time data feeds.

- In April 2018, the redesigned v2 sensor system was integration into the back-end portal systems for improved handling of in-situ data ingestion. The full-integration of the v2 sensor system will facilitate management of multiple overlapping time-series generations (e.g. raw data, provider QCed data, revised data) and include support for QARTOD checks. The new system is also being designed with monitoring and transparency in mind and will make adding new sensor datasets and maintaining existing sensor datasets much less cumbersome. The current system will continue running until full integration of the new system is complete (December 2018).
- AOOS is on track to fully implement QARTOD by the end of the calendar year.
Status: On Track.

1.4.2 Provide DMAC support to the AOOS program

1.4.2.1 Provide overall DMAC project management and oversight.

- Participated in regular, bi-monthly meetings with AOOS to discuss and communicate progress on project tasks. Maintained a Trello project management board to track progress.
Status: On Track.

1.4.2.2 Participate in regional, state, national and international DMAC activities

- Prepared for and participated in IOOS MBON Biological Workshop (Feb 2018) and IOOS DMAC Annual meeting (May 2018).
- Attended or presented at the following meetings related to AOOS DMAC activities: Arctic Domain Awareness Center (ADAC), Alaska Landscape Conservation Cooperative, Ocean Acidification Network, AK Harmful Algal Bloom, Network, AK Department of Natural Resources, Audubon Alaska, Cook Inlet Regional Citizens Advisory Council, Biological and Chemical Oceanography Data Management Office (BCO-DMO), Alaska Fisheries Development Fund, The Nature Conservancy, and NOAA Water Level and NOAA Office of Coastal Management meetings with Axiom.
- Hosted calls, as needed, with PIs about the Research Workspace and its metadata editor.
Status: On Track.

1.4.2.3 Implement recommended and standard data management procedures for AOOS data assets.

- Maintained IOOS compliant services and applications for integration with national products.
 - Upgraded THREDDS to 4.6.10 - <http://thredds.AOOS.org>.
 - Upgraded ERDDAP to 1.80 and then again to 1.82 - <http://erddap.AOOS.org>.
 - Updated AOOS ISO WAF - <https://thredds.AOOS.org/iso>.
- Made programmatic improvements to operationalize the ERDDAP API instance for external users and systems to interact with real-time AOOS data served through the HPC cache. This API emulates the SOS style requests/response services in addition to several higher-level methods which allow users access summary analytics and advanced packaging of data for downloading.
- Provided formal data management support for AOOS-funded projects, including marine mammal gliders, AK DNR coastal profiles, Chukchi Sea ecosystem mooring, and the Seward Line. Support included ingesting, formatting, and serving data and metadata through the AOOS Workspace and related data portals.
Status: On Track.

1.4.2.4 User Engagement, Data Requests, and User Support (feedback, response and actions plus fielding requests for data).

- Hosted a half-day workshop entitled AOOS data portal at Kachemak Bay Science Conference (March 7, 2018).
- Conducted quarterly portal feedback synthesis with AOOS staff to identify, respond to, and develop a strategy to modify and improve AOOS tools to meet end user needs.
- Synthesized a user feedback survey on the AOOS data portal to solicit feedback from end users on the v1.1 and beta v2 portals.
Status: On Track.

1.4.3 *Develop and maintain special data products*

1.4.3.1 Support existing products.

- Developed AOOS-branded data portal help documentation, including animated how-to tutorials, available at: <https://portal.aos.org/help/>.
- Maintained and continued development of an Alaska Harmful Algal Bloom (HAB) map that aims to reduce health risks to humans from HABs by providing access to up-to-date results for phytoplankton and shellfish biotoxin monitoring across Southeast and Southcentral AK regions.
- Created an US Arctic Observing Network website in collaboration with NOAA partners to support the ‘Mobilizing Arctic Observing in Support of Societal Needs’ effort.
Status: On Track.

1.4.3.2 Ingest new data.

- Progress towards ingesting or resolving datasets in the AOOS data portals:
 - AK DOT webcams;
 - NOAA COOPS tide stations updates (all);
 - Lowell Pt camera attribution update;
 - Marine Exchange real-time station ingestion fix;
 - Update ACCCS/AKEPIC wetland map netCDF files;
 - ShoreZone video & image locations fixes;
 - SEATT HAB integration issues with SoundToxin;
 - Wave Watch 3;
 - updated SNAP climate projections;
 - MASIE sea ice extent model (2011-present);
 - OSTIA: Operational Sea Surface Temperature and Sea Ice Analysis.

Status: On Track.

1.4.3.3 Develop new data products.

- Tested and enhanced ncWMS2 for advanced web mapping of gridded datasets. Migrated gridded dataset ingestion to modern, fault tolerant ingestion framework.
- Developing enhancements for visualizing and parsing mobile sensor data.
- Developed Arctic Assets data layer.
- Ingested and updated metadata for Cook Inlet Subsistence data layer.
- Technical support for Research Workspace and folder organization structure developed for Cook Inlet Salmon Modeling project.
- Prepared mock-ups of Tier 2 and 3 data inventories similar to the CO-OPS water level station site to present at and gather feedback during two days of water level working group meetings (May 22-23). Integrated real-time sensor catalog with Alaska HAB Network map to allow for comparisons between phytoplankton abundance and shellfish toxicity values.
- Created climatology tool integrated into the AOOS Ocean Data Explorer that quickly generated timeseries plots and allows users to parse and download data. The product includes the ability to create on-the-fly summary charts, including: seasonal summary statistics, standard deviations, anomalies charts, and custom time binning.
- Developed a prototype version of the Grumbine Model, which is a high-resolution, integrally-coupled ice, tide, wind-wave, and storm surge model for Western Alaska. The intent of this project is to quantify the effect of reduced nearshore ice coverage on coastal flooding.

Status: On Track.

1.4.4 *Provide Data Management services for integrated research programs using other funding:*

- MARES Research Program: Provided BOEM with 2017 field season deliverables and provided vetted metadata.

- Central Beaufort Sea Wave, Sediment and Hydrodynamic Study (BOEM): Most of the historical data have been accessed. Data salvage efforts underway for Endicott data.
- NSB Data Management Project: Continuing data coordination with individual PIs to compile and curate historical data and generate metadata.
- AIERP Research Program: Attended & presented at regular AIERP PI monthly meetings; attend regularly meetings; >60% of PIs have preliminary data stored in Workspace; good progress with PI-authored metadata.
- EVOS (Gulf Watch and Herring Programs): Attended and presented quarterly data management updates. Data ingestion on target. Metadata schema updates in preparation for the next round of archived datasets submitted to DataONE June 2018.
- UAF LTER: Developed a data inventory and management plans for all projects. LTER has completed their first cruise on the Sikuliaq, while simultaneously planning for the next LTER cruise in July.
- NPRB Special Project: Continued support for the annual research data submission cycle and updating of the administrative reporting tool. Research Workspace set up to receive 2018 newly awarded projects. Status: On Track with these projects which use other funding.

1.4.5 Support national IOOS Program data management activities

1.4.5.1 Continue enhancements to the Environmental Sensor Map

- **Develop next generation National Sensor Map deployed with technical documentation; Original Completion Date: April 2018.**

During this performance period, two versions of the beta IOOS Environmental Sensor Map were released with a final, operational version made publicly-available in May 2018. These portal functionality enhancements were informed by earlier feedback from the IOOS user community. A summary of the version releases is below and full release notes can be found at: <https://axiomdatascience.com/portal-updates/>

- Version 2.5: In February 2018 the opt-in 2.5 beta version was released. Enhancements were made to Data Views to include the stations or spatial areas of interest in a map; individual stations or spatial areas were uniquely numbered for easier identification in data charts; and improved the ability for users to download data and add individual charts to a data comparison.
- Version 2.6: In March 2018, the opt-in 2.6 beta version was released, which optimized the portal search engine and metadata views. Enhancements were made to more easily manage layers and download or add interactive data to a map.
- Version 2.7: Enhancements were made to partition real-time from historical data feeds to quicken load speeds. Additionally, real-time conditions are available on a mouse hover and persist to selected data views. The map was made operational with enhancements to the main landing page. Technical document for use of the new sensor map was developed at: <https://sensors.ioos.us/help/>
Status: Complete.

- **Determine best suite of data servers for Environmental Sensor Map; Original Completion Date: May 2018.**

Updated sensor attributions to include accreditation of RAs as owners vs affiliate in map station popups. Provided technical assistance to RAs to correct attribution at the source (e.g. sensor metadata), as appropriate. Implemented administrative interface for sensor dashboard to update agent attributions displayed in the Environmental Sensor Map.

Status: Complete.

- **Develop release plan and test environments to accompany deployment of data servers; Original Completion date: May 2018.**

Installed an ERDDAP server to provide external users and systems programmatic interaction with the data in the HPC cache. Tested output from the server for netCDF compliance using the Compliance Checker. Developed guidelines for RAs for provision of data to the server/cache. Developed a strategy to determine the best suite of data servers (e.g. SOS vs ERDDAP) as the encouraged way to serve data within the IOOS enterprise and to test the efficacy of these servers.

Status: Complete.

1.4.5.2 Support ATN DAC

- **Expose SECOORA OTN Node supporting FACT group and/or the AOOS Arctic telemetry network data through ATN DAC; Original Completion Date: May 2018.**

Axiom worked with existing regional animal telemetry researchers and aggregators, including the Marine

Arctic Ecosystem Study (MARES), NOAA-AFSC Marine Mammal Lab, and the Florida Atlantic Coast Telemetry (FACT) project, to enable their datasets to be ingested into the Stanford ATN DAC through data feeds. This involved ingesting animal telemetry data initially into a Regional Association data system (for example, AOOS and SECOORA) under the support of Axiom and then making it available to the ATN DAC using local ERDDAP servers.

Status: Complete.

- **Deploy ATN Asset Inventory Data Visualization System to IOOS Website; Original Completion Date: June 2018.**

During this performance period a prototype version of an interactive web-based tool was migrated from the NOAA-SWFSC and deployed on Axiom's infrastructure to geographically display ATN assets. The map can be found: <http://atn.axds.co/map/#map> The map is connected to the ATN ERDDAP instance and will continue to be refined to improve the dynamic display.

Status: On Track.

1.4.5.3 *Support NOS OCS AIS, Marine Traffic Information Interactive Web Tool*

- **Develop and refine web page tool for public access to AIS Vessel Traffic Data Products; Original Completion Date: June 2018.**

Axiom researched and developed an interactive web tool for Automatic Identification System (AIS) data storage and high-resolution charts of priority areas.

Through this effort, Axiom provided the research and software development necessary to develop an interactive web portal for accessing AIS data processing and parameters to use AIS information with specified parameters for different projects.

In addition to the web tool, Axiom provided high-resolution products for chart analysis that are needed to improve and enhance vessel management decision-making. Some of these products included a total count of vessels in specific areas and specific grid cell size, as well as Under-Keel Clearance calculations in specific areas and specific grid cell size. The interactive web tool and vessel traffic data products can be accessed at: <http://ais.axds.co/>

Status: Complete.

1.4.5.4 *Create and curate vessel heatmaps from AIS ship location data for NESDIS BEDI*

- **Develop spatio-temporal vessel heatmaps served via existing AOOS/IOOS resources; Original Completion Date: April 2018.**

Status: Complete. For this project we took raw AIS data (provided from Marine Cadastre 2009-2014, NOAA OCS Satellite 2015-2016, and Marine Exchange Alaska 2013-2017) held by a variety of federal entities, cleaned and aggregated the data to produce spatio-temporal vessel heatmaps as GeoTIFF and netCDF files served via publicly-accessible AOOS/IOOS resources. The data have been fully curated in preservation-ready data packages and are available at: <http://ais.axds.co/>.

- **Curate and archive final datasets in NOAA Data Catalog and a federal data repository; Original Completion Date: May 2018.**

Status: On Track. This project resulted in data curation and exposure of the final data products via a number of access methods. Final data products are a series of datasets composed of vessel traffic heatmap files that are segmented by region (US EEZ Continental US, US EEZ Alaska, US EEZ Pacific), ship type, month, and year, which describe aggregate traffic information extracted from the raw AIS data. The files are in GeoTIFF format at 500-meter resolution and in an Albers Equal Area projection. Each data product is accompanied by a metadata record in the ISO 19115-2 standard.

The results of this project are made publicly available without restrictions on use through the AIS Vessel Traffic Data Products portal: <http://ais.axds.co>. Here users can search for and download data and metadata produced by the project, in addition to learning more about the data processing methods.

Effective June 2018, these files will also be exposed through ERDDAP in GeoTIFF and/or netCDF format for interoperable data access. Through this service, metadata will be harvested by the IOOS Catalog and fed to data.noaa.gov. Products from this work will be made available through an existing interactive data catalog and mapping interface maintained by the US IOOS program. The Catalog will allow potential users to discover the data and the mapping interface allows them to quickly and easily explore the resulting summaries, both qualitatively and quantitatively.

Final data products will also be submitted to the NCEI archive for long-term preservation.

1.4.5.5 *Support Marine Biodiversity Observing Network (MBON) portal*

- **Enhance MBON Portal based on user feedback; Original Completion Date: July 2018.**

Status: Complete. During this performance period, two versions of the enhanced MBON Data Portal were released in a test environment. These portal functionality enhancements were informed by earlier feedback from the MBON user community. Additionally, some of these iterations included feature enhancements that were identified at the MBON Biological Workshop held in Seattle, WA during February 2018. A summary of the version releases is below and full release notes can be found at: <https://axiomdatascience.com/portal-updates/>

- Version 2.0: In February 2018 the opt-in 2.5 beta version was released, which featured the integration of biological vector data layers with physical and environmental data. Data comparison tool was added for different data types, including biological, real-time sensor, models and forecast layers. New biological data layers were made available in pilot mode through the MBON Data Portal.
- Version 2.1: This version optimized the portal search engine, integrated feedback from the MBON Progress Review 1, and reworked the catalog and metadata views. The catalog was improved to include icons for quick, visual identification of data types. Enhancements were made to more easily manage layers and download or add interactive data to a map.
- Version 2.2: In May 2018, this version included the operational release of the portal based on feedback from the MBON Phase 2 review. Enhancements were made to partition real-time from historical data feeds to quicken load speeds. More biodiversity data layers were exposed following geoserver migration in version 2.1.
- **Determine most efficient process and data formats for future submissions of data to portal; Original Completion Date: February 2018.**

Status: Complete. Created technical documentation for the desired format for easy ingestion of external data sets into the portal, notably biological datasets. The documentation is available both at publish to ioos.github.io and <https://mbon.ioos.us/help/>.

1.4.5.6 *Support further development of the USGS data portals*

- **Deploy maintenance and software developments to existing CMGP photography and video portal and CMGP oceanographic model and data portal. Original Completion Date: June 2018.**

Status: Complete. Provided high performance data hosting support, including regular periodic updates, back up, troubleshooting and bug fixes for the USGS Coastal and Marine Geology Program (CMGP)'s photography and video portal (<http://cmgvideo.usgsportals.net/>) and oceanographic model and data portal (<http://cmgdata.usgsportals.net/>).

Developed photo server software for the existing CMGP photography and video portal for stakeholders to readily ingest and host images on the video portal. Updated existing applications to use Axiom's photo server and removed Google's retired Picasa API.

Provided technical support to USGS to enhance the existing portal with new data layers, including Hurricane Opal 1995, Gulf Coast Baseline 1996, Hurricane Bertha 1996, Gulf Coast Baseline 1997, West Coast Baseline 1997, Gulf Coast Baseline 98a, Pulley Ridge, Hurricane Elena 1985, Juan de Fuca 1985, Gorda Ridge 1985, Gorda Ridge 1986. Glacier Bay, and USGS California Seafloor Imagery.

1.4.5.7 *Support Marine Mammal Stranding Network*

- **Visualize marine mammal stranding data in all regional IOOS Association portals. Original Completion Date: June 2018.**

Status: Complete. Developed a prototype interactive data map of marine mammal stranding and health data within the International Ocean Observing System (IOOS) portal for access and visualization through Regional Association nodes. <http://axiomdatascience.com/maps/marine-mammal-health-map/>

Incorporated user feedback to refine and optimize the display of the data and map performance.

Worked with Gulf of Mexico project partners to implement a web-based data sharing tool (Research Workspace) to ingest data into the map platform.

Participated in regular planning meetings and hosted several webinars to demonstrate and receive feedback on prototype versions.

1.5 Modeling, Analysis & Product Development Subsystem

1.5.1 *Support existing models & data products including Historical Sea Ice Atlas, Research Assets Map and Yukon-Kuskokwim Chinook Run Timing Forecast*

- **Subaward to University of Alaska International Arctic Research Center to update Historical Sea Ice Atlas twice a year; Original Completion Date: April 2018.**

Status: Complete. The Historical Sea Ice Atlas (HSIA) was updated to include data for the final six months (July-December) of 2017.

- **Subaward to Axiom Data Science to support 2017 Yukon-Kuskokwim Chinook Run Timing Forecast; Original Completion Date: May 2018.**

Status: Complete – May 2018.

- **Subaward to Axiom Data Science to support Research Assets Map; Original Completion Date: Ongoing.**

Status: On Track.

1.5.2 *Continue to assess support for ROMS forecasts for PWS and GOA*

The PWS ROMS Model was funded by PWSSC through May 2017 for completion of a circulation study of Valdez Arm. With that project now complete, we no longer support this model and are still assessing the role of AOOS in various modeling activities.

1.5.3 *Continue support for Model Explorer and increase capabilities*

- **Support Model Explorer; Original Completion Date: Ongoing.**

Status: On Track.

1.5.4 *Continue to explore support for Alaska Modeling Testbed*

- **Explore support for Alaska Modeling Testbed; Original Completion Date: Ongoing.**

Status: Delayed. Our meeting with the Alaska National Weather Service office to discuss how best to collaborate with their new Arctic Modeling Testbed and their new Alaska Environmental Services and Integration Center was delayed due to some temporary personnel assignments by NWS. We plan to re-schedule this meeting for summer 2018, and are exploring, with separate funding, working with Axiom to test the use of a new circulation model for the Arctic.

1.6 Additional Activities and Successes Related to Mission

- Continued financial support for the Alaska Harmful Algal Bloom Network is being sought.
- Future support by AOOS for the ShoreZone program, largely funded by NMFS, continues to be pursued, but with a later timeline.
- With the discontinuation of funding for NOAA's Cooperative Institute for Alaska Research, AOOS was able to work with NOAA's Ocean Acidification Program to ensure funding support continues for the University of Alaska's OA Research Center.
- AOOS continues to facilitate more extensive engagement by NOAA's Office of Coastal Management by hosting a visit of their leadership May 22-25, which included site visits in Anchorage, Nome and Homer.
- McCammon, other members of the Interagency Arctic Research Policy Committee's Environmental Intelligence Team, NOAA's Alaska Regional Coordinator Amy Holman, Darcy Dugan and the Alaska Harmful Algal Bloom (HAB) Network, and Alaska Sea Grant's Gay Sheffield are all working together to facilitate a more coordinated response to increased concerns by Bering Strait residents for potential increased HABs impacts due to warm ocean waters and reduced sea ice. A number of coordination teams and advisory groups have been established.

2.0 Scope of Work

- We do not expect any changes to the project Scope of Work at this time.

3.0 Personnel and Organizational Structure

There have been no changes in AOOS personnel or organizational structure.

4.0 Budget Analysis

All financial reports are up to date and have been submitted on time. There are no risks to the project that need identifying. There was no equipment purchased during this period.