

Progress Report

Project Title: Sustaining NANOOS, the Pacific Northwest component of the U.S. IOOS

Award Number: NA21NOS0120093

Period of Activity: 01/01/2024 - 06/30/2024

Principal Investigator(s): Jan Newton, NANOOS Executive Director

1) Project Summary

Our overall project goal is to sustain the Northwest Association of Networked Ocean Observing Systems, NANOOS, as the Regional Coastal Ocean Observing System for the U.S. Pacific Northwest that serves regional stakeholders in alignment with the vision of the U.S. Integrated Ocean Observing System (IOOS®). NANOOS, with its essential subcomponents (integrated in-water and land-based Observing Systems, Data Management and Communications, Modeling and Analysis, and Education and Outreach) that are closely integrated within the national IOOS® system, provides significant societal benefits across a wide spectrum of users including federal, tribal, state, and local governments, marine industries, scientific researchers, Non-Governmental Organizations (NGOs), educators and the general public.

For FY2023 (= Y3 of the award = Y17 of NANOOS RCOOS) our objectives were to:

- 1) **Maintain NANOOS as the U.S. IOOS PNW Regional Association:** Sustain our proven role for regional coordination, administrative infrastructure, and stakeholder engagement, partnering with federal and non-federal (tribal, academic, state, local, industry, NGO, etc.) entities.
- 2) **Maintain surface current and wave observations:** Maintain existing HF-radar and wave mapping capabilities, providing critical national capacity along coasts and at critical ports.
- 3) **Sustain and enhance buoys and gliders in the PNW coastal ocean in coordination with national and regional programs:** Maintain, harden, enhance existing buoys and gliders, with focus on hypoxia, HABs, OA, and climate.
- 4) **Maintain multidisciplinary observational capabilities in PNW estuaries and the nearshore, in coordination with local and regional programs:** Sustain observing ability to aid sustainable resource management, water quality assessment, and sub-regional climate change evaluation.
- 5) **Maintain core elements of beach and shoreline observing:** Measure nearshore bathymetry, topographic beach profiles, and shoreline morphodynamics along OR and WA, contributing to hazard mitigation by providing essential observations and better decision support tools for coastal managers, planners, and engineers.
- 6) **Provide sustained support to a community of complementary regional numerical models:** Contribute to the operation of regional models, and the tools and products they support, covering the head of tide of estuaries to the outer edges of the Exclusive Economic Zone (EEZ) in both OR and WA.
- 7) **Maintain, harden, and enhance NANOOS' Data Management and Cyberinfrastructure (DMAC) system for routine operational distribution of data and information:** Sustain and enhance the DMAC system, including the NANOOS Visualization System (NVS), for dynamic and distributed data access.
- 8) **Continue to deliver existing and, to the extent possible, create innovative and transformative user-defined products and services for PNW stakeholders:** Continue our NVS innovation to succeed in this vital translation for meaningful and informative data products that address user needs and serve society.

- 9) **Sustain and diversify NANOOS engagement to the extent possible:** Continue ongoing engagement with diverse stakeholders and the public, increasing ocean awareness and literacy; to diversify the ocean and coastal workforce; to improve our ability to provide relevant ocean and coastal data and information to underserved or underrepresented communities; and to facilitate use of NANOOS products for societal objectives, the core task for which NANOOS exists.

During FY23, NANOOS has the following additional tasks funded via IOOS (1-4, 11-12) and the NOAA Ocean Acidification Program (5-10):

1. Further HABs understanding and prediction via a pilot project to support key elements needed to produce the popular Pacific Northwest Harmful Algal Bloom Bulletin including offshore and ESP sampling, beach sampling by tribes and the State of Oregon, analysis, and circulation modeling (Mordy/McCabe (CICOES/NOAA), Trainer (UW ONRC), MacCready (UW Oceanography), Litle (UW Washington Sea Grant), Kavanaugh (OSU), Newton (UW APL))
2. One-time system add-on for HFR system-wide support and replacement for HFR manufactured last century (Kosro, OSU)
3. Expenses associated with SeaSondes for HFR (Kosro, OSU)
4. One year to assist with core needs of the Regional Association in FY23 (Newton, UW)
5. Support for the NANOOS GOA-ON Co-Chair (Newton, UW)
6. Support for the NANOOS GOA-ON Data Portal (Tanner, UW)
7. Support for NOA-ON NANOOS Cha'ba (Mickett/Newton, UW)
8. Support for NOA-ON NANOOS NH-10/CB06 (Hales, UW)
9. OMAO allotment of FY23 resources in support of a vessel charter pool to service Cha'ba (Mickett, UW)
10. Support for NOA-ON NANOOS Cha'ba - Charter Vessel Pool (Mickett, UW)
11. Fabrication of a HAB water sampler for the new Seasats AUV (Mickett, UW)
12. OceanHackWeek sponsorship at UW (Mayorga, UW)

2) Progress and Accomplishments

During the project period, NANOOS accomplished its objectives outlined above. NANOOS maintained the RCOOS subsystems it has developed, implemented, and integrated with NOAA IOOS funding and substantial external leverage. NANOOS remained focused on delivering data-based products and services that are easy to use to diverse stakeholders to address high-priority issues and aid decision making. NANOOS continued its proactive interactions and regional coordination with a wide range of PNW stakeholders, to prioritize and refine our observations, products, and outreach efforts as funding allowed.

NANOOS milestones for this award are provided in Table 1 and reported on in detail throughout this document. Our assessment is that NANOOS has met these milestones for the reporting period. We report here on progress for: a) Governance and Management Subsystem; b) Observing Subsystem (surface currents and waves, shelf buoys/moorings/gliders, estuary buoys/moorings, and beaches and shorelines); c) Modeling and Analysis Subsystem (estuaries and shelves); and d) Data Management and Communications Subsystem (Data Management and Cyberinfrastructure (DMAC), User Products Committee (UPC), and Education and Outreach (E&O)).

Table 1. NANOOS Milestones.

Subsystem / Area	Milestone
Observing Subsystem	
Currents & Waves	<p>Maintain surface current and wave observations: Maintain existing HF-radar and wave mapping capabilities, providing critical national capacity along coasts and at critical ports.</p> <hr/> <p><u>PNW Coast HF Surface Current Mapping:</u> <i>Lead PI: Kosro, OSU</i></p> <ul style="list-style-type: none"> - Maintain and operate 10 SeaSonde HF sites designated as Priority 1 sites by the national HF program; these are four long-range sites in OR, three in WA, one in CA, and two standard-range sites in OR - As resources allow, - 3 Priority 2 standard-range sites covering Heceta Bank, which is a source for HABs and of strong bathymetric flow perturbation, as well as the shelf portion of the OOI Endurance Array - Deliver data via NVS - Bring all data QA/QC to meet Certification standards <hr/> <p><u>Wave Imaging at Critical PNW Ports:</u> <i>Lead PI: Haller, OSU</i></p> <ul style="list-style-type: none"> - Sustain the existing marine radar observing station at USCG Station Yaquina Bay - Provide both real-time and historical wave information via NVS; mean and snapshot radar images are real-time viewable for use in environmental characterization - Bring all data QA/QC to meet Certification standards
Shelf	<p>Sustain and enhance buoys and gliders in the PNW coastal ocean in coordination with national and regional programs: Maintain, harden, enhance existing buoys and gliders, with focus on hypoxia, HABs, OA, and climate.</p> <hr/> <p><u>WA shelf buoys/moorings:</u> <i>Lead PI: Mickett, UW</i></p> <ul style="list-style-type: none"> - Maintain the WA shelf (off La Push) Cha'ba buoy and the NEMO subsurface profiler at existing levels - Deliver NRT data streams via NVS - Bring all data QA/QC to meet Certification standards <hr/> <p><u>WA shelf HAB buoy/mooring:</u> <i>Lead PI: Mickett, UW</i></p> <ul style="list-style-type: none"> - Support for the HAB ESP deployment on NEMO mooring - Deliver NRT data streams via NVS - Bring all data QA/QC to meet Certification standards <hr/> <p><u>WA La Push glider:</u> <i>Lead PI: Lee, UW</i></p> <ul style="list-style-type: none"> - Maintain the La Push line glider at existing levels - Deliver NRT data streams via NVS - Bring all data QA/QC to meet Certification standards <hr/> <p><u>OR shelf buoy:</u> <i>Lead PI: Kosro, OSU</i></p>

	<ul style="list-style-type: none"> - Maintain the CB-06 buoy off Coos Bay at existing levels - Deliver NRT data streams via NVS - Bring all data QA/QC to meet Certification standards <p><u>Columbia shelf mooring:</u> <i>Lead PI: Seaton, CRITFC</i></p> <ul style="list-style-type: none"> - Maintain the CMOP shelf mooring at existing levels - Deliver NRT data streams via NVS - Bring all data QA/QC to meet Certification standards <p><u>Washington shelf glider:</u> <i>PIs: Barth, OSU & Seaton, CRITFC</i></p> <ul style="list-style-type: none"> - Maintain the Washington shelf glider at existing levels - Deliver NRT data streams via NVS - Bring all data QA/QC to meet Certification standards <p><u>Northern California glider:</u> <i>Lead PI: Barth, OSU</i></p> <ul style="list-style-type: none"> - Maintain the Trinidad Head, CA, glider, shared with CeNCOOS, at existing levels - Deliver NRT data streams via NVS - Bring all data QA/QC to meet Certification standards
Estuaries	<p>Maintain multidisciplinary observational capabilities in PNW estuaries and the nearshore, in coordination with local and regional programs: Sustain observing ability to aid sustainable resource management, water quality assessment, and sub-regional climate change evaluation.</p> <p><u>Puget Sound, WA, profiling buoys:</u> <i>Lead PI: Manalang, UW</i></p> <ul style="list-style-type: none"> - Maintain 6 Puget Sound estuarine profiling moorings at existing levels - Deliver data via NVS - Bring all data QA/QC to meet Certification standards <p><u>Puget Sound, WA, US ferry-box:</u> <i>Lead PI: Krembs, WDOE</i></p> <ul style="list-style-type: none"> - Maintain US-Canada ferry-box at existing levels, assuming COVID-19 does not preclude its operation - Deliver data via NVS - Bring all data QA/QC to meet Certification standards <p><u>Columbia River estuary, OR, moorings:</u> <i>Lead PI: Seaton, CRITFC</i></p> <ul style="list-style-type: none"> - Maintain CMOP estuarine moorings at existing levels - Deliver data via NVS - Bring all data QA/QC to meet Certification standards <p><u>South Slough/Coos Bay, OR, moorings:</u> <i>Lead PI: Helms, ODSL</i></p> <ul style="list-style-type: none"> - Maintain South Slough/Coos Bay estuarine moorings for the NERRS at existing levels - Deliver data via NVS - Bring all data QA/QC to meet Certification standards

Beaches & Shorelines	<p>Maintain core elements of beach and shoreline observing: Measure nearshore bathymetry, topographic beach profiles, and shoreline morphodynamics along OR and WA, contributing to hazard mitigation by providing essential observations and better decision support tools for coastal managers, planners, and engineers.</p> <hr/> <p><u>WA beach and shoreline:</u> <i>Lead PI: Kaminsky, WDOE</i></p> <ul style="list-style-type: none"> - Maintain shoreline observations in WA at existing levels - Deliver data via NVS - Bring all data QA/QC to meet Certification standards <hr/> <p><u>OR beach and shoreline:</u> <i>Lead PI: Allan, DOGAMI</i></p> <ul style="list-style-type: none"> - Maintain shoreline observations in OR at existing levels - Deliver data via NVS - Bring all data QA/QC to meet Certification standards <hr/> <p><u>WA and OR bathymetry:</u> <i>Lead PI: Ruggiero, OSU</i></p> <ul style="list-style-type: none"> - Maintain nearshore bathymetric observations of beach and shoreline morphodynamics in WA and OR at existing levels - Deliver data via NVS - Bring all data QA/QC to meet Certification standards
Modeling & Analysis Subsystem	
WA & OR Estuaries & Coast Models	<p>Provide sustained support to a community of complementary regional numerical models: Contribute to the operation of regional models, and the tools and products they support, covering the head of tide of estuaries to the outer edges of the Exclusive Economic Zone (EEZ) in both OR and WA.</p> <hr/> <p><u>NE Pacific and Salish Sea:</u> <i>Lead PI: MacCready, UW</i></p> <ul style="list-style-type: none"> - Support, at existing levels, the daily forecast model, LiveOcean, which simulates ocean circulation and bio-geochemistry in the Salish Sea and in coastal waters of the NE Pacific, including Oregon, Washington, and British Columbia - Deliver model output via NVS - Model verification and validation <hr/> <p><u>Columbia River estuary and plume:</u> <i>Lead PI: Seaton, CRITFC</i></p> <ul style="list-style-type: none"> - Support, at existing levels, the CRITFC circulation modeling and forecasting system, which covers the Columbia River estuary and plume - Deliver model output via NVS - Model verification and validation <hr/> <p><u>PNW Coastal Waters:</u> <i>Lead PI: Zaron, OSU</i></p> <ul style="list-style-type: none"> - Support, at existing levels, the OSU real-time coastal ocean forecast model, which covers the coastal waters off OR and WA - Deliver model output via NVS - Model verification and validation

Data Management & Communications Subsystem	
Data Management & Cyberinfrastructure (DMAC)	<p>Maintain, harden, and enhance NANOOS' Data Management and Cyberinfrastructure (DMAC) system for routine operational distribution of data and information: Sustain and enhance the DMAC system, including the NANOOS Visualization System (NVS), for dynamic and distributed data access.</p>
	<p><u>Mature Regional DAC Operations:</u> <i>Lead PI: Tanner, UW</i></p> <ul style="list-style-type: none"> - Sustain, refresh, and enhance a highly available, robust, distributed hardware and software environment; maintain appropriate staffing and team coordination; maintain up-to-date operations and system documentation to ensure transparent and clear descriptions of DAC architecture - Engage new local providers (not NANOOS funded), integrate their data into NVS and IOOS DMAC services; strengthen DAC capabilities and resources through regional and thematic partnerships
	<p><u>NVS Support and Development:</u> <i>PIs: Tanner & Carini, UW</i></p> <ul style="list-style-type: none"> - Maintain NVS support leveraging regional user needs, feedback, and data reviews to continually improve the relevance and quality of metadata for observing and modeling data assets integrated and served by NANOOS - Sustain & enhance existing data streams, IOOS web services, GTS submission; implement NCEI data archiving, NDBC data archiving, Glider DAC submission, QARTOD; maintain and expand ERDDAP to leverage web services, serve NANOOS applications and users; evaluate where new tech (e.g., cloud, AI, etc.) may afford NANOOS better efficiencies and robustness
	<p><u>Engagement in National and Cross-regional DMAC Efforts:</u> <i>PIs: Tanner & Carini, UW</i></p> <ul style="list-style-type: none"> - Sustain participation in IOOS DMAC community activities, including QARTOD development, semantic mapping, OGC WMS/WFS support, climatology data development, UGRID support, and shared code development and testing - Extend to other areas via pan regional products with sister IOOS RAs; engage and leverage NSF-funded OOI, international GOA-ON activities, and Canadian collaborations; engage with other West Coast and Pacific efforts, including WCGA and IPACOA
User Products Committee (UPC)	<p>Continue to deliver existing and, to the extent possible, create innovative and transformative user-defined products and services for PNW stakeholders: Continue our NVS innovation to succeed in this vital translation for meaningful and informative data products that address user needs and serve society.</p>
	<p><u>Web Site:</u> <i>Lead PI: Tanner, UW</i></p> <ul style="list-style-type: none"> - Continue to evaluate and update web content relevant to stakeholder issues, especially those related to Maritime Operations, Ecosystem Assessment, Fisheries & Biodiversity, Coastal Hazards, and Climate; improve ease of usability and user tracking capabilities
	<p><u>Tailored Products Development:</u> <i>Lead PI: Tanner, UW</i></p>

	<ul style="list-style-type: none"> - Annually evaluate priorities for products at the Tri-Com meeting (DMAC, UPS, and E&O), based on outreach feedback, regional issues, and GC input, and will implement new tailored products to the extent possible
<p>Education & Outreach (E&O)</p>	<p>Sustain and diversify NANOOS engagement to the extent possible: Continue ongoing engagement with diverse stakeholders and the public, increasing ocean awareness and literacy; to diversify the ocean and coastal workforce; to improve our ability to provide relevant ocean and coastal data and information to underserved or underrepresented communities; and to facilitate use of NANOOS products for societal objectives, the core task for which NANOOS exists.</p> <hr/> <p><u>Communication:</u> <i>Lead PIs: Wold & Newton, UW</i></p> <ul style="list-style-type: none"> - Maintain up-to-date success stories, employing effective use of social media and newsletters - Support national communication through IOOS Program Office and IOOS Association collaborations - Be responsive to regional and local events (e.g., harmful algal blooms, fish kills, marine heat waves, hypoxia, floods, etc.) to enhance relevancy to public and highlight regional stories with NANOOS members and partners - Maintain existing and build new relationships to stakeholder user groups and the education community enabling NANOOS to achieve effective education and outreach <hr/> <p><u>Product Co-Development:</u> <i>Lead PIs: Wold, UW & Allan, DOGAMI</i></p> <ul style="list-style-type: none"> - Engage users in product co-development through focus groups; use targeted interviews or surveys to garner feedback and input on products as they are developed; gain feedback and conduct self-assessment after product release - Conduct trainings to broader user groups and evaluate trainings to optimize NANOOS functionality - Engage with regional formal education communities to use ocean observing and NANOOS products to support STEM education, and with regional non-formal education communities to facilitate the use of NANOOS products to foster community ocean literacy <hr/> <p><u>Diversity, Equity, and Inclusion:</u> <i>Lead PIs: Newton & Wold, UW</i></p> <ul style="list-style-type: none"> - Work with the other IOOS regions and the Program Office on workforce development initiatives to expand and diversify the ocean, coastal, and Great Lake workforces and to improve our ability to provide relevant ocean and coastal data and information to underserved or underrepresented communities. - On a more immediate and local scale, the NANOOS “Enabling Change” working group, made up of NANOOS staff and partners (currently federal, university, and state agency) will move forward with actions that match NANOOS’ commitment ability.
<p>Governance & Management Subsystem</p>	
<p>Governance, Representation, Oversight,</p>	<p>Maintain NANOOS as the U.S. IOOS PNW Regional Association: Sustain our proven role for regional coordination, administrative infrastructure, and stakeholder engagement, partnering with federal and non-federal (tribal, academic, state, local, industry, NGO, etc.) entities.</p>

Coordination & Accountability	<p><u>Governance:</u> <i>PIs: Newton, Rome & Carini, UW</i></p> <ul style="list-style-type: none"> - Assure that NANOOS has transparent, effective, and representational governance via its Governing Council and the NANOOS Executive Committee composed of its elected Board and its functional committee chairs - Assure these bodies are engaged in NANOOS prioritization of regional needs, work effort, and product development - Assure balance of stakeholders represented in NANOOS reflects the diversity found in PNW - Conduct annual GC meeting
	<p><u>Representation:</u> <i>PIs: Newton, Rome & Carini, UW</i></p> <ul style="list-style-type: none"> - Represent NANOOS at IOOS Program Office and IOOS Association meetings, and at national meetings of significance - Engage at a regional level at meetings and workshops affecting PNW stakeholders and NANOOS
	<p><u>Project Oversight:</u> <i>PIs: Newton, Rome & Carini, UW</i></p> <ul style="list-style-type: none"> - Conduct annual all-PI meetings and Tri-Committee meetings, providing clear feedback and direction - Share project evaluation at the annual PI meeting
	<p><u>Coordination:</u> <i>PIs: Newton, Rome & Carini, UW</i></p> <ul style="list-style-type: none"> - Coordinate with West Coast RAs and other RAs to optimize and leverage capabilities and assure consistencies - Engage in sub-regional and user-group specific workshops to aid coordination and optimization of effort - Coordinate with Canada (CIOOS, MEOPAR, etc.)
	<p><u>Accountability:</u> <i>PIs: Newton, Rome & Carini, UW</i></p> <ul style="list-style-type: none"> - Submit required IOOS progress reports and respond to other requests - Attain recertification in 2023 as the Regional Information Coordination Entity of US IOOS for the PNW

A. Observing Subsystem:

Data from all assets reported here are served via [NVS](#).

CURRENTS AND WAVES

Maintain surface current and wave observations: Maintain existing HF-radar and wave mapping capabilities, providing critical national capacity along coasts and at critical ports.

PNW Coastal HF Surface Current Mapping:

- *Maintain and operate 10 SeaSonde HF sites designated as Priority 1 sites by the national HF program; these are four long-range sites in OR, three in WA, one in CA, and two standard-range sites in OR [Kosro]*
- *As resources allow, 3 Priority 2 standard-range sites covering Heceta Bank, which is a source for HABs and of strong bathymetric flow perturbation, as well as the shelf portion of the OOI Endurance Array*
- *Deliver data via NVS [Kosro]*
- *Bring all data QA/QC to meet Certification standards [Kosro]*

Status: On track

Summary: During this reporting period, work was completed for the operation and processing of data from the HF sites and their transfer to the IOOS HF data assembly center via our local portal, with CORDC uptime stats of 89% and 82% (#2 and #3 for the system) for Jan-Mar and Apr-June respectively. Our MAN1 site, at Manhattan Beach, is down due to a lightning strike and needs to be completely re-installed. Our WIN1 site, at Winchester Bay, went down March 1st due to a lightning strike and awaiting electricians to rewire the shed. All other damaged components have been replaced or sent off for repairs. Our WSP1 site, at Westport, WA, is experiencing SWR issues with the Tx antenna and will need a new upper antenna mast; it is currently operating at a diminished capacity (60-75%). The new upper mast will cost ~\$4000. The transition to new frequencies requires installation of replacement HF antennas.

Accomplishments/Successes: Operation of HF sites and data delivery. All operating sites have new computers installed and all are operating on updated software, and new updated computers are ready for down sites as well.

Problems/Delays: Permit applied for at northernmost site KAL1, in the Olympic National Park.

Non-core Task 2: *One-time system add-on for HFR system-wide support and replacement for HFR manufactured last century [Kosro]*

Status: Completed

Summary: See "Accomplishments/Successes"

Accomplishments/Successes: Updated FCC licenses, computers. Received antennas from Codar (PO funding). In process of installing.

Problems/Delays: Permission from the National Park Service still needed.

Non-core Task 2: *One-time system add-on for HFR system-wide support and replacement for HFR manufactured last century [Kosro]*

Status: Completed

Summary: See "Accomplishments/Successes"

Accomplishments/Successes: Updated FCC licenses, computers. Received antennas from Codar (PO funding). In process of installing.

Problems/Delays: Permission from the National Park Service still needed.

Non-core Task 3: Expenses associated with SeaSondes for HFR [Kosro]

Status: In Progress

Summary: Installed several new antennas and new receivers/transmitters.

Accomplishments/Successes: Updated SEA1 and several long-range systems.

Problems/Delays: Negotiating for permissions to install new equipment at PSG1, MAN1.

Wave Imaging at Critical PNW Ports:

- Sustain the existing marine radar observing station at USCG Station Yaquina Bay [Haller]
- Provide both real-time and historical wave information via NVS; mean and snapshot radar images are real-time viewable for use in environmental characterization [Haller]
- Bring all data QA/QC to meet Certification standards [Haller]

Status: On track

Summary: The radar station on the USCG Yaquina Bay watchtower at Newport, OR, was operated nearly continuously through this reporting period. The data acquisition and processing system generated imagery and reported wave parameters and wave spectra from nearshore locations in near-real-time. These were published to NVS and a comprehensive Oregon State University website (linked to from NVS). A listing of recorded radar data is available via the OSU website, and work continues to make a searchable database of radar recordings. Data recorded by the radar system during this period will be used to inform and validate coastal storm model development in collaboration with the US Army Corps of Engineers.

Accomplishments/Successes: No new changes were made to the radar system or web products during this period. With the exception of occasional maintenance outages, the system continues to operate reliably.

Problems/Delays: On 2024-05-20, the radar's received signal intensity dropped to below noise levels. An investigation revealed that the radar's magnetron had failed, having been used well past its life expectancy. As of the end of the reporting period, the replacement magnetron was in-hand and scheduled for replacement and back online in late July.

SHELF

Sustain and enhance buoys and gliders in the PNW coastal ocean in coordination with national and regional programs: Maintain, harden, enhance existing buoys and gliders, with focus on hypoxia, HABs, OA, and climate.

Washington Shelf Buoys/Moorings:

- Maintain the WA shelf (off La Push) Cha'ba buoy and the NEMO subsurface profiler at existing levels [Mickett]
- Deliver NRT data streams via NVS [Mickett]
- Bring all data QA/QC to meet Certification standards [Mickett]

Status: On track

Summary: The Washington Coast buoy observation program continued the work of maintaining and operating two real-time moorings 13 miles NNW of La Push, Washington. Most of the effort during this period was focused on the recovery of the Winter Cha'Ba mooring and deployment of the Summer Cha'Ba and NEMO profiling moorings, which was carried out from April 29-May 2nd aboard the R/V Jack Robertson out of La Push. As of the end of the reporting period, both Cha'Ba and NEMO-subsurface were working well, reporting real-time surface and water column observations available on NANOOS NVS Explorer and Real-time HABs websites. An exception to this is the pCO₂ system on Cha'Ba that we maintain in collaboration with the NOAA-PMEL Carbon Group. Following poor performance of the pCO₂ system in 2023, we scheduled several all-hands meetings to develop a plan for improving system performance and comprehensive pre-deployment checks. Despite this increased effort and attention to detail, the system stopped working shortly

after deployment and it does not appear that a “buoy ride” will fix the problem. These recent problems are likely in part due to an aging system, with the original unit purchased for Cha’Ba 14 years old. Another setback was that once again Winter Cha’Ba appears to have been struck by a fishing vessel. Recovered instruments indicated that this occurred in early February, though again, a search of AIS tracks wasn’t fruitful in identifying potential culprits. The strike damaged the recovery line pack so that the release and anchor and line-pack could not be recovered. Also, several sensors were stripped from the mooring wire and are lost or unrecoverable. It is worth noting that the buoy is lighted, has a radar reflector and an AIS beacon— all of which were functional when the buoy was struck.

A few positive highlights are that 1) the newly-purchased HydroCat EP V2 (replacing the now-defunct shallow WQM CTD) is working well, providing shallow CTD measurements including DO and pH, and 2) the new NEMO-Subsurface controller continues to perform well, with the McLane crawler collecting over 700 profiles prior to the end of June. The deep SeapHOx, once again borrowed from Seabird, also continues to perform well and provide real-time deep DO and pH data.

The process of transferring all historical Cha’Ba and NEMO-Subsurface data—going back to 2010—onto the group’s ERDDAP server continues. In addition to the Cha’Ba wind data, WQM CTD data, and NEMO-subsurface CTD data, much of the historical ADCP data is now accessible. Most of the near-real time data streams are also now passing through an ERDAPP server prior to being available on NANOOS Explorer, an improvement in QA/QC and streamlining data flow and archiving. All data currently available on the ERDDAP server can be found here: <https://nwem.apl.washington.edu/erddap>.

The team continued collaboration with Jennifer Hagen, Marine Policy Advisor for Quileute Natural Resources, who participated in our spring operations. The team also continued collaboration with Sea-Bird Electronics, which refurbished and renewed the loan of a Sea-Bird SeapHOX instrument that was deployed on the winter Cha’Ba mooring to collect deep (84 m) measurements of conductivity, temperature, depth, dissolved oxygen, salinity, and pH. As usual, fieldwork was coordinated with the NOAA/APL MERHAB ESP team, who deployed the ESP mooring nearby Cha’Ba and NEMO-subsurface during the spring cruise.

Accomplishments/Successes: Winter Cha’ba mooring recovery, Summer Cha’Ba and NEMO-Subsurface deployment. As of the end of the reporting period, again excellent data return on NEMO-Subsurface with new buoy controller. With the exception of the pCO₂ system (as noted above), real-time data transfer worked flawlessly for both moorings.

Problems/Delays: See pCO₂ system problems above.

Non-core Task 7: *Support efforts for OA observing on NANOOS NOA-ON Cha’ba on the WA shelf [Mickett, Newton]*

Status: On track

Summary: Carbon measurements are conducted in partnership with PMEL Carbon Programs. The Cha’Ba MapCO₂ carbon system is operated on both the summer and winter Cha’Ba buoys, with instruments swapped every 6-8 months in the spring and fall.

Accomplishments/Successes: Although not yet bearing fruit, we coordinated efforts with PMEL to improve pre-deployment checks and communication. We also wrote the 3 year proposal to OAP to continue this effort and were funded.

Problems/Delays: As described in the previous section, despite increased coordination, planning and training, the pCO₂ system failed to perform once again, stopping shortly after deployment on Cha’Ba. Discussions with the PMEL team suggest that a trip to the buoy would likely not remedy the issue and that a full system swap might be necessary. Despite these low odds of repairing this while the buoy is deployed, if weather permits we will attempt to power-cycle the system the first week of August during the ESP mooring swap. This is the second of three successive

deployments with a problem with this system. We will continue to work with PMEL to try to identify the source of these issues and how to correct them prior to deploying on Cha'Ba. It is important to note that due to the regularly rough sea-state at this site and angled fencing on the buoy to prevent sea-lion damage (a lesson learned from the first deployment in 2010), it is very difficult to swap this system once it is deployed. The best sea-state conditions are needed, and given the distance of La Push from Seattle (~5 hours), it is challenging to coordinate a rapid-response when the weather is sufficiently good.

Non-core Task 9: *Support for OMAO allotment of FY23 resources in support of a vessel charter pool to service Cha'ba [Mickett]*

Status: On track

Summary: These funds are to augment NCCOS MERHAB funds to deploy the ESP HAB-monitoring mooring adjacent to the Cha'Ba mooring.

Accomplishments/Successes: Part of these funds were used to support the ESP deployment that occurred at the end of April. Remaining funds will be used to support the August 2024 and October 2024 mooring operations.

Problems/Delays: None

Non-core Task 10: *Support NOA-ON NANOOS Cha'ba - Charter Vessel Pool [Mickett]*

Status: On track

Summary: Funding to support Cha'ba mooring servicing cruises will be used to cover the fall 2024 cruise aboard the R/V Pacific Storm.

Accomplishments/Successes: Booked the R/V Pacific Storm for 6 days in October 2024. Received quote, working on setting up a contract with the vessel.

Problems/Delays: None

Washington Shelf HAB Buoy/Mooring:

- *Support for the HAB ESP deployment on NEMO mooring [Mickett]*
- *Deliver NRT data streams via NVS [Mickett]*
- *Bring all data QA/QC to meet Certification standards [Mickett]*

Status: Complete for the season

Summary: Due to constraints caused by the COVID19 pandemic this deployment was delayed from the spring of 2021, as originally planned, to the spring of 2022. The ESP mooring was deployed near the NANOOS NEMO and Cha'ba moorings on May 3rd with regular, real-time measurements of the HAB toxin domoic acid extending until late June as planned. The mooring was recovered on August 3rd.

Reliable, regular, real-time measurements of offshore domoic acid concentrations were made available to stakeholders via the NANOOS Real-time HABs website. The website was updated prior to the spring ESP deployment.

Accomplishments/Successes: This deployment was an unqualified success, with reliable, regular, real-time measurements of offshore domoic acid concentrations distributed to stakeholders via weekly email summaries and the [NANOOS Real-time HABs website](#). The website was successful in providing HAB toxin and valuable contextual data to stakeholders. This information was critical to assessing the risk of HABs on the Washington coast.

Problems/Delays: None

Non-core Task 11: Support for fabrication of a HAB water sampler for the new Seasats AUV [Mickett]

Status: Complete

Summary: Funding will support the fabrication of a custom, APL-designed Water Sampling System (WSS) that will be fitted in the Seasats Lightfish Autonomous Surface Vehicle (ASV). This supports an IOOS OTT project that was delayed/set back due to the switch to a more capable ASV.

Accomplishments/Successes: The APL-UW Water Sampling System (WSS) is complete with the first operational mission planned for mid-July. A successful field test of the Lightfish with the WSS was completed in Puget Sound in June. Used aboard the Lightfish Autonomous Surface Vehicle (ASV) this system will allow the rapid collection of offshore whole water and filtered samples for subsequent shoreside processing. It represents a significant leap forward in offshore HAB sampling.

Problems/Delays: None

Oregon Shelf Buoy:

- Maintain the CB-06 buoy off Coos Bay at existing levels [Kosro]
- Deliver NRT data streams via NVS [Kosro]
- Bring all data QA/QC to meet Certification standards [Kosro]

Status: On track

Summary: The mooring system was deployed in March 2024 and operating normally. Assembly for the next buoy recovery/deployment in September has begun. Previously lost down-tether thermistors still need replacing.

Accomplishments/Successes: Persistent deployment and monitoring. Maintained working relationship with Coos Bay vessel service provider.

Problems/Delays: Vessel scheduling for workable ocean conditions continues to be a challenge for the OR coast.

Non-core Task 8: Support efforts for OA observing on NANOOS NOA-ON CB-06 off the OR shelf [Hales]

Status: On track

Summary: The mooring system was deployed in March 2024 and operated normally for several weeks, at which point the MAPCO2 system failed. PMEL personnel remotely shut down the system, and delivered replacement hardware in early July, and we are awaiting a vessel/weather opportunity to replace the faulty components, although the mooring swap-out target date is fast approaching.

Accomplishments/Successes: Persistent deployment and monitoring. Maintained working relationship with Coos Bay vessel service provider.

Problems/Delays: Vessel scheduling for workable ocean conditions continues to be a challenge for the OR coast. MAPCO2 system is in need of certain components swapped out.

Columbia River Shelf Mooring:

- Maintain the CMOP shelf mooring at existing levels [Seaton/Gradoville]
- Deliver NRT data streams via NVS [Seaton/Gradoville]
- Bring all data QA/QC to meet Certification standards [Seaton/Gradoville]

Status: On track

Summary: The CRITFC Columbia River Shelf Mooring (SATURN-02) is a multi-depth, inter-disciplinary buoy with real-time telemetry. Deployed seasonally off the mouth of the Columbia River at ~35m depth, it measures wind, air temperature, barometric pressure, PAR, and water

velocity, as well as temperature, salinity, dissolved oxygen, chlorophyll, turbidity, and quantum yield at 1, 6, 11, 16, 21, and 35m.

The SATURN-02 buoy was successfully recovered in January 2023. Since CRITFC had not received the expected FCC license to deploy an AIS beacon by spring 2024, SATURN-02 was instead outfitted with a radar enhancer to increase its radar footprint and reduce ship strike risks. Additionally, the mooring was upgraded with the SUNA v2 nitrate sensor, which captures the full UV spectrum range and enables post-corrections for temperature and salinity biases. The mooring was successfully deployed in June 2024. Real-time preliminary data are available on NVS and the ERDDAP server, with subsequent delivery to NDBC.

CRITFC continues to manage a major field staff transition, including the retirement of the former field lead and the training of two new field technicians. In April 2024, CRITFC technicians participated in hands-on field training during the NANOOS/UW-APL fieldwork in La Push, WA, and attended the MTS Buoy Workshop in May 2024 to enhance their buoy design and deployment skills for future in-house projects.

Accomplishments/Successes: Successful deployment June 2024, with real-time data showing no current data issues. Improved nitrate data quality. Progress with staff transition and training.

Problems/Delays: None

Washington La Push Glider:

- *Maintain the La Push line glider at existing levels [Lee]*
- *Deliver NRT data streams via NVS [Lee]*
- *Bring all data QA/QC to meet Certification standards [Lee]*

Status: On track

Glider IDs serving this line: SG249,

Summary: SG249 was deployed on 11 March, 2024. Between deployment and 30 June 2024 it completed 304 profiles along the LaPush Line, and is currently projected to operate into May 2025.

Accomplishments/Successes: After a long period adrift, SG236 washed ashore in February 2024 in Coffman Cove, Prince of Wales Island, AK. The glider was recovered and will be placed back into service after repairs. In the meantime, occupation of the LaPush line has resumed using a glider from the IOP fleet. Fabrication of a second NANOOS glider is nearing completion, with the vehicle expected to be ready to enter service in fall 2024. Data processing and QC have been updated to our current standards, and data is flowing to the DAC.

Problems/Delays: None

Washington Shelf Glider:

- *Maintain the Washington shelf glider at existing levels [Barth in collaboration with Seaton and Schumacker]*
- *Deliver NRT data streams via NVS [Barth]*
- *Bring all data QA/QC to meet Certification standards [Barth]*

Status: On track

Glider IDs serving this line: osu551, osu1138

Summary: Through a collaboration with the Columbia River Inter-Tribal Fish Commission (CRITFC), the OSU Glider Research group is conducting the NANOOS-funded glider sampling on the central Washington shelf. The program is designed to fly gliders off the central Washington coast, centered off Grays Harbor, WA, and south toward the Columbia River. The glider flies a mapping grid, from roughly the 30-m isobath, offshore to approximately the shelfbreak (~200 m). The mapping is done in consultation with the Quinault Indian Nation via Joe Schumacker, NANOOS Governing Council Representative and Executive Committee Representative for Tribes.

During the January to June 2024 reporting period, one glider map was made off central Washington in the second half of May. The glider was deployed for a total of 10 days, and

produced 4 cross-shelf sections over 195 km with about 762 vertical profiles of water properties. Glider data show that the summer upwelling season was just beginning and that near-bottom, low-oxygen (~2 ml/l, so not hypoxic) water was being upwelled on to the shelf and reached about to the 40-50 m isobath. These data are displayed on NVS.

Accomplishments/Successes: Began the fourth, summer-season glider work off central Washington; continued operations with a reliable charter boat operator out of Westport, WA; Joe Schumacker (Quinault Indian Nation - QIN) briefed ocean users about oxygen levels in the coastal ocean.

Problems/Delays: None. Upgraded glider 251, now S/N 1138, was returned to OSU in late 2023 and will be used off the WA coast in July 2024.

Northern California Glider:

- *Maintain the Trinidad Head glider, shared with CeNCOOS, at existing levels [Barth]*
- *Deliver NRT data streams via NVS [Barth]*
- *Bring all data QA/QC to meet Certification standards [Barth]*

Status: On track

Glider IDs serving this line: osu685, osu686

Summary: Starting in early December 2014, the Oregon State University glider research group has been obtaining vertical sections of ocean properties off Trinidad Head, CA (41° 3.5'N) using an underwater glider. We use a 1000-m capable Seaglider equipped with the following sensors: CTD, dissolved oxygen (Aanderaa 4831 optode), light backscatter (700 nm), chlorophyll fluorescence and Colored Dissolved Organic Matter (CDOM) fluorescence (WET Labs Ecopuck). The gliders also measure depth-averaged velocity, which can be combined with geostrophic estimates of relative velocity to get absolute velocity and hence transport. The glider samples from approximately the 100-m isobath (~10km offshore) to 130W (~500 km offshore), repeating the line every 30 days. We collaborated with Dr. Eric Bjorkstedt (NOAA Southwest Fisheries Science Center, Humboldt State University) to facilitate fieldwork off Trinidad Head. We used two of our Seagliders in order to “hot swap” them on the line when their batteries ran low. During this reporting period, this effort was jointly funded by NANOOS and CeNCOOS.

For the reporting period, January to June 2024, a glider was on the TH line for 192 days during two deployments, sampled along 3776 km of track line covering the transect 8 times, and collected about 1823 vertical profiles of ocean properties. Glider uptime during this period was 100%! Data are being sent in near real-time to the IOOS Glider Data Acquisition Center and, simultaneously, to the CeNCOOS and NANOOS data centers.

Accomplishments/Successes: We successfully put Seaglider 686, purchased with NANOOS and CeNCOOS funds, into operation on the TH line. Data from the Trinidad Head glider line are being used to monitor the continuation of the extended 2020-2023 La Niña and the progression of the 2023-2024 El Niño.

Problems/Delays: None

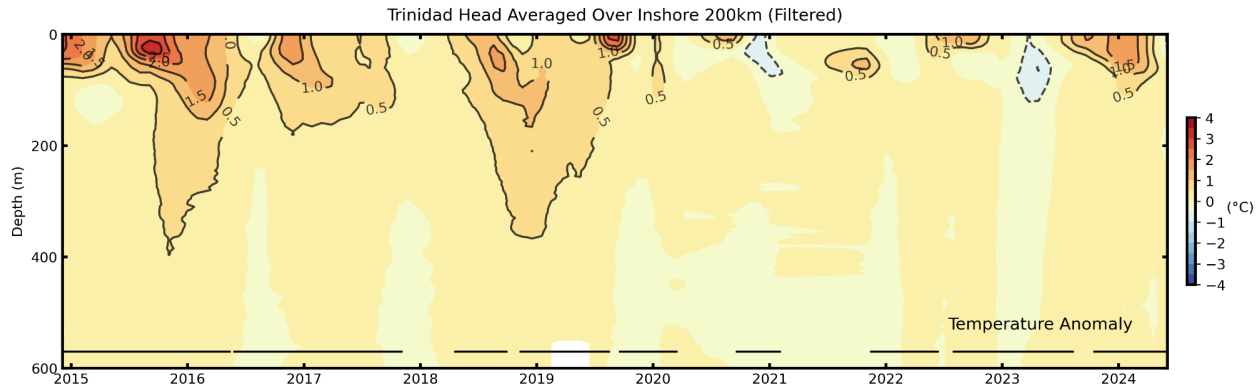


Figure 1: Temperature anomaly from the Trinidad Head, CA (41° 3.5'N) glider line. Horizontal lines above the time axis indicate when the TH-Line glider was in the water.

Non-core Task 1: Further HABs understanding and prediction to be distributed to tribes, UW, WA Sea Grant, OSU, and for data services relevant to HABs in service of the PNW HAB Bulletin for WA and OR and other PNW HAB observing [Mordy/McCabe (CICOES/NOAA), Trainer (UW ONRC), MacCready (UW Oceanography), Little (UW Washington Sea Grant), Kavanaugh (OSU), Newton (UW APL)]

Mordy/McCabe

Status: On track

Summary: PI McCabe has continued to collaborate with Barbara Hickey (UW School of Oceanography) and Vera Trainer (UW) to produce the Pacific Northwest Harmful Algal Blooms Bulletin (PNW HAB Bulletin) for coastal shellfish managers. A total of eight PNW HAB Bulletins are typically produced each calendar year, with nominally four Bulletins during spring razor clam digs and another four during fall razor clam digs.

Accomplishments/Successes: McCabe, Hickey, and Trainer produced five PNW HAB Bulletins to support coastal shellfish managers during the reporting period. These included the 02-Apr-2024, 15-Apr-2024, 30-Apr-2024, 20-May-2024, and 02-Jun-2024 Bulletins. The Washington Department of Fish and Wildlife made the decision to end public recreational razor clam digging in mid-May, so the final two spring Bulletins were issued to support Washington commercial, tribal, and Oregon recreational harvests. Risk of a toxic *Pseudo-nitzschia* bloom started off low in early April but increased to medium risk in late April after the transition to seasonal upwelling. Immediately after the onset of upwelling conditions, coastal winds reverted to a northward and onshore direction as a series of fronts inundated the region. Large size *Pseudo-nitzschia* cells and quantifiable seawater particulate domoic acid concentrations were documented at coastal beaches during this period. Razor clams began to accumulate domoic acid at both Washington and Oregon beaches, but thankfully tissue concentrations did not exceed regulatory limits as a result of this event. The PNW HAB Bulletins are made publicly available on both the [ORHAB](#) and [NANOOS](#) websites.

Problems/Delays: None

Trainer

Status: On track

Summary: The funds from the current performance period were distributed to each tribe partnering in the ORHAB program to improve off-shore HAB monitoring capacity over-and-above the weekly shore-side sampling undertaken as part of ORHAB's state-funded monitoring program. In addition, funds were used to support training on the use of the Autonomous Surface Vehicle

(ASV), the SeaSats “Lightfish”, which will be used to sample at offshore HAB retentive sites. Some funds still remain after the current reporting period, but will be spent as soon as UW approvals have been obtained for high cost (>\$10k items), such as the distilled water system (including travel and installation). We onboarded our new UW Olympic Natural Resources Center (UW ONRC) administrative assistant, Renee Reed, in late January 2024, so purchasing is becoming more streamlined.

Accomplishments/Successes: UW ONRC in collaboration with ORHAB (Olympic Region Harmful Algae Bloom Partnership), serves as a primary data source for state and tribal shellfish managers and the PNW HAB Bulletin on Washington’s outer coast. The four Coastal Treaty Tribes (Hoh, Quileute, Makah, and the Quinault Indian Nation) are members along with state, federal and academic partners. Core funding for ORHAB’s shore-based monitoring is provided by the Washington State Legislature from a percentage of recreational shellfish license fees but off-shore monitoring is not mandated.

The June 2024 fund balance for tribal allocation of APL funds through ONRC is \$25,426.61 and the carryover from previous years is \$55,809.06. The funds allow each tribe to address individual capacity issues necessary for participating in offshore sampling over-and-above their weekly shore-side sampling. This included equipment upgrades necessary to process the higher volumes of samples and the support of new activities, such as the planned spring 2024 deployments of the Lightfish, an Autonomous Surface Vehicle (ASV). The equipment and supplies allow the Tribes to establish independent sampling and laboratory operations, which will be the focus for the remaining funds for Hoh Tribe. An agreement between ONRC and the Hoh Tribe will allow the Tribe to use the ONRC facility as a laboratory resource. The recent field testing and installation of the water sampling system in the ASV technology for off-shore monitoring in the region has exposed the pivotal role existing tribal labs are playing in processing samples and hosting the launching and retrieval for remote vehicle missions. The funds provided here are proving important in helping each tribe meet that new challenge.

Trainer continued discussions with the Washington State Department of Health and PI, Kavanaugh, to explore future possibilities to expand ORHAB sampling to help manage Dungeness crab. In addition, she has been instrumental in assisting Maria Kavanaugh’s project and the Oregon Department of Fish and Wildlife (ODFW) by making available new enzyme-linked immunoassay (ELISA) kits for the detection of domoic acid. Trainer worked extensively with a new company, Beacon Analytical, to develop new kits for paralytic shellfish toxin (PST) detection for both ORHAB and our Oregon partners. Following the paralytic shellfish poisoning event in Oregon that sickened over 30 people (2 were intubated in the ICU), Trainer began working with Beacon Analytical, the ODFW, and WDOH to obtain samples to screen for paralytic shellfish toxins using ELISA, currently in development. The ultimate goal is to provide a cost-effective, easy-to-use ELISA for all coastal monitoring personnel in WA and OR.

Problems/Delays: The transition of the University of Washington financial system to a new platform and the purchase of high-cost items (>\$10k) required 3 independent bids which delayed the purchase of equipment by several months.

Trainings:

- ORHAB annual training and meeting, 29-31 January 2024
- Lightfish training for coastal collaborators with SeaSats corporation, Forks, WA, 11-12 October 2023
- Lightfish testing of water collection systems, Shilshole Marina, 5 June 2024
- Lightfish training for Oregon collaborators, Newport, OR, 22-26 July 2024

MacCready

Status: On track

Summary: During this reporting period NANOOS support for MacCready's salary allowed for improvements to the reliability of the LiveOcean model system.

Accomplishments/Successes: MacCready runs the LiveOcean daily forecast model that is used as part of the information for the PNW HAB Bulletin. The model continued to run with high reliability during this period, and post-processing particle tracking results used by managers were produced daily. A paper was published (Xiong and MacCready 2024) comparing 5 different particle tracking software packages in LiveOcean. Particle tracking is a key analysis technique for the model contribution to the PNW HAB Bulletins.

Problems/Delays: None

Litle

Status: On Track

Summary: The SoundToxins program continues to provide support for phytoplankton monitoring throughout Puget Sound.

Accomplishments/Successes: For this reporting period we received and addressed 98 requests for support from SoundToxins participants and partners including requests for monitoring support, phytoplankton identification and data use requests. We received 46 emails alerting to the presence of harmful algal bloom species of which 5 of the alerts were passed on to the Washington State Department of Health as part of the phytoplankton cell presence alert system. During the reporting period we held our annual meeting which involved a day of phytoplankton taxonomy and protocol training and a day of scientific presentations. We also conducted 3 virtual training sessions and 4 in-person training sessions for new volunteer monitors. We conducted 3 site visits to establish new sites and support existing sites. Presentations about SoundToxins were given at the ORHAB annual meeting, at the Shellfish Growers Conference, and as part of a webinar organized by the Ocean Decade Collaborative Center for the Northeast Pacific on HABs and Food Security.

Problems/Delays: The previous PI, Teri King, left the program for a new position in September 2023. The SoundToxins program continues the essential functions of providing support for phytoplankton monitoring in Puget Sound, but is still operating under reduced capacity causing some delays for lower priority tasks.

Kavanaugh

Status: On track

Summary: We have transitioned to Year 3 of Cooperative Fisheries Plankton Research project to target plankton taxa, in particular the domoic-acid producing species *Pseudo-nitzschia* sp (P/N). Commercial fishermen, including charter boats, as well as recreational fishermen, have been trained to collect seawater samples which are preserved and/or frozen for analyses in the lab. In the lab, we utilize imaging flow cytometry, to rapidly assess plankton community composition, P/N abundance, dominant morphology (thick, thin), and environmental correlates. A regular exchange of new sampling kits and collected samples was tested, and successfully implemented at a central location, Hatfield Marine Science Center in Newport, Oregon. A second kit exchange station has been established at Umpqua Bait in Winchester Bay, Oregon. The project funds graduate student stipend (for project coordination), technician time (to assist with running and annotating samples), and hourly undergraduate assistants.

Accomplishments/Successes: For the 2024 sampling season, George has successfully maintained the sample kit station at Hatfield Marine Science Center (HMSC), and trained Post-Bac Researcher Amanda Kent on fishermen/sample coordination, HMSC station maintenance, and outreach related to the project. The station at HMSC was reinstated for the summer sampling season in late May, 2024, and fishermen sampling has remained steady since June.

George and Kent have increased outreach for this project this year in two key ways. They have established a monthly newsletter that is sent out to all sample-collecting participants of the project, as well as any other interested parties. The newsletter includes three to four different topics each month, such as: updates on how the samples they have collected are being processed, information about the taxa being detected in the samples, educational information related to Harmful Algal Bloom (HAB) forming taxa such as *Alexandrium* sp. that caused recent shellfish closures on the Oregon Coast, sampling calls-to-action during HAB events, and more. In addition to the newsletter, George has attended two Oregon coast fishermen-centered meetings to engage a broader audience of Oregon fishermen. These meetings were ODFW's 7th Fishermen-Scientist Ocean Acidification and Hypoxia (OAH) Roundtable Meeting in Newport, OR in May, and the July Oregon Coast Anglers (OCA) meeting in Winchester Bay, OR, which Kent also attended. At the OCA meeting, George gave a 20 minute presentation on the Cooperative Fisheries Plankton Research project in an effort to recruit participants local to the Reedsport and Winchester Bay, OR area.

A second fishermen sampling kit station, located at Umpqua Bait in Winchester Bay, OR, was established in July. This location was selected with the assistance of local fishermen and coordinator of the OCA meetings, Steve Godin. George and Kent are awaiting new fishermen collaborators that will collect samples using the Winchester Bay sampling station supplies. Multiple parties expressed interest at the OCA meeting earlier in the month, so it is anticipated that Winchester Bay area sampling will begin soon.

During the Paralytic Shellfish Poisoning (PSP) outbreak due to *Alexandrium* sp. during the Summer of 2024, Kavanaugh, George, and Kent conducted beach sampling to assist Oregon Department of Fish and Wildlife (ODFW) in detecting *Alexandrium* sp. abundance at six beach locations on the Oregon coast. These locations were: Roads End State Recreation Site and Nelscott Beach in Lincoln City, Gleneden Beach and Moolack Beach in Lincoln County, Fogarty Creek State Recreation Area in Depoe Bay, and Agate Beach State Recreation Site in Newport, Oregon. At each site, environmental data including salinity and temperature were recorded, and seawater samples were collected. Seawater samples included whole seawater, as well as concentrated seawater samples that were collected using a plankton net. Samples were then analyzed for *Alexandrium* sp. and *Pseudo-nitzschia* sp. counts, which were then shared with ODFW to help inform management decisions regarding the PSP outbreak.

Challenges/Delays: One challenge has been the coordination of pDA and TDA samples for comparisons. There have been some issues with kit availability and/loss of kits. We will network through NANOOS and ORHAB to include pDA pilot for Spring of 2024-Fall of 2024.

Hunter

Status: On Track

Summary: The funds from the performance period were used to provide near-shore HAB monitoring capacity in Oregon coastal waters as there is no state-funded program. Funds pay for a phytoplankton specialist and all supplies and services.

Accomplishments/Successes: ODFW, has continued to have difficulties retaining staff in the phytoplankton specialist position. For the reporting period, the position was staffed for 2 months, from January 1-Feb 22 and from June 24-30. A total of 43 near-shore samples were analyzed for HABs and 21 of those had *Pseudo-nitzschia* in elevated numbers. Only 4 samples were further analyzed for particulate domoic acid (pDA). All data collected was summarized and used in the PNW HAB bulletin. A total of 8 samples from these vessels were collected and analyzed.

Problems/Delays: ODFW phytoplankton specialist position has been vacant for extended durations during the reporting period which has delayed sample collection/analysis and meant that the PNW HAB bulletin does not have Oregon shore-side HAB data for further analysis.

Newton

Status: On Track

Summary: During this reporting period, Newton oversaw all aspects of the NANOOS HABON effort. This included attending ORHAB meetings and discussing progress with each of the HABON PIs in Washington and Oregon. She coordinated with Tanner (UW, NANOOS web) to assure that all PNW HAB Bulletin and other HAB content matched the needs of the community.

Accomplishments/Successes: PNW needs that NANOOS could help address through the IRA proposal were incorporated into our submission, which has been accepted.

Problems/Delays: No continuing funding from Oregon has been identified, as of yet, though this remains a high priority. A recent large-scale HAB event with several people sick is unfortunate, but possibly will further highlight this need to the state government.

ESTUARIES

Maintain multidisciplinary observational capabilities in PNW estuaries and the nearshore, in coordination with local and regional programs: Sustain observing ability to aid sustainable resource management, water quality assessment, and sub-regional climate change evaluation.

Puget Sound, WA, Profiling Buoys:

- *Maintain 6 Puget Sound estuarine profiling moorings at existing levels [Manalang]*
- *Deliver data via NVS [Manalang]*
- *Bring all data QA/QC to meet Certification standards [Manalang]*

Status: On track

Summary: Work to maintain Puget Sound Profiling Buoys continued, including regular maintenance conducted at each of six buoy sites. Buoy maintenance includes instrument package swaps, winch repairs, and electrical and mechanical maintenance.

Since April 2024, the Twanoh mooring has been profiling via a float system instead of the winched system. This is part of a test deployment of a new mooring design, and will return to a winched system in August 2024.

All Puget Sound Profiling buoy data products can be found on the team ERDDAP server (found here: <https://nwem.apl.washington.edu/erddap>) and are utilized for providing streamlined product creation into a uniform workflow. Puget Sound profiling buoy data is also delivered to NVS.

Accomplishments/Successes: Multiple successful maintenance operations, and continued troubleshooting to identify root causes of rapid failure modes. Additional monitoring of sensor calibrations have improved the recency of instrument calibration.

Problems/Delays: Continued profiling downtime was experienced due to aging systems and external factors, such as poor winter weather, preventing service visits to the buoys. Long lead times have caused challenges in keeping sensor calibrations recent. Problems with cellular coverage resulted in intermittent data harvesting from the profiling mooring at Twanoh.

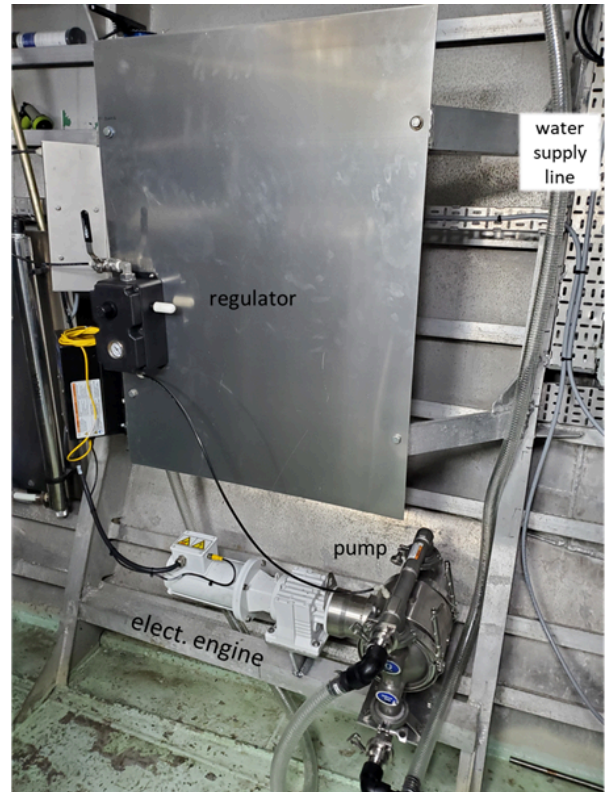
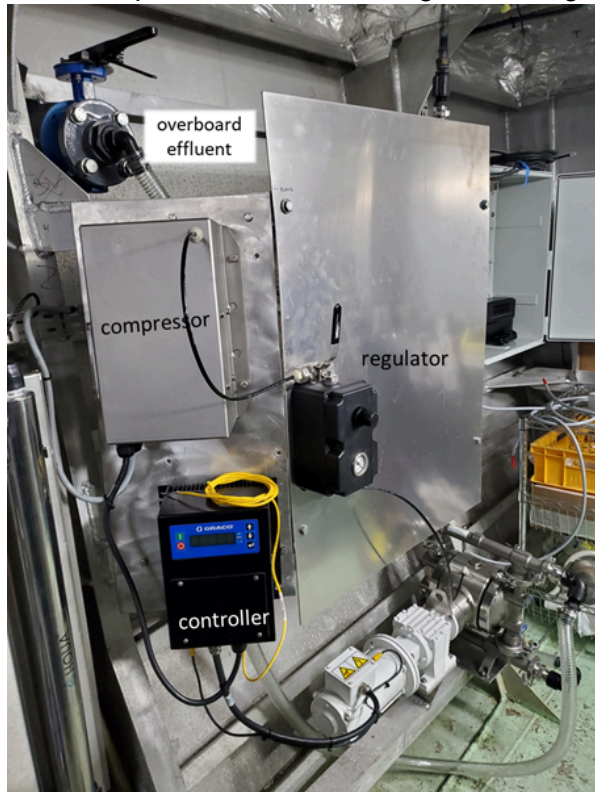
Puget Sound, WA, US-Canada ferry-box:

- *Maintain US-Canada ferry-box at existing levels following COVID-19 and the companies struggle to regain profitability [Krembs]*
- *Deliver data via NVS [Krembs]*
- *Bring all data QA/QC to meet Certification standards [Krembs]*

Status: Regaining momentum

Summary: Ecology has maintained its en route ferry monitoring system by relying on the support of Victoria Clipper engineering staff. In the last months engineers have been following through with installations and we are poised to complete the remaining re-installation of the ferry box back onto the ferry.

Accomplishments/Successes: Ship engineers installed the new pump, controller, necessary plumbing modifications and electrical supply. This allowed us to test pump, power and water supply and plumbing systems as intended. Test runs were successful and flow rates and pump priming surpassed our initial expectations. Because of the high performance of the pump, positive modifications to the plumbing system were made thereby improving the placement sensors. Following a more traditional setting of sensors downstream of the pump, we can now use commercially available de-bubbler while running sensors at ambient pump water pressures. This alleviated prior technical challenges for integrating additional sensors into the flow stream.



We were able to successfully complete half of the tasks laid out in the last progress report, including testing and overworking the plumbing line, pump and controller fine tuning, to testing of flow rates and self-priming of the pump. Redesign of the plumbing feeding water to individual sensors and de-bubbler into the flow is completed and needs to be installed.

The remaining tasks currently are in the process of implementation are:

- Workflow and implementation of data logging and data post-processing
- Final system testing
- Integrating additional sensors (e.g. pCO₂) into the ferry system.
- QA/QC web app implementation

Problems/Delays: None

Columbia River Estuary, OR, Moorings:

- Maintain CMOP estuarine moorings at existing levels [Seaton/Gradoville]
- Deliver data via NVS [Seaton/Gradoville]
- Bring all data QA/QC to meet Certification standards [Seaton/Gradoville]

Status: On track

Summary: CRITFC continued to maintain NANOOS-supported stations in the Columbia River estuary. The Point Adams (SATURN-03) pier-based, pumped station experienced a major power

outage after a January 2024 ice storm downed a nearby power pole. Power to the station was temporarily restored using batteries and an industrial extension cord, and pier power was eventually restored in April 2024. These power issues resulted in some data gaps for SATURN-03. A new pump was installed for the pCO₂/TCO₂ instrument at this station, and successful troubleshooting resulted in high quality pCO₂ and TCO₂ data, which are now being ingested into the CMOP database in real time. The Tongue Point (SATURN-04) pier-based, pumped station is still in the process of transitioning to a neighboring pier due to the US Coast Guard demolishing the previous pier. A new pumped station was constructed fall 2023, including near-surface and sea-bed water intakes and an in-situ CTD at the seabed location. A shed to house instruments and pumps was moved to the new pier and improved to include insulation to prevent instruments from freezing during winter. Problems with circuit boards and charge controllers have caused data gaps during this period. These are currently being troubleshoot, and the station is being modernized. The Baker Bay (SATURN-07) buoy was deployed in November 2023 and is currently on station. The buoy is still collecting high quality physical data, but the biogeochemical sensors have had intermittent data quality issues since spring 2024. A new Baker Bay buoy is currently being constructed, with plans to deploy it and recover the current buoy in summer 2024. The Cathlamet Bay (CBNC3) buoy was deployed October 2023 and remains on station. The Youngs Bay (SATURN-09) buoy was recovered for servicing December 2023 and re-deployed March 2024. Later in March 2024, the buoy was recovered, serviced on-site, and redeployed, providing a training opportunity for field technicians. All stations except for CBNC3 (Cathlamet Bay) are real-time, and data are displayed on NVS. Data are subject to QA/QC, which is included in data submitted to NCEI via NANOOS and to the recently deployed ERDDAP server. In May 2024, CRITFC's Data Quality Analyst, Science Lead, and Field Staff collaborated on a week of QA work, including testing several chlorophyll standards and 0% oxygen solutions on fluorometers and oxygen sensors; results from this work will be used to improve long-term QA procedures.

Accomplishments/Successes: Estuary stations were maintained, including deploying and servicing Baker Bay and troubleshooting the power outage and pCO₂/TCO₂ instrument at Point Adams. The field team continued to work through this personnel transition period. Improved QA procedures are being developed. PIs Seaton and Gradoville both gave presentations on the Columbia River estuary stations at the Ocean Sciences Meeting in February 2024.

Problems/Delays: Overall on track, with data gaps due to power issues (Point Adams) and station pier transition (Tongue Point).

South Slough/Coos Bay, OR, Moorings:

- *Maintain South Slough/Coos Bay estuarine moorings for the NERRS at existing levels [Helms/DeMarzo]*
- *Deliver data via NVS [Helms/DeMarzo]*
- *Bring all data QA/QC to meet Certification standards [Helms/DeMarzo]*

Status: On track

Summary: South Slough Reserve continued data collection for a network of moored estuarine water quality observing stations as part of the NERRS System-Wide Monitoring Program with additional support provided by NANOOS. There are four real-time water quality stations in the South Slough estuary that measured continuous water temperature, salinity, dissolved oxygen, pH, turbidity, and water level measurements every 15 minutes over the period 1/01/24 – 6/30/24. Tom's Creek weather station provided real-time measurements of air temperature, relative humidity, barometric pressure, and wind speed/direction. Telemetry transmissions were continuous for the Winchester Arm and Elliot Creek water quality and Tom's Creek weather platforms. Water quality data collection was completed at the Charleston Bridge and Valino Island stations, but telemetry status has been offline for replacement of the station platforms with steel pilings due to aged wood infrastructure and heavy biofouling, before upgrading to YSI Storm 3 telemetry systems. The

Reserve is working with Knutson Towboat for planning the piling replacements. In collaboration with the Confederated Tribes of the Coos, Lower Umpqua and Siuslaw Indians (CTCLUSI), SSNERR maintains telemetry for the North Spit BLM water quality station, located in the lower Coos estuary with data available through NVS. Monthly sonde instrument exchanges, maintenance, and data management for all sites were completed for the station network following NOAA NERRS Centralized Data Management Office protocols.

Accomplishments/Successes: Water quality and weather time-series data collected as part of NANOOS/NERRS SWMP programs were incorporated into various research and education programs at the Reserve. One project included a NERRS Science Collaborative Hydrodynamic Model project to understand sediment and temperature effects on native species restoration in the Coos estuary with data products developed this summer, including salinity and temperature maps for adult oyster and eelgrass populations, where environmental conditions are exceeding or below ranges for optimal growth and survival. The second project is an Oregon Ocean Science Trust biophysical modeling project evaluating the interaction of water quality and eelgrass in the Coos estuary. The Reserve's Margaret A. Davidson Fellow, Lara Breitreutz, utilized water quality data for her research on eelgrass seedling response to marine heat waves and presented results at the World Seagrass Conference and International Seagrass Biology Workshop in June 2024 held in Naples, Italy and she presented her research to the South Slough Management Commission Meeting in Charleston, OR on 7/25/24. The Reserve education team accessed water quality datasets for programs on climate change and developing exhibits for the Reserve's Visitor Center. The Reserve hosted two Summer interns, from the NSF Research for Undergraduate program and NOAA's National Centers for Coastal Ocean Science that assisted the science program with water quality and eelgrass fieldwork and laboratory sample processing.

Problems/Delays: The Charleston Bridge water quality station continues to have seasonal fouling issues in the summer during monthly instrument exchanges and the protective instrument housing will be replaced in the short term with a new steel piling installation planned to replace the wood pile. The Valino Island station aged wood pile is too unstable to support new telemetry equipment and will be upgraded to a steel pile, with partial funding requests through the NERRS IRA non-competitive Resilience funds. A large wasp nest was removed from the water quality enclosure at the Winchester Creek water quality station in June 2024.

BEACHES AND SHORELINES

Maintain core elements of beach and shoreline observing: Measure nearshore bathymetry, topographic beach profiles, and shoreline morphodynamics along OR and WA, contributing to hazard mitigation by providing essential observations and better decision support tools for coastal managers, planners, and engineers.

Washington Beach and Shoreline:

- *Maintain shoreline observations in WA at existing levels [Kaminsky]*
- *Deliver data via NVS [Kaminsky]*
- *Bring all data QA/QC to meet Certification standards [Kaminsky]*

Status: Complete for the season

Summary: NANOOS funds contribute to the Washington State Department of Ecology Coastal Monitoring & Analysis Program (CMAP) led by G. Kaminsky. CMAP completed winter and spring seasonal beach monitoring surveys in the Columbia River Littoral Cell (CRLC), collecting 50 beach profiles, 5 ATV surface maps, and 58 sediment samples along 12 of the profiles in March and 46 beach profiles and two surface maps in June. This spring marks 27 years of CRLC beach monitoring for the team! Seasonal beach profile data and contour change plots are made available through the [NANOOS beach and shoreline portal](#). An update report with both the beach and

nearshore data from summer 2023 has been published by the USGS at <https://doi.org/10.5066/P9W15JX8>.

CMAAP continues to monitor active and planned dynamic revetments along the Pacific coast at Westport, North Cove, and Benson Beach. At Westport, the CMAAP team and Coastal Engineers collected beach topography data of the ~215 m (700 ft)-long constructed dynamic revetment fronting the Westport by the Sea condominiums in March and June 2024. At North Cove, the CMAAP team completed winter and spring seasonal beach monitoring surveys to monitor the performance of the dynamic revetment, including the collection of surface sediment photos to assess how sediments have changed over time. In March, RFID antennas were used to scan the beach and revetment to locate individual rocks that were deployed in 2019 to track their movement over time, an activity the CMAAP team does each winter. Also at North Cove, the CMAAP team provided support to researchers at the University of Washington in surveying ground control targets for rectifying digital photos taken from two metal photo stations that will be used for shoreline change analysis as part of an effort called Coasts Camera Action. At Benson Beach, CMAAP and the Coastal Engineers continue to collect condition surveys to obtain baseline beach and dune topography data before the planned construction of a dynamic revetment. Data collected by Ecology, OSU, and USGS is used to monitor the Columbia River dredged sediment deposited offshore of the beach by the USACE. Sediment transport modeling results from Andrew Stevens with the USGS suggest the sediment placed offshore of Benson Beach moves shoreward.

As a comparison to the North Cove and Westport engineered dynamic revetment sites, the CMAAP team continues to collect seasonal topographic surveys near the South Beach campground south of Kalaloch on the Olympic Peninsula to monitor the cobble berm found on this natural composite beach. Photos of the surface sediments were collected in April for digital grain size analysis. RFID cobble tracking was conducted in April, but only 10% of the rocks deployed in 2019 were located (15 out of 150). We suspect that the rocks have traveled outside the study area as the rounded and generally smaller (~28 mm median) particles have been highly mobile compared to the angular and generally larger (~41 mm) materials placed at North Cove. At both sites, there is a landward increase in grain size and slope up to ~14 ft MLLW (13.8 ft, or 6.0 ft above MHHW, at North Cove and 14.3 ft, or 6.8 ft above MHHW at Kalaloch). At Kalaloch, there is a decrease in slope on the berm face ~17.5 ft MLLW, possibly associated with runup of winter storm waves. This is similar to what is observed at the North Cove site where there is flattening of the revetment surface ~15.4-17 ft MLLW, presumably due to wave runup/overtopping. Metrics derived from observing a natural cobble berm can inform engineering design and dynamic revetment construction or maintenance requirements.

Accomplishments/successes: Data collected by CMAAP continue to be used by the USACE and geoconsultants to assess local and regional coastal changes on Washington beaches, particularly at locations with dynamic revetments. Our growing team of Coastal Engineers provided technical assistance to shoreline planners at Ecology in the review and evaluation of five shoreline development projects as well as served on technical advisory committees for eight sea level rise vulnerability assessments being conducted by local jurisdictions along Washington's shorelines.

Staff presented at several scientific conferences and community meetings/workshops during this reporting period. In March, we presented a poster and led a field trip for the Navigating Coastal Hazards Workshop hosted by the Cascadia Coastlines and Peoples Hazards Research (CoPes) Hub. The field trip was at Cape Disappointment State Park about our work in the CRLC with a focus on Benson Beach and the history of coastal erosion hazards and sediment management at the mouth of the Columbia River. In May, we presented at the Pacific County Marine Resource Committee (MRC) Science Conference about our ongoing coastal monitoring of erosion hotspots in Pacific County, including regional monitoring of the CRLC and site-specific monitoring work at North Cove, Benson Beach, Graveyard Spit, and Shoalwater Bay. In June, two of our staff presented posters at the Young Coastal Scientists and Engineers of Americas

conference in Quebec, Canada comparing sediment grain size and beach slope data from the engineered dynamic revetment at North Cove and natural cobble berm at Kalaloch.

Problems/Delays: Progress in processing all seasonal topographic survey data continues to be slow due to workload demands on staff. CRLC plots on NVS are available through spring 2023. Attention has been given to sites with dynamic revetments to assess performance for providing technical guidance. We are in the process of acquiring two new GNSS receivers to increase our efficiency in the field and are looking at options to increase efficiency and surveyor safety through the use of Structure from Motion or lidar collected using unmanned aerial vehicles.

Oregon Beach and Shoreline:

- *Maintain shoreline observations in OR at existing levels [Allan]*
- *Deliver data via NVS [Allan]*
- *Bring all data QA/QC to meet Certification standards [Allan]*

Status: Complete for the season

Summary: The Oregon Beach and Shoreline Mapping Analysis Program (OBSMAP) efforts are led by J. Allan and his team at the Oregon Department of Geology and Mineral Industries (DOGAMI). Beach profile data – winter surveys – were successfully collected in the Rockaway littoral cell (25 sites), along the Clatsop Plains (6 sites), and along the Neskowin cell (15 sites). All surveys were performed in March 2024. Furthermore, updated winter surveys were collected for the Netarts Cell (25 sites) in April 2024. In addition to measurements of the transects, datum-based shorelines were also collected along each of the study areas. Beach profile and shoreline data have been processed, QA/QC'd, and archived both locally and remotely. The reduced profile plots, change plots, and trends have been posted to the [NANOOS beach and shoreline portal](#).

In late summer 2023, DOGAMI staff established a new pilot terrestrial lidar scanning (TLS) profile network in the Beverly Beach littoral cell. The purpose of this new activity is to provide high resolution change information on coastal cliffs adjacent to US Highway 101, in order to assist with management decisions. Monitoring consists of 3-5 TLS scans at 13 beach profile sites established by DOGAMI in 2007. Scan coverage for each site extends approximately +/-50 m either side of the transect locations and covers the entire cliff face. This compares with previous approaches that consisted of only a few discrete point surveys made down the cliff face (where feasible) using GPS. Survey control is provided by a GNSS receiver mounted on top of the TLS scanner. The scan data is then post-processed to yield georeferenced scan data of the cliff face with point densities of ~1 cm and errors of ~5 cm. Our initial survey in the Beverly Beach cell was completed in October 2023 and a follow-up survey was undertaken in May 2024. Preliminary evaluation of results from the serial lidar demonstrated huge variations in change across the cliff face, indicative of the local geology and the effects of wave processes along the cliff toe and subaerial processes on the upper cliff face. In addition, the approach successfully captured the movement of two large translational landslide blocks that intersect with the beach.

In addition to the TLS scans at Beverly Beach, DOGAMI staff successfully used the TLS scanner to document changes on the Columbia River dynamic revetment and foredune, adjacent to the south jetty. An initial baseline scan was completed in December 2023 and a follow-up scan was performed in March 2024. Post-processing of these data successfully demonstrated the utility of this approach at this location for documenting changes on the cobble berm and foredune. Our preliminary results indicated the following:

- Significant erosion responses along the sandy foredune, with the entire 500 m long section of foredune having retreated by up to -6 m over a 3-month window. This region will likely breach in the ensuing 2024-25 winter posing problems for the USACE who manage the area.

- The scanning successfully documented the exposure and movement of the cobble berm southward along the dynamic revetment. The scan data also demonstrated significant losses of cobble in a sacrificial area adjacent to the jetty root. Erosion at this location has not been observed since construction of the dynamic revetment in 2013.

Accomplishments/successes: Data collected as part of OBSMAP continue to be used by regional coastal managers (e.g., Oregon State Parks, Oregon Department of Land Conservation and Development agency), geoconsultants (e.g., Integral Corporation's work to evaluate erosion at Cannon Beach) and the public to assess local and regional coastal changes taking place on Oregon beaches. Results from our monitoring are also being used to by an OSU PhD student (under PI Ruggiero) to field-check satellite-based shoreline extractions and for future shoreline modeling.

Problems/delays: None

Washington and Oregon Bathymetry:

- *Maintain nearshore bathymetric observations of beach and shoreline morphodynamics in WA and OR at existing levels [Ruggiero]*
- *Deliver data via NVS [Ruggiero]*
- *Bring all data QA/QC to meet Certification standards [Ruggiero]*

Status: Complete

Summary: P. Ruggiero's group at Oregon State University completed, via collaborations with the USGS and the Washington Department of Ecology, the processing of nearshore bathymetry data collected in summer 2023 along the four sub-cells of the Columbia River littoral cell (CRLC). Over 220 individual cross-shore profiles were collected during summer 2020 extending from the lower inter-tidal to ~12 m of water depth (~2000 m from the shoreline). Approximately 400 kilometers of nearshore mapping took place within ~6 days of field data collection. These data have been processed from their raw format into deliverable text files and have passed a rigorous quality assurance process bringing the data to certification standards. In all cases these nearshore bathymetry measurements have been combined with topographic measurement collected by Ecology developing complete maps of the nearshore planform. Data through 2023 are available via Stevens, A.W., Weiner, H.M., Wood, J.M., Ruggiero, P., Kaminsky, G.M., and Gelfenbaum G.R., 2019, Beach topography and nearshore bathymetry of the Columbia River littoral cell, Washington and Oregon (ver. 4.0, January 2024): U.S. Geological Survey data release, <https://doi.org/10.5066/P9W15JX8>.

Accomplishments/successes: These data continue to provide a critical source of information for improving coastal hazard mitigation along the coastlines of the CRLC and for understanding the morphodynamics of high-energy beaches. For example, P. Ruggiero co-authored, along with NANOOS investigator George Kaminsky and others, a paper summarizing morphological evolution near the Mouth of the Columbia River and the Mouth of Grays Harbor (Stevens, A., Ruggiero, P., Parker, K., Vitousek, S., Gelfenbaum, G., and Kaminsky, G., Climate controls on wave-drive sediment transport and coastal morphology adjacent to engineered inlets, in revision at Coastal Engineering). During this period Ruggiero's group also continued developing and testing a new generation Coastal Profiling System with two new Personal Watercraft. The plan is to use the new CPS during summer 2024.

Problems/delays: None

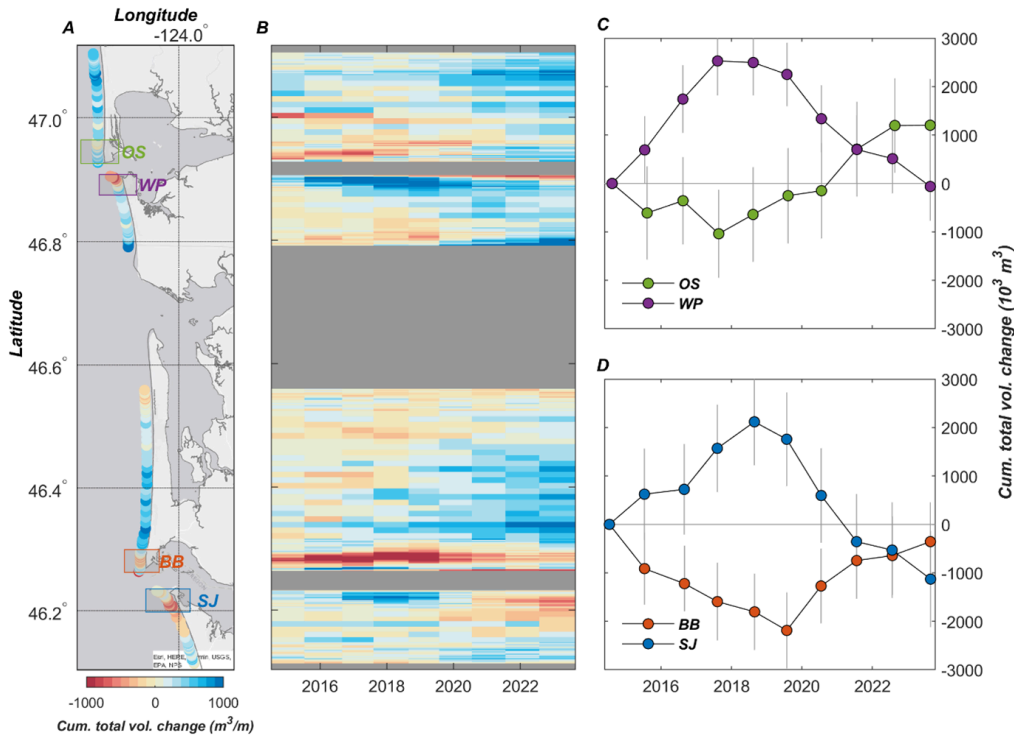


Figure 2. Cumulative sediment volume change for each survey profile, A, during the period 2014-2023 and, B, for each annual survey. Time-series of integrated beach and nearshore volume change for regions immediately adjacent to Grays Harbor and the Columbia River are shown in C and D, respectively. The alongshore extents used for integrated volume change calculations are provided in Figure 2B-C (OS = Ocean Shores, WP = Westport, BB = Benson Beach, SJ = South Jetty). Error bars in C-D represent estimated uncertainty in cumulative sediment volume change for each region.

B. Modeling & Analysis Subsystem:

WA & OR ESTUARIES & COAST MODELS

Provide sustained support to a community of complementary regional numerical models:

Contribute to the operation of regional models, and the tools and products they support, covering the head of tide of estuaries to the outer edges of the Exclusive Economic Zone (EEZ) in both OR and WA.

NE Pacific and Salish Sea:

- Support, at existing levels, the daily forecast model, LiveOcean, which simulates ocean circulation and bio-geochemistry in the Salish Sea and in coastal waters of the NE Pacific, including Oregon, Washington, and British Columbia [MacCready]
- Deliver model output via NVS [MacCready]
- Model verification and validation [MacCready]

Status: On track

Summary: During this reporting period NANOOS support for MacCready's salary allowed for continued upgrades of the LiveOcean model system. Daily forecasts from the large NE Pacific domain and the nested Willapa Bay-Grays Harbor domain were reliably produced during this period and distributed to the public and stakeholders through the NANOOS NVS, the LiveOcean website, and a NANOOS server.

Accomplishments/Successes: We processed a number of new observational datasets, expanding our ability to do rapid quantitative evaluation of new simulations. The datasets included ORCA moorings in Puget Sound and OCNMS moorings on the WA shelf. We initiated a new long hindcast (October 2012 - present) that will allow better scientific understanding of interannual variability and marine heat waves. It currently has run through 2023. Negotiations are underway with NOAA to port this long hindcast to their Cloud Sandbox. This will greatly improve public access to LiveOcean output.

Problems/Delays: None

Columbia River Estuary and Plume:

- *Support, at existing levels, the CRITFC circulation modeling and forecasting system, which covers the Columbia River estuary and plume [Seaton]*
- *Deliver model output via NVS [Seaton]*
- *Model verification and validation [Seaton]*

Status: On track

Summary: CRITFC has maintained an extensive modeling system for the Columbia River coastal margin, denoted Virtual Columbia River (VCR). The VCR has evolved from multi-institutional collaborations involving modelers and non-modelers, in academia and across regional, federal, and tribal agencies. The modeling capabilities of the VCR has assisted the region in the study of salmon life cycle, habitat, estuarine pathways, and status under the Endangered Species Act and in relation to hydropower management and climate change.

Anchoring the system are simulations of circulation, conducted in four distinct forms: (1) daily forecasts, (2) multi-year simulation databases, currently 1999-2018, (3) scenario simulations, and (4) process simulations. Of these, daily forecasts are displayed on NVS. To meet the challenges that the highly energetic and strongly stratified Columbia River estuary and plume pose to numerical models, we have experimented with—and contrasted among—multiple codes (Thetis, SLIM, SELFE and SCHISM) representing different classes of unstructured-grid finite element methods.

Accomplishments/Successes: Maintained forecasts, with forecast overlays provided through CMOP website and NVS. During this reporting period we have continued calibration and evaluation of a new SCHISM model to be used for a new multi-year simulation database and eventual updated forecast.

Problems/Delays: None

PNW Coastal Waters:

- *Support, at existing levels, the OSU real-time coastal ocean forecast model, which covers the coastal waters off OR and WA [Zaron]*
- *Deliver model output via NVS [Zaron]*
- *Model verification and validation [Zaron]*

Status: On track

Summary: We continued real-time operation and support of our RTDAOW (Real Time Data Assimilation for Oregon and Washington) system on a daily basis. The data delivery is near-real time and stable. At this moment we do not anticipate any substantive changes to the project Scope of Work.

Accomplishments/successes: The data assimilation and modeling system continue to provide real-time forecasts to fishers and the public via the NANOOS Visualization System, e.g., as the Tuna Forecast and SeaCast applications.

Problems/delays: None

C. Data Management & Communications Subsystem:

DATA MANAGEMENT & CYBERINFRASTRUCTURE (DMAC)

Maintain, harden, and enhance NANOOS' Data Management and Cyberinfrastructure (DMAC) system for routine operational distribution of data and information: Sustain and enhance the DMAC system, including the NANOOS Visualization System (NVS), for dynamic and distributed data access.

Mature Regional DAC Operations:

- *Sustain, refresh, and enhance a highly available, robust, distributed hardware and software environment; maintain appropriate staffing and team coordination; maintain up-to-date operations and system documentation to ensure transparent and clear descriptions of DAC architecture [Tanner, Travis]*

Status: On track

Summary: Continued maintenance and development of BlueHarvest, as needed. BlueHarvest is the internal NANOOS DMAC application for harvesting data from a wide range of data providers. The system is robust and maintains flexibility to accommodate a wide range of data providers/sources. It populates the NANOOS internal database in a standardized way so the data can be easily integrated into the various data products served on NVS. BlueHarvest also provides immediate feedback about data transmission frequency/latency, which enables NANOOS to identify and fix data flow issues more efficiently.

Accomplishments/Success: Consistent, reliable data harvesting.

Problems/Delays: None

Non-core Task 4: A one-time increase for core needs [Newton]

Status: On track

Summary: This one-time increase is being used to support NANOOS fiscal and administrative needs. Hana Sawanobori was hired in November 2023 as NANOOS Grants and Contracts Manager. Sawanobori serves as fiscal lead for NANOOS, assisting with proposals, grants administration, as well as reporting on work completed.

Accomplishments/Successes: Sawanobori aided NANOOS to submit our IRA proposals and remains incredibly helpful to improving program management.

Problems/Delays: None

- *Engage new local providers (not NANOOS funded), integrate their data into NVS and IOOS DMAC services; strengthen DAC capabilities and resources through regional and thematic partnerships [Tanner, Travis]*

Status: On track

Summary: At PIs request, updated Quileute Lander harvester to accommodate new dataflow.

Accomplishments/Successes: Update Quileute Lander Harvester.

Problems/Delays: None

NVS Support and Development:

- *Maintain NVS support leveraging regional user needs, feedback, and data reviews to continually improve the relevance and quality of metadata for observing and modeling data assets integrated and served by NANOOS [Tanner, Carini]*

Status: On track

Summary: Continued development of new HF Radar overlays. Started development of new WaveWatch III forecast overlays.

Accomplishments/Success: HF Radar overlay and WaveWatch III overlay development.

Problems/Delays: None

- *Sustain & enhance existing data streams, IOOS web services, GTS submission; implement NCEI data archiving, NDBC data archiving, Glider DAC submission, QARTOD; maintain and expand ERDDAP to leverage web services, serve NANOOS applications and users; evaluate where new tech (e.g., cloud, AI, etc.) may afford NANOOS better efficiencies and robustness [Tanner, Travis, Carini]*

Status: On track

Summary: All NANOOS gliders transmit their data to the Glider DAC. All NANOOS HFR transmit their data to the HFR DAC. NDBC harvest in situ buoy data from the NANOOS ERDDAP. Columbia River Estuary buoys and land-based stations are archived periodically and automatically via an [NCEI Data Submission Agreement](#) (set up for PI Seaton). NANOOS will pursue establishing an analogous pathway with NCEI and the Washington Shelf Buoys/Moorings and Puget Sound Profiling Moorings (PIs Manalang, Travis and Mickett).

Accomplishments/Success: Maintained existing data streams.

Problems/delays: None

Engagement in National and Cross-regional DMAC Efforts:

- *Sustain participation in IOOS DMAC community activities, including QARTOD development, semantic mapping, OGC WMS/WFS support, climatology data development, UGRID support, and shared code development and testing [Tanner, Travis]*

Status: On track

Summary: NANOOS platforms available via the NANOOS ERDDAP are being included in IOOS datasets.

Accomplishments/Successes: In situ datasets transmitted via the NANOOS ERDDAP.

Problems/Delays: None

- *Extend to other areas via pan regional products with sister IOOS RAs; engage and leverage NSF-funded OOI, international GOA-ON activities, and Canadian collaborations; engage with other West Coast and Pacific efforts, including WCGA and IPACOA [Tanner, Carini]*

Status: On track

Summary: Tanner and Carini continue to collaborate with PacIOOS and AOOS DMAC through their NSF-funded Convergence Accelerator Backyard Buoys project.

Accomplishments/Successes: Development of data services for Backyard Buoys project.

Backyard Buoys mobile app (iOS and Android) are in beta testing. Development of Backyard Buoys ERDDAP is starting.

Problems/Delays: None

USER PRODUCTS COMMITTEE (UPC)

Continue to deliver existing and, to the extent possible, create innovative and transformative user-defined products and services for PNW stakeholders: Continue our NVS innovation to succeed in this vital translation for meaningful and informative data products that address user needs and serve society.

Website:

- *Continue to evaluate and update web content relevant to stakeholder issues, especially those related to Maritime Operations, Ecosystem Assessment, Fisheries & Biodiversity, Coastal Hazards, and Climate; improve ease of usability and user tracking capabilities [Tanner]*

Status: On track

Summary: Added new J-SCOPE forecast. Started development of new Data Explorer mobile app (iOS and Android).

Accomplishments/Successes: New and updated content.

Problems/Delays: None

Non-core Task 6: *Sustain NANOOS' work to develop and maintain the GOA-ON data portal [Tanner]*

Status: On track

Summary: Updated slideshow, webinar, and other content. Created web pages for regional hubs.

Accomplishments/Successes: Maintained GOA-ON website.

Problems/Delays: None

Tailored Products Development:

- *Annually evaluate priorities for products at the Tri-Com meeting (DMAC, UPS, and E&O), based on outreach feedback, regional issues, and GC input, and will implement new tailored products to the extent possible [Tanner]*

Status: On track

Summary: This committee is composed of members from OHSU, UW, OSU, NANOOS E&O, and NOAA. NANOOS UPC chair Tanner participates in weekly "tag-up" calls with members from DMAC, UPC, E&O, and Web development to facilitate consistent work efforts, synergy across the committees, and improvements to product development and enhancements. Activities for this period centered around weekly NANOOS meetings.

Accomplishments/Success: Started development of new Data Explorer mobile app (iOS and Android). Created Multi-stressors for the California Current product page. Created NWEM ERDDAP. Updated HABs bulletins. Added new J-SCOPE forecasts. Updated Puget Sound Metrics Dashboard product page. Added and updated Salish Cruise data and plots.

Problems/delays: None

EDUCATION & OUTREACH (E&O)

Sustain and diversify NANOOS engagement to the extent possible: Continue ongoing engagement with diverse stakeholders and the public, increasing ocean awareness and literacy; to diversify the ocean and coastal workforce; to improve our ability to provide relevant ocean and coastal data and information to underserved or underrepresented communities; and to facilitate use of NANOOS products for societal objectives, the core task for which NANOOS exists.

Communication:

- *Maintain up-to-date success stories, employing effective use of social media and newsletters [Wold, Newton]*
- *Support national communication through IOOS Program Office and IOOS Association collaborations [Wold, Newton]*
- *Be responsive to regional and local events (e.g., harmful algal blooms, fish kills, marine heat waves, hypoxia, floods, etc.) to enhance relevance to public and highlight regional stories with NANOOS members and partners [Wold, Newton]*
- *Maintain existing and build new relationships to stakeholder user groups and the education community enabling NANOOS to achieve effective education and outreach [Wold, Newton]*

Status: On track

Summary: During this reporting period, NANOOS staff engaged with end users and educational partners (fishers and boaters in Washington and Oregon, colleagues from Transport Canada and CIOOS in British Columbia, Sound Water Stewards, Pacific Coast Marine Resources Committee, Seattle Maritime High School, Technology Access Foundation, Earthlab Internship, Oregon Sea Grant Coastal Haz), mentored 10th graders at the Maritime High School, published a new curriculum (developed by an Earthlab intern) that brings NVS data into the classroom, maintained content on social media, newsletters, website slideshow, etc., and regularly participated in IOOS Outreach Committee meetings.

Accomplishments/Successes: “Ocean Acidification and the Intertidal” middle school curriculum

Problems/Delays: None

Product Co-Development:

- *Engage users in product co-development through focus groups; use targeted interviews or surveys to garner feedback and input on products as they are developed; gain feedback and conduct self-assessment after product release [Wold, Allan]*
- *Conduct trainings to broader user groups and evaluate trainings to optimize NANOOS functionality [Wold]*
- *Engage with regional formal education communities to use ocean observing and NANOOS products to support STEM education, and with regional non-formal education communities to facilitate the use of NANOOS products to foster community ocean literacy [Wold, Allan]*

Status: On track

Summary: Incorporated informal user feedback, collected via engagement activities by Wold and Allan, into enhancing NVS.

Accomplishments/Successes: None

Problems/Delays: None

Non-core Task 12: Support execution of OceanHackWeek [Mayorga]

Status: Complete

Summary: Planning for OceanHackWeek 2024 (<https://oceanhackweek.org/ohw24/>) is well underway, with applications opening on June 14 and selected applicants already notified. OceanHackWeek 2024 will be held on August 26-30 as two in-person events, at the Bigelow Laboratory for Ocean Sciences in East Boothbay, Maine and in Sydney, Australia.

OceanHackWeek will bring together oceanographers across disciplines and career stages, primarily from the US and Australia, to advance capabilities in data science focused on oceanographic applications and cultivate an open-science and sharing culture. It is being supported by IOOS, NOAA Global Ocean Monitoring and Observing program, the Schmidt Ocean Institute, the UW Applied Physics Laboratory (APL-UW), Bigelow Laboratory for Ocean Sciences, Australia CSIRO and a lot of volunteer labor from many individuals in the US and abroad (<https://oceanhackweek.org/ohw24/organizers.html>), including Wu-Jung Lee and Emilio Mayorga from APL-UW.

Accomplishments/Successes: We continue to sustain a collaboration with individuals in multiple institutions in the US and Australia that enables the organization of OceanHackWeek to benefit from many voices and support participants from different backgrounds.

Problems/Delays: None

Diversity, Equity, and Inclusion:

- *Work with the other IOOS regions and the Program Office on workforce development initiatives to expand and diversify the ocean, coastal, and Great Lake workforces and to improve our ability to provide relevant ocean and coastal data and information to underserved or underrepresented communities [Newton, Wold]*
- *On a more immediate and local scale, the NANOOS “Enabling Change” working group, made up of NANOOS staff and partners (currently federal, university, and state agency) will move forward with actions that match NANOOS’ commitment ability [Newton, Wold]*

Status: On track

Summary: During this reporting period, NANOOS Staff and members of the Enabling Change working group met regularly to discuss opportunities to progress DEI efforts.

Accomplishments/Successes: Hosted EarthLab summer interns, presented OA to students at TAF@Saghalie, mentored students at the Maritime High School.

Problems/Delays: None

D. Non-Core Funded Activities:

Reported throughout the “Core Funded Activities” sections, wherever thematically relevant. Each activity is labeled as “Non-core Funded Task #”.

E. Governance & Management Subsystem:

Governance:

- *Assure that NANOOS has transparent, effective, and representational governance via its Governing Council and the NANOOS Executive Committee composed of its elected Board and its functional committee chairs [Newton, Rome & Carini, UW]*
- *Assure these bodies are engaged in NANOOS prioritization of regional needs, work effort, and product development [Newton, Rome & Carini, UW]*
- *Assure balance of stakeholders represented in NANOOS reflects the diversity found in PNW [Newton, Rome & Carini, UW]*
- *Conduct annual GC meeting [Newton, Rome & Carini, UW]*

Status: On track

Summary: J. Newton (NANOOS Executive Director) and A. Barnard (NANOOS Board Chair), and M. Kosro (NANOOS Board Vice Chair) continued to provide leadership to NANOOS operations and connection to the US IOOS enterprise. Newton, R. Carini (NANOOS Deputy Director), and N.

Rome (NANOOS Senior Program Manager) assured progress on the above milestones. Executive Committee meetings were held virtually on 27 February, 23 April, and 25 June, to advise NANOOS on its strategy and priorities for the upcoming IRA fund opportunity.

Accomplishments/Successes: Plans have been made for the Annual NANOOS *Governing Council* (GC) and *Principal Investigator* (PI) meetings to be held 13-14 August in Vancouver, WA. The event will be a great opportunity to build community and implementation of Year 4 priorities.

Problems/Delays: None

Non-core Task 5: *Support for salary for Newton as GOA-ON Co-Chair [Newton]*

Status: On track

Summary: Newton continued to serve on several international scale coordination committees during the period. Newton is a co-Chair of *Global Ocean Acidification Observing Network* (GOA-ON), along with Steve Widecombe, Plymouth Marine Labs. She represented IOOS on GOA-ON Executive Committee (EC) calls and activities.

Accomplishments/Successes: Over the period, she aided the following activities: GOA-ON North American Hub Meeting on 17-18 Jan, where she gave an OARS Update and a talk on the GOA-ON Data Portal. From 29 Jan-2 Feb, Newton attended the GOA-ON India meeting in Kolkata, and presented on "*Partnerships for effective co-production of mitigative and adaptive action to Ocean Acidification, from local to regional to global solutions*" and "*The importance of partnerships, from local to global scales, for crafting effective co-production of mitigative and adaptive action to Ocean Acidification*". Newton also attended the Ocean Sciences Meeting in New Orleans, Louisiana on 19-23 Feb, and presented on "*International Capacity Building for Ocean Acidification Through the Global Ocean Acidification Observing Network (GOA-ON)*". NANOOS powers the GOA ON web and data portal through funding from NOAA OAP (non-core task 6).

Problems/Delays: None

Representation:

- *Represent NANOOS at IOOS Program Office and IOOS Association meetings, and at national meetings of significance [Newton, Rome & Carini, UW]*
- *Engage at a regional level at meetings and workshops affecting PNW stakeholders and NANOOS [Newton, Rome & Carini, UW]*

Status: On track

Summary: Newton participated in IOOS Program Office and IOOS Association calls. Newton is a member of the IOOS Association Executive Committee and participated in their teleconferences during the period.

Accomplishments/Successes: Newton, Carini, and Rome attended the IOOS Spring Meeting in Washington, D.C. on 11-15 March. Newton presented at the meeting on "Perspectives from NANOOS: Observing Prioritization". Newton also attended the MARACOOS 20th anniversary events in Washington, D.C. on 21-23 May. Throughout the period, Newton continued representing NANOOS and IOOS at CLIVAR Steering Committee meetings to plan the workshop Optimizing Ocean Observation Networks to be held in Boulder, CO, in October 2024.

Problems/Delays: None

Project Oversight:

- Conduct annual all-PI meetings and Tri-Committee meetings, providing clear feedback and direction [Newton, Rome & Carini, UW]
- Share project evaluation at the annual PI meeting [Newton, Rome & Carini, UW]

Status: On track

Summary: Newton, Carini, and Rome participated in weekly Tri-Comm calls and coordinated with PIs throughout the period. The Annual Tri-Comm meeting, during which the group reflected on the past year's accomplishments and prioritized the next year's developments for Engagement, User Products, and DMAC, was held 30-31 May in Seattle, WA.

Accomplishments/Successes: A complete and prioritized list of activity for the upcoming year was generated from the Tri-Comm meeting.

Problems/Delays: None

Coordination:

- Coordinate with West Coast RAs and other RAs to optimize and leverage capabilities and assure consistencies [Newton, Rome & Carini, UW]
- Engage in sub-regional and user-group specific workshops to aid coordination and optimization of effort [Newton, Rome & Carini, UW]
- Coordinate with Canada (CIOOS, MEOPAR, etc.) [Newton, Rome & Carini, UW]

Status: On track

Summary: Newton, Carini, and Rome engaged activities over the period with regional and local entities in a variety of venues and opportunities.

Accomplishments/Successes: See below for additional activities.

- Newton and Carini attended the NSF Convergence Accelerator PI Meeting in Washington, D.C. on 24-25 Jan, where Newton gave a talk on "*Backyard Buoys, sustainability model*".
- Newton, Carini, and Wold attended the Backyard Buoys All-Hands Meeting in Honolulu, Hawaii on 5-7 Feb.
- Newton began serving on the Blue Ventures Advisory for NOAA Climate Accelerator, attending the first Advisory Committee meeting on 24 April (virtual) and the in-person Blue Ventures Showcase on 7 June.

Problems/Delays: None

Accountability:

- Submit required IOOS progress reports and respond to other requests [Newton, Rome & Carini, UW]
- Attain recertification in 2023 as the Regional Information Coordination Entity of US IOOS for the PNW [Newton, Rome & Carini, UW]

Status: On track

Summary: Progress report and other requests have been fulfilled during the period. NANOOS was successfully recertified in 2023.

Accomplishments/Successes: While Progress Reports in the IOOS requested format have been filed on time, a more readable format is produced and these reports maintained publicly available at https://www.nanoos.org/about_nanoos/documents.php

Problems/Delays: None

Additional NANOOS coordination and representation included:

- On 9 Jan, Newton attended the Salish Sea Tidal Power Workshop in Seattle, WA and gave a talk on NANOOS capabilities.
- On 4 April, EarthLab hosted Newton for a lightning talk on Backyard Buoys for the EarthLab Showcase in Seattle, WA.
- In coordination with Washington state agencies, tribes, industry, and others, Newton represented NANOOS at the Marine Resources Advisory Council meetings on 24 March (virtual).
- NANOOS provided updates on oceanographic conditions in the Pacific Northwest for the *NOAA WestWatch* webinar series on 27 Feb, 16 April, and 18 Jun, along with the other two west coast RAs.
- NANOOS made contributions to *PSEMP Puget Sound Marine Condition Updates* bi-monthly throughout the period.
- NANOOS continued work on the development of OA indicators for the *West Coast Ocean Data Portal*, and Newton, Boyar, and Busse virtually attended the Best Practices for OA Biological Monitoring Workshop on 18-19 Apr.
- NANOOS is supporting a project in collaboration with Oregon State University and NOAA PMEL on Multi-Stressors off the Pacific Northwest Coast. Newton attended the Multi-stressors MTAG meeting in Forks, WA on 29-30 April.
- On 1 May, Newton presented results from NANOOS observations in coastal Washington waters at the Puget Sound Marine Waters 2023 Year in Review meeting.
- Locally, Newton served on the Steering Committees of C-CAN, OASeS, ORHAB, Cascadia CoPes Hub, OCNMS Climate Vulnerability Assessment Working Group and the Puget Sound Environmental Monitoring Program. She informed regional and national groups about the west coast OAH indicator work.
- Newton attended an in-person OASES meeting in Forks, WA on 14-16 May and gave a talk on "*Ocean Acidification and Vulnerability: Regional Species Stories*".
- Carini represented NANOOS at the 31 Jan ORHAB meeting (virtual) and at the Cascadia CoPes Annual Meeting on 9-13 May in Newport, OR.
- Barth attended the "OCEAN OBSERVING IN CALIFORNIA: Celebrate the Past, Showcase the Present, Envision the Future" celebration in San Diego, CA, May 14-16, 2024. Attendees celebrated the 20th anniversaries of CeNCOOS – NANOOS and CeNCOOS share funding of the glider observations on the Trinidad Head Line in northern California – and SCCOOS, as well as the 75th anniversary of CalCOFI. Rome attended the meeting also and presented a poster "NANOOS efforts for ocean data accessibility in the Pacific Northwest and northern California."

Keeping the goals and capabilities of NANOOS and IOOS represented internationally, NANOOS Administration and PIs made several important contributions:

- Newton served as a member of the *Canadian IOOS (CIOOS) Pacific Regional Oversight Committee* and maintained communication over the period. Also in Canada, Newton chaired the *Marine Environmental Observation, Prediction, and Response Network*, a Canadian Center of Excellence (MEOPAR) International Science Advisory Committee, which was renewed for funding during the period and will start active meetings in the next period.
- Barth and Newton were on the Advisory Committee of the *UN Ocean Decade Collaborative Center for the Northeast Pacific* and attended meetings during the period, but this Center was discontinued in spring 2024.
- Newton attended the Ocean Decade Meeting in Barcelona, Spain on 9-12 April. At the

meeting, Newton presented on *"The importance of partnerships, from local to global scales, for crafting effective co-design and co-production of adaptive actions to Ocean Acidification"*.

- Newton continued as a member of the Science Advisory Team for the *Joint European Research Infrastructure in the Coastal Ocean* (JERICO) along with Henry Ruhl (CeNCOOS) and Clarissa Anderson (SCCOOS).
- Coordination with the Global Ocean Acidification Observing Network (GOA-ON) is described in non-core task 5.
- Newton attended the World Fisheries Conference in Seattle, WA on 6 March.
- Newton also attended the Ocean Sciences Meeting in New Orleans, Louisiana on 19-23 Feb, and presented on *"International Capacity Building for Ocean Acidification Through the Global Ocean Acidification Observing Network (GOA-ON)"* (as described above in non-core task 5) and on *"Bringing a focus to the nearshore: A case for refining projections to aid coastal communities"*.
- The Workshop on Methodology for Capacity Building was held in Monaco on 18-20 March. Newton represented NANOOS and the region with a presentation on *"Coastal Ocean Observing in the PNW US: Perspectives on scope and scale"*.
- Representing GOA-ON, Newton attended and moderated the International Workshop to Advance Ocean Carbon and Acidification Data Management and Interoperability in Venice, Italy, 7-8 May.
- On 25 April, Newton attended One Ocean Advisory Meeting (virtual) with Haakon Vatle, Tall ship Statsraad Lehmkuhl CEO and expedition leader for the One Ocean Expedition.
- MacCready continued service on the Olympic Coast National Marine Sanctuary's Advisory Council as the primary Research representative (2023-2026). He also serves on the SeaGrant Willapa Grays Harbor Estuary Collective Scientific Advisory Committee.
- Barth serves on the Joint European Research Infrastructure for Coastal Observatories (JERICO) Scientific and Technical Advisory Committee and attended their annual meeting in Brest, France, in June 2024.
- Barth serves on National Academy of Sciences, Engineering and Medicine's "Standing Committee on Environmental Science and Assessment for Ocean Energy Management" that advises the Bureau of Ocean Energy Management in its efforts to manage development of the nation's offshore energy resources in an environmentally and economically responsible way.

F. Presentations & Publications Acknowledging NANOOS Support:

Presentations: underline indicates NANOOS PI

Breitkreutz, Mueller, Tomas, and Helms. 2024. Dynamics and drivers of eelgrass seed-based recovery potential along an estuarine gradient. World Seagrass Conference 6/2024, Naples, Italy.

Breitkreutz, Mueller, Tomas, and Helms. 2024. Spatiotemporal variability in eelgrass reproduction in South Slough and Coos Bay: Implications for conservation and restoration efforts. South Slough Management Commission Meeting, Coos Bay, OR, 7/25/24.

Gradoville, MR, Riseman, S, Salazar Estrada, AE, Swirsky, M, Needoba, J, Seaton, C. 2024. Coastal Margin Observation and Prediction (CMOP): Sustained observations and modeling of the Columbia River estuary and plume to enhance understanding of a critical ecosystem. Ocean Sciences Meeting, 02/2024, New Orleans, LA.

Gradoville, MR. 2024. Hypoxia in the Columbia River estuary: Using CMOP data to uncover patterns, mechanisms, and potential effects on salmon. CRITFC Brown Bag Seminar, 04/2024.

Gradoville, MR. 2024. Oceanography for the tribes: Connecting the dots from ocean observing to salmon management at the Columbia River Inter-Tribal Fish Commission (CRITFC). Ocean Ecology and Biogeochemistry Seminar, Oregon State University, 05/2024.

Kaminsky, G, Alampay, G., and Gostic, M., 2024. Coastal Monitoring of Erosion Hotspots in Pacific County. Pacific County Marine Resource Committee (MRC) Annual Science Conference, Long Beach, WA. 18 May 2024.

MacCready, P. and W. R. Geyer 2024. PO Seminar: “What Controls the Estuarine Exchange Flow of the Salish Sea?” UW 1/2024.

MacCready, P. 2024: Ocean Sciences talk: “On the Size & Consequences of Vertical Mixing in Estuaries” New Orleans 2/2024.

Maran, H. and Kaminsky, G., 2024. Columbia River littoral cell beach monitoring: Informing coastal resilience work. Cascadia Coastlines and Peoples Hazards Research (CoPes) Hub, Navigating Coastal Hazards Workshop, Astoria, Oregon. 11 March 2024.

Maran, H., Selden, K., Alampay, G., Drummond, H., Gostic, M., and Kaminsky, G., 2024. Morphology and substrate monitoring of a dynamic revetment at North Cove, Washington. Young Coastal Scientists and Engineers – Americas, Quebec, Canada. 8 June 2024.

Newton, J. 2024. *Northwest Association of Networked Ocean Observing Systems*. Salish Sea Tidal Power Workshop. Seattle, WA. 9 January 2024.

Newton, J. 2024. *GOA-ON Data Portal*. GOA-ON North American Hub Meeting. Newark, Delaware. 17-18 January 2024.

Newton, J. 2024. *OARS Update for the North American Hub: What might you (we) do?* GOA-ON North American Hub Meeting. Newark, Delaware. 17-18 January 2024.

Newton, J. 2024. *Backyard Buoys, sustainability model*. NSF Convergence Accelerator PI Meeting. Washington, D.C. 24-25 January 2024.

Newton, J. 2024. *The importance of partnerships, from local to global scales, for crafting effective co-production of mitigative and adaptive action to Ocean Acidification*. GOA-ON India. Kolkata, India. 29 January - 2 February 2024.

Newton, J. 2024. *Partnerships for effective co-production of mitigative and adaptive action to Ocean Acidification, from local to regional to global solutions*. GOA-ON India. Kolkata, India. 29 January - 2 February 2024.

Newton, J., S. Widdicombe, K. Isensee, K. Schoo, S. Flickinger, K. Grabb, and A. Kenworthy. 2024. *International Capacity Building for Ocean Acidification Through the Global Ocean Acidification Observing Network (GOA-ON)*. Ocean Sciences Meeting. New Orleans, Louisiana. 19-23 February 2024.

Newton, J., S. Siedlecki, S. Alin, J. Mickett, J.A. Koehlinger, R. Carini, J. Waddell, R. Feely, and M. Poe. 2024. *Bringing a focus to the nearshore: A case for refining projections to aid coastal communities*. Ocean Sciences Meeting. New Orleans, Louisiana. 19-23 February 2024.

Newton, J. and R. Carini 2024. *Perspectives from NANOOS: Observing Prioritization*. IOOS Spring Meeting. Washington, D.C. 11-15 March 2024.

Newton, J. 2024. *Coastal Ocean Observing in the PNW US: Perspectives on scope and scale*. Workshop on Methodology for Capacity Building. Monaco and Villefranche. 18-20 March 2024.

Newton, J. 2024. *Backyard Buoys Lightning Talk*. EarthLab Showcase. Seattle, WA. 4 April 2024.

Newton, J. 2024. *The importance of partnerships, from local to global scales, for crafting effective co-design and co-production of adaptive actions to Ocean Acidification*. Ocean Decade Meeting. Barcelona, Spain. 9-12 April 2024.

Newton, J. and J. Mickett. 2024. Observations from Washington Coastal Observations. Marine Waters Overview. Seattle, WA. 1 May 2024.

Newton, J., M. Poe, S. Alin, S. Siedlecki, J. Schumacher, J. Hagen, J.A. Koehlinger, R. Svec, T. Moore, S. Fradkin, J. Waddell, H. Berger, and R. Carini. 2024. *Ocean Acidification and Vulnerability: Regional Species Stories*. OASeS. Forks, WA. 14-16 May 2024.

Rome, N., J. Newton, R. Carini, R. Wold, T. Tanner, J. Allan, C. Seaton, and M. Kosro. *NANOOS efforts for ocean data accessibility in the Pacific Northwest and northern California*. Ocean Observing in California: Celebrate the Past, Showcase the Present, Envision the Future. San Diego, CA, May 14-16, 2024.

Seaton, C., Swirsky, M, Baptista, A. 2024. Improving a Watershed-to-Ocean Model of the Columbia River Estuary. Ocean Sciences Meeting 02/2024. New Orleans, LA

Selden, K., Maran, H., Alampay, G., Drummond, H., and Kaminsky, G., 2024. Substrate and Slope Characterization of a Natural Cobble Berm: A Case Study of South Beach, Washington. Young Coastal Scientists and Engineers – Americas, Quebec, Canada. 8 June 2024.

Travis. 2024. NWEM ORCA Moorings: Observations from Puget Sound profiling buoys & metrics. Marine Waters Overview. Seattle, WA. 1 May 2024.

Trainer, V.L. *Everything I needed to know I learned from Pseudo-nitzschia*, Invited Plenary Lecture, 20th International Conference on Harmful Algae, Hiroshima, Japan, October 2023

Weiner, H., Gostic, M., Drummond, H., Kaminsky, G., Alampay, G., Hacking, A., and Selden, K., 2024. Beach monitoring near Kalaloch in Olympic National Park for applications in nature-based coastal protection engineering designs. National Park Service North Coast & Cascades Science Days, Virtual. 15 February 2024.

Publications: underline indicates NANOOS PI

Barth, J. A., S. D. Pierce, B. Carter, A. Y. Erofeev, J. L. Fisher, R. A. Feely, K. C. Jacobson, A. A. Keller, C. A. Morgan, J. E. Pohl, L. K. Rasmuson, and V. Simon, 2024. Widespread and increasing near-bottom hypoxia in the coastal ocean off the United States Pacific Northwest. *Nature Sci. Rep.*, **14**, 3798, <https://doi.org/10.1038/s41598-024-54476-0> ,

McCabe, R.M., Hickey, B.M., Trainer, V.L. 2023. The Pacific Northwest harmful algal blooms bulletin. *Harmful Algae*. 127. DOI:10.1016/j.hal.2023.102480.

Newton, J., S. Wisdom, M. Iwamoto, R. Carini, J. Watson, S. Boulay, D. Mactavish, J. Hagen, J. Schumacker, D. Rudolph, D. Kattil-Debrum, P. Tuaua, E. Brown, J. Hopson Jr., and J. Evans. (*accepted*). Backyard Buoys: Meeting needs of coastal, indigenous communities through co-design and co-production, *Oceanography Magazine*.

Newton, J.A., S. Widdicombe, K. Isensee, S. Dupont, S. Flickinger, K. Grabb, E.F. Keister, K. Schoo, A. Kenworthy, A. Valauri-Orton. (*accepted*). Ocean acidification capacity at all levels for a multistakeholder ocean acidification action platform, *Oceanography Magazine*.

Alin, S.R., J.A. Newton, R.A. Feely, S. Siedlecki, and D. Greeley. 2024. Seasonality and response of ocean acidification and hypoxia to major environmental anomalies in the southern Salish Sea, North America (2014–2018). *Biogeosciences*, bgs-2023-181.

Alin, S.R., J.A. Newton, R.A. Feely, B. Curry, D. Greeley, J. Herndon, and M. Warner. 2024. A decade-long cruise time-series (2008–2018) of physical and biogeochemical conditions in the southern Salish Sea, North America. *Earth System Science Data*, <https://doi.org/10.5194/essd-16-837-2024>.

Siedlecki, S.A., S.R. Alin, E.L. Norton, N.A. Bond, A.J. Hermann, R.A. Feely, and J.A. Newton. 2023. Can seasonal forecasts of ocean conditions aid fishery managers? Experiences from 10 years of J-SCOPE. *Oceanography* 36(2–3):158–167, <https://doi.org/10.5670/oceanog.2023.219>.

Alin, S.R., S.A. Siedlecki, H. Berger, R.A. Feely, J.E. Waddell, B.R. Carter, J.A. Newton, E.J. Schumacker, and D. Ayres. 2023. Evaluating the evolving ocean acidification risk to Dungeness crab: Time-series observations and modeling on the Olympic Coast, Washington, USA. *Oceanography* 36(2–3):138–147, <https://doi.org/10.5670/oceanog.2023.216>.

Norton, E.L., I.C. Kaplan, S. Siedlecki, A.J. Hermann, S.R. Alin, J. Newton, K. Corbett, D. Ayres, E.J. Schumacker, N.A. Bond, K. Richerson, and M.A. Alexander. 2023. Seasonal ocean forecasts to improve predictions of Dungeness crab catch rates, co-developed with state and tribal fishery managers, *ICES Journal of Marine Science*, fsad010, <https://doi.org/10.1093/icesjms/fsad010>

Koehlinger J.A., J. Newton, J. Mickett, L. Thompson, and T. Klinger. 2023. Large and transient positive temperature anomalies in Washington’s coastal nearshore waters during the 2013–2015 northeast Pacific marine heatwave. *PLoS ONE* 18(2): e0280646. <https://doi.org/10.1371/journal.pone.0280646>

Stevens, A.W., Weiner, H.M., Wood, J.M., Ruggiero, P., Kaminsky, G.M., and Gelfenbaum G.R., 2019, Beach topography and nearshore bathymetry of the Columbia River littoral cell, Washington

and Oregon (ver. 4.0, January 2024): U.S. Geological Survey data release, <https://doi.org/10.5066/P9W15JX8>.

Trainer, V.L., King, T.L., 2023. SoundToxins: A research and monitoring partnership for harmful phytoplankton in Washington State. *Toxins* 15 (3). DOI 10.3390/toxins15030189

Xiong, J., & MacCready, P. (2024). Intercomparisons of Tracker v1.1 and four other ocean particle-tracking software packages in the Regional Ocean Modeling System. *Geoscientific Model Development*, 17(8), 3341-3356. doi:10.5194/gmd-17-3341-2024