

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, 2018 – May 31, 2019
Prepared by Molly McCammon, Project PI on June 27, 2019

1.0 PROGRESS AND ACCOMPLISHMENTS

1.1 Regional Governance & Management Subsystem

1.1.1 Support ongoing board and committee activities.

- The AOOS Board’s Executive Committee met March 1 to take action on spending some of the discretionary funding in the FY18 budget. The Board approved using Fill the Gaps funds for a new AIS/weather station on St. Lawrence Island. The biology funds are being used to incorporate the COASTT seabird die-off surveys into the Ocean Data Explorer. The EXCOM also met April 10 to conduct McCammon’s review of her past year’s performance and proposed work plan.
- The full AOOS board met in Anchorage May 22 to approve the annual budget and work plan, which starts June 1.
- The 3 state Trustees have been replaced following the election last November of a new Governor. These are Commissioners Doug Vincent-Lang (ADF&G), Jason Brune (ADEC) and Corri Feige, with Deputy Commissioner Sara Longan, designee (ADNR).
- The makeup and functions of the Data Management Advisory Committee are still being reviewed.

1.1.2 Provide ongoing fiscal and administrative oversight for program.

- Executive Director Molly McCammon conducted the annual evaluation for Administration and Outreach Director, Holly Kent.
- Staff collected statements of work and budgets from PIs in preparation for Year 4 of our cooperative agreement with NOAA.
- AOOS staff helped with the annual audit, which is nearly complete.
- AOOS continues to seek additional external funding, and in this reporting period, an award from NPRB was received by Axiom, in collaboration with AOOS, to standardize and make publicly accessible 220 terabytes of acoustic data collected by Shell during its Arctic drilling exploration in 2007-2015.

1.1.3 Support national and international partnerships and collaborations.

- AOOS Director Molly McCammon testified in Washington DC in May at a House subcommittee hearing on reauthorization of the ICOOS and Sea Grant College Program Acts.
- McCammon attended two meetings in December and May by teleconference of the NOAA Science Advisory Board’s Ecosystem Services Management Working Group. The group is working on a report on new technologies to help with NMFS stock assessments.
- McCammon moderated a panel at the Consortium for Ocean Leadership’s public policy forum March 13. She also attended the spring meeting, as well as several teleconferenced meetings for the consortium.
- Operations Director Carol Janzen provided an overview of AOOS activities in the Arctic for a Japan-US Arctic Science Collaboration meeting hosted by UAF in Fairbanks March 4-6.
- Janzen provided a final report presentation to the Department of Homeland Security during the annual ADAC meeting April 11-12, highlighting the AIS for Prioritizing Arctic Charting tool.

- McCammon participated in the March IOOS meeting in Washington DC and numerous teleconferences and work groups with the IOOS Program Office and the IOOS Association.
- As one of the co-leads for IARPC's Environmental Intelligence Collaboration team, McCammon helped organize and lead a number of events highlighting the unusual weather, ice and ecosystem conditions in 2018 in the Bering Sea: oral and poster sessions, as well as a town hall at AGU in Washington DC in December; a town hall at AK Marine Science Symposium in January; and a joint multi-team session in March 2019 to discuss the additional unprecedented 2019 winter sea ice conditions and potential impacts to coastal communities, subsistence users, and fish and wildlife resources.

1.1.4 Support Alaska and regional partnerships and collaborations.

- McCammon presented at the Alaska Sea Grant site review in April.
- McCammon was re-appointed by the Anchorage mayor to serve as the municipality's representative on the Cook Inlet Regional Citizens Advisory Council. She will also continue as chair of its Environmental Monitoring Committee.
- McCammon presented to the Ocean Tuesday seminar series in March.
- McCammon participated in Alaska Sea Grant's oil spill workshop February 20-21.

1.1.5 Finalize certification application

- AOOS is working with other RAs on branding/outreach efforts for certification.

1.2 Outreach, Stakeholder Engagement & Education Subsystem

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

- 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 monthly (as needed) proposal updates for board members.
- Staff circulated an e-newsletter in May to a list-serve of over 500 recipients and distributed a printed newsletter in January 2019 at several events and meetings.
- Staff produced and distributed a press release announcing a stakeholder and general public meeting in February in Juneau on ocean acidification in Alaska.
- Kent has been working with a contractor on a refresh of the AOOS website.
- AOOS launched project webpages with data portals for Arctic Oil Spill Risk Assessment Products Using AIS and Subsistence Use Data for Decision Support and the Central Beaufort Sea Wave and Hydrodynamic Modeling Study at Foggy Island Bay/Stefansson Sound.

1.2.2 Support ongoing stakeholder interactions.

- AOOS continues to use the Alaska OA Network, the AK HAB Network, the AK Water Level Watch and other forums to engage with stakeholders. Staff are now identifying what additional engagement needs to occur in preparation for the next AOOS 5-year proposal to NOAA.

1.2.3 Support stakeholder working groups including ocean acidification network, integrated water level observation network, harmful algal bloom network.

Alaska Ocean Acidification Network

- Based on input from the network's 5 working groups, director Darcy Dugan produced a work plan for the Alaska Ocean Acidification Network and presented it to the network steering committee.
- Dugan organized a community presentation and Q&A session in Juneau with over 100 people in attendance.
- Community presentations about OA were held in Nome and Homer.
- OA presentations or briefings were provided to United Fishermen of Alaska, the Alaska Mariculture Task Force, classes at APU and University of New Haven, as well as groups in Anchorage such as Ongoing Learning and Education (OLE) and the Bartlett Club.

- An Alaska OA ‘State of the Science’ report was circulated to agencies, communities, and stakeholders across Alaska, including Alaska coastal legislators and Congressional offices.
- Dugan continued writing and producing monthly eNews, including articles about monitoring, research, outreach and scientist interviews.
- The network is working towards the production of a data catalogue for the network website.

Alaska Harmful Algal Bloom Network

- With AOOS support, Sea Grant Fellow Kayla Schommer has been coordinating the network this year.
- Schommer has been working on finalizing an AHAB Action Plan.
- The network hosted a statewide workshop in Anchorage February 15 to share updates on statewide HABs research, demonstrate the AHAB data portal supported by AOOS, revitalize the working groups, and set priorities for the coming year.
- AOOS staff and several members of the network submitted a proposal to NOAA seeking funds to enhance existing efforts in Alaska and to support a full-time AHAB coordinator. Unfortunately, the proposal was not funded.

Alaska Water Level Watch

- McCammon and Janzen continue to work with partners to implement pilot projects for alternative water level observation technologies. AOOS and Axiom used part of their Fill the Gaps add-on to develop phase I of the Alaska Water Level Watch (AWLW) data portal for the tiered water level data in Alaska. This portal will accommodate a range of observational water level data beyond just the NWLON data (which is currently the most accessible real-time data) and will mirror the CO-OPS Tides & Currents system, but will be inclusive of other Tiered water level data (B & C). Funds for Phase II of the data portal development are included in the Year 4 AOOS grant award.
- The AWLW team met April 24 to continue its collaborative activities to support water level planning and research activities. The team would like to formalize its efforts with a charter.

1.2.4 Support partnerships with marine education and outreach programs.

- Kent participated on the organizing committee for the 2019 Communicating Ocean Sciences Workshop (COSW) featuring Editor in Chief of Hakai Magazine, Jude Isabella, in conjunction with AMSS. This committee also organized a one-day science communication workshop in January led by the American Geophysical Union’s Sharing Sciences group.
- 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 January, March and May 2019.

1.2.6 Continue AOOS short film contest.

- AOOS has discontinued the film contest. The fourth and final annual Short Film Contest was held in November 2017 with 13 entries.

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

- AMSS was challenged by another government shutdown, but even with reduced attendance is still the premier marine science workshop in Alaska. AOOS had an exhibit table and several posters, and helped host the Communicating Ocean Sciences session.
- AOOS staff coordinated workshops and keynote addresses for symposium week.

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.

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.**
 - Service Snotel stations in Prince William Sound; Original Completion Date: May 2019.
Status: Delayed - Working on contract issues.

1.3.1.2 Increase access to weather observations using AIS.

- **Subaward to the Marine Exchange of Alaska to increase access to Weather Observations using AIS.**
 - Install Savoonga, St. Lawrence weather sensor; Original completion Date: August 2018.
Status: Completed – April 2019.
 - Install Gambell, St. Lawrence weather sensor; Original completion Date: August 2018.
Status: Completed – April 2019.
 - Install new weather sensor and service existing peripheral equipment at Cape Decision lighthouse; Original completion Date: August 2018.
Status: Pending - trip is scheduled for mid-July 2019
 - Install new “weather camera” on Nome Causeway showing weather conditions at Nome entrance breakwater; Original completion Date: September 2018.
Status: Delayed to week of 10 June 2019.
 - Install new weather sensor and service existing peripheral equipment at Pt. Gardner (Frederick Sound/Chatham Strait); Original completion Date: May 2018.
Status: Pending – mid-July 2019, if weather and schedule allow for the work to be done in conjunction with the Cape Decision work.
 - Install new weather sensor and service existing peripheral equipment at Rocky Island; Original completion Date: May 2018.
Status: Completed – May 2019. Upgraded the weather sensor – replaced Airmar WX150 with a Gill GMX500.

1.3.1.3 Support sea ice radar in Barrow

- **Subaward to University of Alaska Fairbanks (UAF), Geophysical Institute.**
 - Replace the UAF coastal sea ice radar system in Utqiagvik. Original Completion Date: May 2019.
Status: Pending. – System needs complete replacement. PI is seeking funds to do so, with possible AOOS contribution.

1.3.1.4 Sustain critical wave buoys for navigation safety.

- **Operate and maintain Cook Inlet buoy; Original completion date: May 2019.**
Status: On Track. The buoy was recovered last year and a replacement buoy was deployed and has been operational through May 2019.

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.**
 - Winterize systems to combat wear and tear on equipment; Original Completion Date: December 2018/January 2019.
Status: Complete – January 2019.

1.3.1.6 Install two new high frequency radar field sites in the Bering Strait

- **Subaward to University of Alaska Fairbanks to install two new HFR field sites in the Bering Strait Region.**

- Order CODAR SeaSonde equipment and remote power components; Original Completion Date: November/December 2018. Status: Complete – January 2019.
- Fabricate and test remote power module in Fairbanks, AK, acquire permits and permissions for desired field sites; Original Completion Date: January – April 2019. Status: Delayed. Permits and permissions for desired field sites have been obtained, but fabrication and testing of the HF Radar and remote power module is still in process.

1.3.2 Coastal Hazards & Inundation

1.3.2.1 Increase water level observations in western & northern Alaska

- **Subaward to the Alaska Department of Natural Resources to Facilitate an Integrated, Interagency Water Level Network for the Alaska Coast.**
 - Support 5 locations with operational real-time water level sensors by conducting maintenance. Status: On track.
 - Install tide staffs for the documentation of maximum storm water levels at locations that can be opportunistically travelled to. Status: complete.
 - Create color-indexed maps for flood communication at communities where tide datums, community infrastructure, and elevation information are available. Status: on track.
 - Develop state database for coastal storm flood documentation. Status: on track.
 - Inform the National Weather Service (NWS) of potential flood impacts in advance of storm events. Status: on track.
 - Maintain Alaska Water Level Watch Webpage. Status: on track.
 - Train NWS and SEOC to use coastal flood mapping products. Status: on track.
 - Attend conferences and meetings for discussions on water level sensors and deployments. Status: Complete
- **Subaward to ASTRA LLC for a Pilot Study to Monitor Ocean Tides and Space Weather Using GPS Receivers.**
 - Build and deliver remote power support for GPS hardware; Original Completion Date: May 2019. Status: Delayed – Delivery and installation is scheduled for completion by September 2019.
 - Remove and redeploy equipment from Seward to Anchorage and Homer and train AOOS personnel in deployment and routine maintenance of equipment; Original Completion Date: July 2018. Status: Complete – July 2018.
 - Monitor daily health status of the re-deployed equipment, review and provide quality-controlled tide and space weather data on a daily basis for these new locations; Original Completion Date: May 2019. Status: Delayed – status of equipment is monitored daily and will continue to end of agreement extended to September 2019. Equipment will be re-deployed to Utqiagvik.

1.3.2.2 Increase wave observations for forecasting and planning

- **Deploy & support CDIP Buoy in Nome; Original completion date: May 2019.** Status: On track. A new U.S. Army Corps of Engineers Coastal Data Information Program (CDIP) wave and current buoy was deployed off the Port of Nome in 2018 and will be redeployed in June 2019. Support for this buoy and data comes from the U.S. Army Corps of Engineers, the Port of Nome, AOOS, and the Marine Exchange of Alaska.

1.3.2.3 Initiate statewide geospatial mapping coordination

- Funding was acquired 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.

Status: On Track. The survey to help prioritize locations for coastal mapping was conducted in the spring. A compilation of the results into a draft report is completed and is now being reviewed internally before being circulated for broader review. A final report is expected in September.

1.3.2.4 Improve the robustness of NOAA tsunami warnings for earthquakes in Alaska.

- **Subaward with the Alaska Earthquake Center at the Geophysical Institute of the University of Alaska Fairbanks.**
 - Nikolski (NIKH) was visited February 26-28 to swap power systems and reinforce the vault door. Original Completion Date: October 2019.
Status: On Track

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 sampling along the Seward Line; Original Completion Date: May 2019.**
Status: Complete.
 - **Support determination of Carbonate Chemistry; Original Completion Date: May 2019.**
Status: Complete.

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.**
 - Continue and complete purchase of observatory equipment and hardware; Original Completion Date: October 2018.
Status: Complete.
 - Begin construction of project website; Original Completion Date: March 2019.
Status: On Track.
 - Continue equipment purchases with funds that would become available in UAF Fiscal Year 2019 (FY19); Original Completion Date: October 2018.
Status: Complete.
 - Assemble first mooring for deployment; Original Completion Date: January 2019.
Status: On Track.
- **Continue support to UAF for Chukchi Sea Ecosystem Mooring.**
 - 2019 mooring turnaround being planned for July 2019.

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.**
 - Update marine mammal call library, prepare DMON. Original Completion Date: April 2019.
Status: Complete.
 - Prepare glider for summer/fall 2019 mission. Original Completion Date: May 2019.
Status: Complete.

1.3.3.4 Host regional ATN workshop

AOOS to host a regional ATN workshop and build on data tools previously developed; Original Completion Date: December 2017.
Status: Complete.

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 2018.
Status: Completed December 2018
 - Upload data from OTN array. Original Completion Date: February 2019.
Status: Completed February 2019
 - Submit data to OTN. Original Completion Date: March 2019.
Status: Completed February 2019.
 - Upload PWSSC OTN data to PWSSC historical data workspace. Original Completion Date: March 2018.
Status: Delayed due to change in personnel.
 - Swap and calibrate conductivity sensor: Original Completion Date: May 2019. Status: Calibration completed May 2019. Swap delayed until June 2019 due to late arrival of the sensor.
- **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 2019.
Status: Complete for period, with exception of January 2019 survey, which could not be completed due to Federal government shutdown. Monthly mid-Kachemak Bay oceanographic surveys were completed on 6 December 2018, 7 February 2019, 19 March 2019, 24 April 2019 and 14 May 2019.
 - Conduct three seasonal surveys at outer Kachemak Bay transect (spring, summer, fall); Original Completion Date: May 2019.
Status: Complete for the period, with one extra survey completed for two outer bay surveys on 7 February 2019 and 14 May 2019.
 - Conduct two seasonal oceanographic surveys on an along-Kachemak Bay transect (spring, summer). Original Completion Date: May 2019.
Status: Complete for period. Five along-Kachemak Bay oceanographic surveys (3 more than milestone) were completed for the reporting period, on 6 December, 7 February, 19 March, 24 April, and 14 May 2019. 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 2019.
Status: Complete for period. QA/QC'd oceanographic data from the Kachemak Bay surveys through 19 March 2019 have been 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 2019.
Status: Complete for period. Kachemak Bay oceanographic sampling results were presented at the Alaska Marine Science Symposium in Anchorage, AK in January 2019 in two posters entitled "Ocean Acidification Variability in Kachemak Bay, Alaska" and "Zooplankton Community Variability in Cook Inlet and Kachemak Bay Alaska."

- Participate in one or more science outreach events, using graphic products developed from Kachemak Bay oceanography data; Original Completion Date: May 2019.
Status: Complete for period.
- 1) Kris Holderied and Dominic Hondolero from NOAA Kasitsna Bay Lab used graphics from project data in an evening science lecture for the public in Seldovia, Alaska in May 2019.
- 2) Project data visualizations were used by Kris Holderied in a training for Center for Alaskan Coastal Studies (CACs) seasonal education staff in April 2019. CACS staff provide marine science education for K-12 students in Kachemak Bay.

1.3.3.6 Climate Products

- **Subaward to University of Alaska Fairbanks, Alaska Center for Climate Assessment and Policy to develop distance learning modules on climate decision support.**
 - Identify training objectives, scope, delivery format, and potential audiences; original Completion Date: December 2018.
Status: Complete.
 - Develop prototype module; Original Completion Date: October 2019.
Status: On Track.

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 OA Sampling along Seward Line; Original Completion Date: May 2019.
Status: Complete.
 - Support equipment maintenance and turnaround for OA surface mooring at GAKOA; Original Completion Date: May 2019.
Status: Complete.
 - Support recovery and service of surface mooring platform at M2 and M8; Original Completion Date: May 2019.
Status: Complete.
- **Subaward to Alutiiq Pride Shellfish Hatchery to maintain continuous ocean acidification monitoring using a permanently installed Burke-o-Lator; Original Completion Date: May 2019.**
Status: Complete.

1.3.4.2 Support Alaska OA Network

- **AOOS received funding from the national OA Program to support the Alaska OA Network. Original Completion Date: May 2019.**
Status: Complete.

1.3.4.3 Support Alaska Harmful Algal Bloom Network

- **Subaward to the Native Village of Kotzebue to collect water samples and analyze for microcystins; Original Completion Date: May 2019.**
Status: Complete.
- **Subaward to Alaska Sea Grant to provide outreach support to Bering Strait Communities; Original Completion Date: September 2019.**
Status: On Track, workshops and presentations are being planned for several Bering Strait Communities.

1.3.4.4 Support the University of Alaska's Ocean Acidification Research Center (OARC).

- **Subaward to the University of Alaska Fairbanks to execute a comprehensive carbonate chemistry assessment of US Distributed Biological Observatory (DBO) activities.**
 - Analyze samples collected from the 2018 research cruise; Original Completion Date: February 2019.
Status: Delayed – Sample shipping was delayed due to the government shut down so analysis was delayed and will be completed by December 2019.
 - Participate in a national meeting or workshop; Original Completion Date: May 2019.
Status: Complete. Natalie Monacci attended the Alaska Marine Science Symposium (AMSS) in January 2019 where she met with DBO collaborators.
- **Subaward to the University of Alaska Fairbanks to support the ocean acidification monitoring network in Alaska Coastal Seas.**
 - Support equipment maintenance and turnaround for OA surface mooring at GAKOA; Original Completion Date: Spring 2019.
Status: Complete.
 - Support equipment maintenance and turnaround for OA surface mooring at M2; Original Completion Date: Spring 2019.
Status: Complete.
 - Participate in a national meeting or workshop to present any new findings; Original Completion Date: May 2019.
Status: Complete. OARC Deputy Director Natalie Monacci attended the Alaska Marine Science Symposium (AMSS) in January 2019. Poster title: Ocean Acidification Research: Using Observations and Models to Support Alaska's Blue Economy.

1.3.5 *Streamline access to Observations*

AOOS received \$75k to help fill gaps and streamline access to ocean observations.

Original Completion Date: June 2019.

Status: On track. The AOOS Board approved \$25k to go towards Phase I of a pilot data portal for Tier B and C water level data. The remaining funds are to be used for an additional AIS/weather station on St. Lawrence Island to support needs of the National Weather Service and subsistence hunters. That project is still being scoped.

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.

- Began phasing in newer generation compute nodes for faster and denser processing with lower total energy usage, evaluated new storage hardware for next storage appliance generation, implemented universal log collector for all Axiom applications; and added new data center racks for expanded capacity and growth.

Status: Complete.

1.4.1.2 Continue development of AOOS Data Portal.

- A version 2.10 of the AOOS data portal was released, which introduced portal display of existing data quality flags from sources, layer opacity controls, and updates to the visualization and data handling for moving platforms. A summary of the version releases is below and full release notes can be found: <https://axiomdatascience.com/portal-updates/>.

Status: Complete.

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

- Flags from quality tests run by data provider are viewable and available for download in the data portal and/or Axiom data servers. The basic/required quality tests for all additional AOOS assets are run on observation data in a staging environment with documentation of the test code and thresholds, with expected live release in August 2019.

Status: On Track.

1.4.2 Develop and Maintain Special Data Products

1.4.2.1 Support existing data products.

- Axiom operated and maintained existing products, as identified by AOOS and its partners, including adding tide & surge water level variable parameters to real-time sensor layer, universally updating Burkolator parameter units for consistency, updating and backfilling Extratropical Storm Surge (ETSS) model to latest production version (v2.2), and migrating source ingest and backfilling of WaveWatch III model.
Status: Complete.

1.4.2.2 Ingest new datasets and metadata.

- Axiom worked to ingest and visualize the following new datasets and metadata during this performance period: [FAA Sectional Aeronautical Charts base map](#); [UAF Shaktoolik real-time sensor station](#); 2013-2016 glider deployments from visualization test (see [example](#)); and the [Operational Sea Surface Temperature and Sea Ice Analysis \(OSTIA\)](#), an operational model that serves as an SST and ice analysis back-up to the GHRSSST MUR model.
Status: Complete.

1.4.2.3 Develop new data products.

- Axiom worked to support the needs of AOOS, through the Alaska Water Level Watch (AWLW) partnerships, to augment the existing NWLON network with coastal water level observation products (real-time stations, short-term time series, and high-water mark measurements) derived from sites with accuracy standards adequate for identified application. During this performance period, Axiom completed nearly all the Tier A (short term) data sources; identified datums for all Tier A sources; and completed the first round of visualization including station data inventories, datums in y-axes, and heatmap visualizations to aggregate water levels with different datums. This project relates to the water level activities and implementation of the NOAA tiered water level data policy for AK region. The AHAB data portal was refreshed to connect to the Sound Toxin phytoplankton database system upgrade.
Axiom created pilot Sankey diagram visualizations for the Arctic Observing Network to show the departure of sea ice from historical averages. Libraries were established to persist diagrams into the future.
Status: On Track.

1.4.2.4 Engage with data providers and data stakeholders.

- Axiom provided support services to ensure that data providers and users can access, understand, and appropriately document data (metadata and QA/QC).
Status: On Track.

1.4.3 Host and Support AOOS Website

- During the performance period the AOOS web site, hosted by Axiom, was stable and secure. Axiom worked with the AOOS Web Team on the early scoping for the website redesign and new portal interface pages.
Status: On Track.

1.4.4 Provide DMAC support to the AOOS program

1.4.4.1 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. Contributed monthly data management highlights to the AOOS newsletter
Status: Complete.

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

- Axiom attended or presented at the following meetings related to AOOS DMAC activities: Arctic Domain Awareness Center (ADAC), AK Harmful Algal Bloom, Network, AK Department of Natural Resources, Audubon Alaska, Cook Inlet Regional Citizens Advisory

Council, Alaska Fisheries Development Fund, Defenders of Wildlife, The Nature Conservancy, the NOAA Arctic Research Program Water Level and the National Weather Service, and the Bureau of Ocean Energy Management (BOEM). Axiom also participated in the 2019 Alaska Marine Science Symposium and hosted three workshops focused on data tools leveraging the AOOS data system: Metadata 411, Jupyter Notebooks, and two open office hours to provide technical assistance to researchers. Axiom also participated in national meetings of interest to AOOS and/or the IOOS community, including: NERACOOS Biological data workshop (April 2019), IOOS DMAC (April 2019), MBON All Hands meeting (May 2019), the SECOORA WebCam workshop (November 2018), and the AOOS BOD meeting.

Status: Complete.

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

- Through this period Axiom maintained IOOS compliant services and applications for integration with national products. Further, Axiom implemented ERDDAP ‘gold standard’ updates relative to the new IOOS Metadata Profile 1.2, which is being developed to inform a larger IOOS-wide strategy for migrating national sensor data products to an ERDDAP ingestion service.

Status: Complete.

1.4.4.4 Implement AOOS Data System Review recommendations

During this period Axiom began drafting the business plan based on IP considerations and cost sharing transparency, as recommended by the independent AOOS DMAC review committee in November 2017. Axiom staff continued testing of a draft disaster recovery plan with test case system failures that was established in November 2018. The test outcomes are in the process of being solidified into a formal recovery plan with an anticipated completion date of August 2019.

Status: On Track.

1.4.5 Support national IOOS Program data management activities

1.4.5.1 Continue enhancements to the Environmental Sensor Map

- Flags from quality tests run by data provider are viewable and available for download in the data portal and/or Axiom data servers for the AOOS, SECOORA, and CeNCOOS regions. The basic/required quality tests for all additional IOOS RA assets are run on observation data in a staging environment with documentation of the test code and thresholds, with expected live release in August 2019.
- A version 2.10 of the Environmental Sensor Map was released, which introduced portal display of existing data quality flags from sources, layer opacity controls, and updates to the visualization and data handling for moving platforms. A summary of the version releases is below and full release notes can be found: <https://axiomdatascience.com/portal-updates/>
- Began phasing in newer generation compute nodes for faster and denser processing with lower total energy usage, evaluated new storage hardware for next storage appliance generation, implemented universal log collector for all Axiom applications; and added new data center racks for expanded capacity and growth.

Status: On Track.

1.4.5.2 Support ATN DAC

- Evaluate, Refine and Generate Standard Operating Procedures (SOPs): v1 of the SOPs was completed and added to the IOOS Help Docs website to inform new contributors on how to register and submit data to the ATN DAC.
- Integrate programmatically with tag manufacturers to automate the ingestion of ATN data feeds: Axiom prototyped, evaluated and refined the automated ingestion and monitoring cyberinfrastructure to interact with tag manufacturer data systems at Wildlife Computers, Argos and SMRU. Wildlife Computers and Argos data flows were fully automated into the

ATN data system. Progress was made towards data ingestion from SMRU, which still currently requires manual intervention by Axiom staff due to issues on the SMRU service API end.

- Configure Research Workspace for Animal Telemetry Network: The ATN Research Workspace instance was established. The ATN instance in the Research Workspace currently contains 16 contributing organizations amounting to 38 projects representing over 250 tag deployments (73 GB), all of which contain data and metadata submitted by data providers.
 - Develop ATN PI registration and project management application: This application was prototyped and operationalized in April 2019 as the backbone for centralizing tag registration, tag manufacturer information, and project data that is streaming into the ATN DAC.
 - Deploy live ATN portal to showcase ATN datasets with other IOOS data streams: The live version of portal (v1.2) was released on May 1, which incorporated user feedback and expanded real-time tag layer from beta version feedback. The ATN Data portal can be accessed at: <https://portal.atn.ioos.us/>.
 - Publish & archive ATN data, making it available for research, management, and general audiences: During this period 5 animal telemetry datasets were archived with DataONE using the automated pathway from the Research Workspace DataOne Member Node. An additional 2 datasets were prepared to a near-final curation state and are waiting final revisions from the PI prior to dataset archive.
 - Hire IOOS ATN Data Coordinator: The position was hired by CeNCOOS in March 2019, and training was completed in the Axiom office that month. Axiom maintains regular communications and weekly meetings with the ATN Data Coordinator to provide technical assistance for onboarding new data contributions to the ATN DAC.
 - Participation and presentation at the Northeast Biological Observations Workshop (May 2019) in Durham, NC, the IOOS DMAC Meeting in Silver Spring, MD (April 2019), and the MBON All Hands Meeting in Washington D.C. (May 2019).
 - Participation in regular weekly or bi-weekly calls with project partners to provide progress summaries and coordinate on Phases 2 and 3 activities of this project.
 - Evaluate current ATN functionality and synthesize feedback: Axiom complete a full technical design scoping of the backend data ingestion pathway and project management system of the ATN DAC to isolate core functionality enhancements and development to be made in Year 2.
 - Develop new use cases and functional improvements: Pilot animations of bearded seal telemetry tracks (PI: Josh London NOAA-PMEL) were created via the Research Workspace in reproducible Jupyter Notebooks.
- Status: On Track.

1.4.5.3 USGS Geospatial Data Portal Development

- Axiom worked with Rich Signell and Ellyn Montgomery to set up the USGS CSW server to serve out the USGS observations database and allow for streamlining of the portal data ingestion process. During this performance period the next steps were isolated with partners to setup a new sensor pipeline that uses the CSW server to check for new data.
- Axiom supported Ellyn to add new waves datasets to the collection of netCDF files, which were not included in the previous phases of work due to the complexity of the historic data formats.
- A new layout and style of the portal were created to be compliant with hosting on a .gov address.
- Axiom worked with Sky Bristol and Steven Aulenbach to prototype a flexible, Jupyter Notebook-based pipeline to allow their team to answer science questions asked against two very large datasets: the CONUS GAP Analysis Project and the Protected Area Database of the US.

- Axiom gave a workshop to USGS spatial analysts to familiarize them with the system and get them started using the scripts and modifying them for their own needs.
Status: On Track.

1.4.5.4 *Maintain and Enhance Data Access Services (ERDDAP) for the Environmental Sensor Map on ioos.us*

- Axiom worked collaboratively with IOOS staff to draft and revise a set of [Data Contribution Guidelines](#) that outlines standards and requirements for the formatting and dissemination of data and metadata.
- A document entitled [IOOS Data Contribution Guidelines: Proposed ERDDAP Standards](#) was created that explains proposed IOOS changes needed to switch to ERDDAP and improve data and metadata ingestion into national products. This document was vetted with a subset of the IOOS RA DMAC staff and NOAA (Kevin O'Brien, Bob Fleming) who actively work to maintain ERDDAP instances in order to get their perspective on the draft guidelines and metadata profiles. Their feedback was integrated into a revised version of these procedures.
- In concert with the proposed ERDDAP standards the IOOS Metadata Profile v1.2 was updated to accommodate these changes ([link](#)).
- To bring these standards to full light, Axiom developed "Gold Standard" ERDDAP examples that were presented and discussed at the IOOS RA DMAC meeting. See: <https://standards.sensors.ioos.us/erddap/index.html> and accompanying documentation.
Status: On Track.

1.4.5.5 *MBON Portal Development*

- New biodiversity data were ingested into the MBON Data Portal or IOOS RA portals data via standard interfaces: [Florida Coral Reef Evaluation & Monitoring Project \(CREMP\)](#) (ERDDAP refresh); [Florida Keys Reef Fish Visual Census](#); Florida Gardens NMS coral and fish biodiversity (pending); Southeast Area Monitoring and Assessment Program - South Atlantic (SEAMAP-SA) (in progress waiting for additional species data from provider); [AMBON biodiversity datasets for epifauna, seabird, marine mammals, fish, and zooplankton](#) (the later are pending NCEI data archive before public release); [Zooplankton Species Distribution and Abundance Data from the Applied California Current Ecosystem Studies \(ACCESS\)](#); and [Bering Arctic Subarctic Integrated Survey \(BASIS\)](#).
- Technical assistance was provided to data providers for aligning data to the Darwin Core and OBIS—ENV formats. All new datasets (listed above) were transformed to the Darwin Core standard for ingestion and access through the MBON Data Portal. Technical assistance was also provided to the Florida Keys National Marine Sanctuary group on their fish, coral, and water quality database for standardization and ingestion to the MBON Data Portal.
- Throughout the performance period, standard services for output enabling users to retrieve biological data from the MBON Portal were maintained.
- The MBON Data Portal infrastructure was updated to the Version 2.10, which introduced portal display of existing data quality flags from sources, layer opacity controls, and updates to the visualization and data handling for moving platforms. A summary of the version releases is below and full release notes can be found: <https://axiomdatascience.com/portal-updates/>
- Axiom participated in program meetings to represent data management for biological data and data products via the MBON Data Portal, including the Florida Keys product development workshop (April 2019) in Miami, FL and the MBON All Hands Meeting (May 2019) in Washington D.C.
Status: On Track.

1.4.5.6 *Finalize HFR Range Series File Archiving through the Research Workspace*

- Axiom worked to gain familiarity with the data formats and types coming from IOOS HFRNet to scope out the implementation for this project.

- Technical scoping was completed for the ingestion and processing workflow in Jupyter Notebook to display HFR data stored within the Research Workspace.
Status: On Track.

1.4.6 Increase Access to Biological Data

- Axiom provided initial input into biological datasets that could add value to the AOOS data portal and reviewed the OTT biology project solicitation circulated by AOOS regional stakeholders.
- Axiom participated in two planning calls with data providers for the COASST biological timeseries dataset to discuss data visualizations, standards-compliant data in the Darwin Core standard, and metadata for ingestion to the AOOS and MBON data portal
- A subaward with the COASST program at the University of Washington to prepare data for ingestion into AOOS using Darwin Core standards is underway.
Status: On Track.

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: May 2019.
Status: Complete.

1.6 Additional Activities and Successes Related to Mission

- Continued financial support for Alaska Harmful Algal Bloom Network is being sought.
- Future support for the Shorezone program is also being pursued.

2.0 Scope of Work

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

3.0 Personnel and Organizational Structure

AOOS is funding a one-year Alaska Sea Grant fellow to assist with harmful algal bloom network activities. The fellowship ends in September 2019. We did not seek an additional fellow in this year.

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. The following equipment was purchased during this period:

Quantity	Description	Cost
2	Codar System	\$138,500
1	Freezer Hut	\$9,417
1	Triodetic Foundation	\$25,350
1	Wind Turbine Set	\$18,000
1	Sea-Bird Electronics Inc / Seaphox Ocean Ctd+Ph+Do Sensor	\$23,410
1	Kongsberg Underwater Technology Inc / Contros Hydroc Co2 W/Sbe-5m	\$33,952
1	Sequoia Scientific Inc / Sediment Size Distribution Sensor	\$39,770
1	Maximet Weather Station	\$11,614
1	ISAMI-p Sensor	\$5,085
1	SAMI-Alk sensor	\$28,750