Progress Report

Project Title: Sustaining NANOOS, the Pacific Northwest component of the U.S. IOOS
Award Number: NA21NOS0120093
Period of Activity: 01/01/2022 - 06/30/2022
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 FY 2021 (= Y1 of the new award = Y15 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 FY21, NANOOS has the following additional tasks (2-6) from the NOAA Ocean Acidification Program, coordinated via IOOS, and (1, 7-9) from IOOS and other sources:

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
2) Support for salary for Newton as GOA-ON Co-Chair (Newton, UW)
3) Sustain NANOOS' work to develop and maintain the GOA-ON data portal (Tanner, UW)
4) Support efforts for OA observing on NANOOS NOA-ON CB-06 off the OR shelf (Hales, OSU)
5) Support efforts for OA observing on NANOOS NOA-ON Cha'ba on the WA shelf (Manalang, UW)
6) Support Cha'ba Ship-Time (Manalang, UW)
7) NOS funds for "Enhancement of NOS modeling capabilities for the Northern Pacific in support of disaster prevention and safe navigation" (Seaton, CRITFC)
8) NOAA/NOPP funds for the BIO GO-SHIP pilot on US-supported GO-SHIP cruises (Graff, OSU)
9) Support execution of OceanHackWeek (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. 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)).

A. Observing Subsystem:

Data from all assets reported here are served via NVS.

CURRENTS AND WAVES

PNW Coastal HF Surface Current Mapping (Kosro):

- *Maintain and operate 10 SeaSonde HF sites designated as Priority 1 sites by the national HF program; these are six long-range sites in OR, two in WA, 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 [Kosro]*
- *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 using no-cost extension funds from the previous 5-year award. That work was reported in the progress report submitted 30 June 2022. We look forward to conveying our achievements for the new award in a progress report, when appropriate.
Accomplishments/Successes: N/A
Problems/Delays: N/A

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 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 and published these to NVS and a comprehensive Oregon State U. website (linked to from NVS). Backup data drives were swapped in late March 2022 to ensure continuous archival of recorded radar data. In late June 2022 preventative maintenance was performed on the radar (motor brush replacement).
Accomplishments/Successes: Continuous operation, data reporting and archiving.
Problems/Delays: None.

SHELF

Washington Shelf Buoys/Moorings:
- *Maintain the WA shelf (off La Push) Cha'ba buoy and the NEMO subsurface profiler at existing levels [Manalang]*

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. The spring 2022 Coastal Buoy deployment cruise occurred May 3, 2022 - May 6, 2022. Work was conducted aboard the R/V Robertson out of La Push, WA.

The cruise included 3 mooring deployments (Summer Cha'Ba, NEMO-Subsurface profiling mooring, and the Environmental Sampling Processor (ESP) mooring), and the deployment of NANOOS seaglider SN 236. CTD casts were conducted at the Cha'Ba site, and at stations through the Strait of Juan de Fuca. Because the winter Cha'Ba mooring broke away from its anchor in February 2022 and was subsequently recovered the same month on an emergency recovery charter of the F/V Alyeska, no moorings were recovered during this cruise.

The summer Cha'Ba and NEMO-SS moorings are deployed in 100m of water and collectively support instrumentation for measuring temperature, salinity, dissolved oxygen, water current, chlorophyll, and pH from near the seabed to the sea surface, in addition to surface water and air pCO2 and meteorological variables. Both moorings include telemetry to shore for near-real-time data analysis and publishing.

The team continued collaboration with Jennifer Hagen, Marine Policy Advisor for Quileute Natural Resources, who participated in our May operations. The team also continued collaboration with Sea-Bird Electronics, which refurbished and renewed the loan of a Sea-Bird SeapHOX instrument to collect integrated measurements of conductivity, temperature, depth, dissolved oxygen, salinity, and pH near the seafloor on the WA coast.
Accomplishments/Successes: Successful Summer Cha'Ba and NEMO-Subsurface mooring deployments in May 2022
Problems/Delays: The winter Cha'Ba mooring broke away from its anchor in February 2022, leaving a 3-month deployment gap for shelf moorings.

- *Deliver NRT data streams via NVS [Manalang]*
Status: On track
Summary: Data streams were maintained, with the exception of those systems seasonally offline or being serviced, as described above.
Accomplishments/Successes:
Problems/Delays: NEMO-Subsurface real-time telemetry failed ~1 month after deployment. Data will be collected and archived following recovery.

- *Bring all data QA/QC to meet Certification standards [Manalang]*
Summary: This continues to be an aspiration, and the team continues to work with NANOOS on planning for implementing improved data flow.
Accomplishments/Successes: We have identified a candidate to work with the team on data formatting and QA/QC in 2022-23.
Problems/Delays: Identifying and funding a qualified candidate for dedicated QA/QC work has been an ongoing challenge.

Non-core Task 5: *Support efforts for OA observing on NANOOS NOA-ON Cha'ba on the WA shelf [Manalang, Newton]*
Status: On track
Summary: Carbon measurements are conducted in partnership with PMEL Carbon Programs. The Cha'ba mapco2 carbon system went offline in early December 2021, but a fresh system was deployed on the summer Cha'Ba mooring in May.
Accomplishments/Successes: Coordination with the PMEL carbon program to ensure a newly tuned mapco2 carbon system is deployed on each mooring installation - this saves valuable time during cruises and improves system performance outcomes by only using recently-verified instrumentation systems. Previously, systems were moved from one deployed mooring to another without thorough testing between deployments.
Problems/Delays: Cha'Ba mapco2 system was offline from Dec 21-early May 2022.

Non-core Task 6: *Support Cha'ba Ship-Time [Manalang, Newton]*
Status: On track
Summary: The R/V Robertson Research Vessel, operated by the UW Applied Physics Lab, was successfully used to conduct mooring operations in May, 2022, out of La Push, WA.
Accomplishments/Successes: Successful mooring operations aboard the R/V Robertson
Problems/Delays: N/A

Washington Shelf HAB Buoy/Mooring:
- *Support for the HAB ESP deployment on NEMO mooring [Mickett]*
Status: On track

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 3th with regular, real-time measurements of the HAB toxin domoic acid extending until late June as planned.
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.
Problems/Delays: None

- *Deliver NRT data streams via NVS [Mickett]*

Status: On track
Summary: 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: 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

- *Bring all data QA/QC to meet Certification standards [Mickett]*

Status: On track
Summary: This will be completed upon recovery of the ESP mooring in August 2022.
Accomplishments/Successes: N/A
Problems/Delays: N/A

Washington Shelf 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
Summary: SG249 was deployed on 26 April 2021 and was recovered on 24 March 2022 after completing 1411 dives. SG236 was deployed on 24 March 2022, but recovered on 29 March 2022 due to an internal oil leak. This imposed a pause in operations as SG249 was refurbished for redeployment. SG249 was deployed on 12 July 2022, and is currently occupying the La Push line with a May 2023 projected recovery.
Accomplishments / Successes: SG249 is on track to operate into May 2023, at which time it will be replaced by a fresh vehicle. Fabrication of a second NANOOS glider is nearing completion.
Problems / Delays: Data processing and QC have been updated to our current standards, and the resulting data sets are available through NANOOS and data is flowing to the DAC.

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: During this reporting period, work was completed using no-cost extension funds from the previous 5-year award. That work was reported in the progress report submitted 30 June 2022. We look forward to conveying our achievements for the new award in the next 6-month progress report.
Accomplishments/Successes: N/A

Problems/Delays: N/A

Non-core Task 4: *Support efforts for OA observing on NANOOS NOA-ON CB-06 off the OR shelf [Hales]*
Status: On Track, with field service of mooring needed.
Summary: The replacement mooring was deployed on 11 March, 2022, on the first ocean/vessel opportunity that presented itself. All systems initially functional, however, the MAPCO2 system has encountered several failures. First, the span-gas stopped flowing within a few weeks after deployment, and recently the main unit has failed to maintain valve control. Replacement components are being delivered from PMEL, and will be replaced with a small vessel visit in the coming weeks.
Accomplishments/Successes:
Deployment in winter season using vessel of opportunity.
Problems/Delays:
Failure of MAPCO2 components limited data recovery.

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

Status: On track
Summary: SATURN-02 is a seasonal inter-disciplinary buoy, with real-time telemetry, located off the mouth of the Columbia River at ~35m depth. SATURN-02 data routinely contributes to model validation, capturing near-field Columbia River plume dynamics. Data also routinely offer local temporal context and for specialty buoy deployments and for cruises

Accomplishments/Successes: SATURN-02 was deployed on May 20, 2022. Parameters measured are (a) wind speed, direction and gust, air temperature, barometric pressure and PAR; (b) water velocity profile; and (c) the scalar water parameters: (in-situ) temperature, salinity, dissolved oxygen/oxygen saturation, chlorophyll, turbidity, CDOM, and phytoplankton health/quantum yield. Scalar water measurements (except temperature) are made through single at-surface sensors and a multi-level pumping system. Levels measured are 1, 6, 11, 16, 21 and 35m depth.

Real time data from SATURN coastal stations are displayed on NVS while the station is deployed. CMOP also provides access to SATURN long-term datasets via a newly established ERDDAP data server, including QA flagging. CMOP stations are expected to be the next batch of NANOOS stations integrated into the NANOOS centralized ERDDAP server for delivery to NDBC.
Problems/Delays: none

Washington Shelf Columbia 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 (for all)
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 shelbreak (~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 2022 reporting period, one glider map was made off central Washington in late May to early June using a glider on loan to OSU from CRITFC. The glider was deployed for a total of 13 days, and produced 10 cross-shelf sections over 297 km with 2764 vertical profiles of water properties. Glider data show that the summer upwelling season had just begun and near-bottom, low-oxygen (hypoxic, DO <= 1.4 ml/l) waters were just starting to creep shoreward, reaching about the 75-m isobath.

Accomplishments/Successes: Started the second, summer-season glider work off central Washington; established at operations with a reliable charter boat operator out of Westport, WA.

Problems/Delays: none

Northern California Shelf 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 (for all)

Summary: Starting in early December 2014, the Oregon State University glider research group has been obtaining vertical sections of ocean properties from 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 measured 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 run low. During this reporting period, this effort was jointly funded by NANOOS and CeNCOOS.

For the reporting period, January to end of June 2022, the glider was on the TH line for 167 days during one deployment, sampled along 2896 km of track line covering the transect 7 times, and collected about 1448 vertical profiles of ocean properties. Glider uptime during this period was 93%. 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: Data from the Trinidad Head glider line are being used to monitor the continuation of the extended 2020-2022 La Niña (Figure 1).

Problems/Delays: Still awaiting the delivery of a recapitalized Seaglider due to delays from the manufacturer due to buoyancy pump problems. The problem has been fixed and we expect delivery in August 2022.

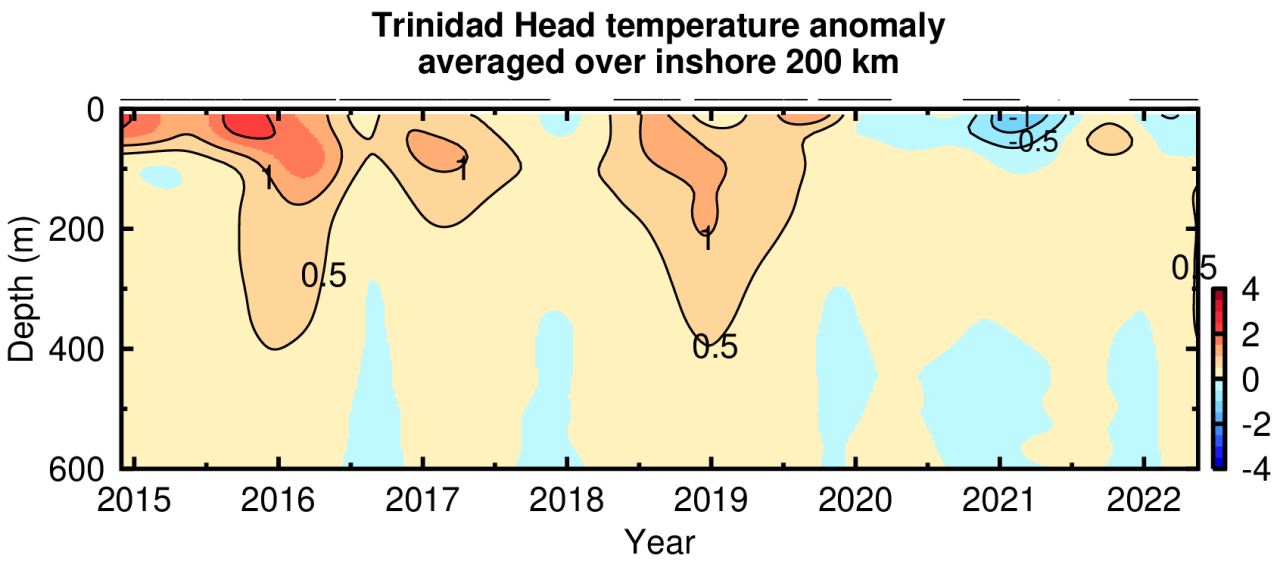

Figure 1: *Temperature anomaly from the Trinidad Head, CA (41° 3.5'N) glider line. Horizontal lines above the panel indicate when the TH-Line glider was in the water.*

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 [McCabe, Osborne, MacCready, Callender/King, Newton]*

McCabe
Status: On track
Summary: PI McCabe has continued to collaborate with Barbara Hickey (UW School of Oceanography) and Vera Trainer (NOAA NWFSC) 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 four PNW HAB Bulletins to support coastal shellfish managers during the reporting period. These included the 7-Apr-2022, 21-Apr-2022, 13-May-2022, and 26-May-2022 Bulletins. Since Washington Department of Fish and Wildlife managers ended their public recreational razor clam season early on 7-May-2022, the final two spring Bulletins specifically targeted digs conducted by the Quinault Indian Nation (and support Oregon Department of Fish and Wildlife shellfish managers as well). All PNW HAB Bulletins issued during spring 2022 received a "low" risk assessment rating, thanks to the low *Pseudo-nitzschia* abundances observed in the region and overall cool ocean conditions. Prior to the final Bulletin on 26-May-2022, *Pseudo-nitzschia* cell concentrations increased dramatically to levels beyond established toxin testing thresholds (as high as 119,000 cells/L of large morphology cells in northern Oregon). No shore-based toxin results were available for the 26-May Bulletin, but an analysis of conditions suggested that a large toxic *Pseudo-nitzschia* bloom was unlikely at that time. Subsequent analysis of samples collected at sites off both northern OR and WA indicated that domoic acid was undetectable, confirming the "low" risk rating. To date, seawater domoic acid concentrations continue to remain low all along the Washington and Oregon coasts. McCabe also began the process of introducing a UW CICOES employee to the PNW HAB Bulletins so that they may assist in Bulletin production at a future date. Results from the ESP mooring off La Push, WA, continue to be incorporated into the temporally overlapping Bulletins. The PNW HAB Bulletins are

made publically available on both the ORHAB (https://orhab.uw.edu/pnw-hab-bulletin/) and NANOOS (http://www.nanoos.org/products/habs/forecasts/bulletins.php) websites.
Problems/Delays: None

Osborne
Status: On track.
Summary: During this reporting period, work was completed using the last of the no-cost-extension funds from the previous 5-year award and 56% of the current award. Funds 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. Most of that work was reported in the No Cost Extension progress report submitted 30 June 2022.
Accomplishments/Successes: UW Olympic Natural Resources Center, 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.

During this reporting period the first phase budgetary allocation of $40,000 ($10,000 a piece for each of the four tribes) was fully allocated, along with 56% of the current second phase funding. These funds have allowed each tribe to address individual capacity issues necessary for participating in offshore sampling over-and-above their weekly shore-side sampling. This included new microscopes that allow fluorescent analysis for enhanced taxonomic identification of off-shore species, and equipment upgrades necessary to process the higher volumes of samples these new activities require. Some tribes have already initiated offshore sampling operations this year that are drawing on their allocations, others are still working on the staffing to bring them up to independent sampling and laboratory operation, which will be the focus for the remaining funds for Hoh Tribe. Additionally, the recent introduction of new AAUV 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 reported on here are proving important in helping each tribe meet that new challenge.
Problems/Delays: The unique locations and existing capacities of each ORHAB tribal member requires a different strategy to support off-shore monitoring in every case. Some partners already have complimentary monitoring programs and platforms for adding off-shore HAB monitoring, others are struggling to develop the core staff and laboratory capacity to participate. For tribes with existing programs the supplemental funds were quickly dispersed to fill already identified gaps in capacity, for tribes without those internally funded programs in place, the supplemental funds serve as seed money for developing that capacity with other tribal resources and has led to delays.

MacCready
Status: On track
Summary: During this reporting period, work was completed using no-cost-extension funds from the previous 5-year award. That work was reported in the progress report submitted by 31 December 2021. We look forward to conveying our achievements for the new award in the next 6-month progress report.
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 (http://faculty.washington.edu/pmacc/LO/p5_Phab_full_salt_top.html). Dr. Hally

Stone, a former grad student, submitted a manuscript to the journal Harmful Algae in May 2022 analyzing the forecast skill in relation to past HAB events.
Problems/Delays: None

King
Status: On Track
Summary: During this reporting period one month of work was completed using no-cost-extension funds from the previous 5-year award. That work was reported in the progress report submitted by 31 December 2021. The information provided below is for the remaining 5 months funded by this grant.
Accomplishments/Successes: For the five months covered by this reporting period we received and resolved 169 unique individual requests for support from SoundToxins participants relative to monitoring support and phytoplankton identification. During these 5 months we also provided 10 harmful algal bloom alerts to the Washington State Department of Health as part of the phytoplankton cell presence alert system.
Problems/Delays: During this time period we hired new staff to replace the staff that left the program in August 2021.

Kavanaugh
Status: The Cooperative Fisheries Plankton Research project is on track, after slight delays associated with methodological development and delays in the fishing season.
Summary: We have initiated a cooperative fisheries research project to target plankton taxa, in particular the domoic-acid producing species Pseudo-nitzschia sp (P/N). Commercial fishermen, including charter boats, 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 has been coordinated. Finally, we will develop a methodological comparison to determine utility of total domoic acid collected from frozen seawater samples. The project funds graduate student stipend (for project coordination) and technician time (to assist with running and annotating samples).
Accomplishments/Successes: Graduate student Raquel Gilliland has been successful in coordinating a diverse suite of fishermen (6 currently) from the midwater trawl cooperative, Dungeness crab (fishing midwater in Dungeness off-season), charter fishery, as well as researchers associated with NOAA's Northwest Fisheries Science Center (Jennifer Fisher, Anna Bolm, Ryan McCabe). While June was relatively slow, so far 40 samples have been collected in July in Oregon coastal waters, primarily within Oregon waters off Newport, but moving further offshore as the tuna fishing increases. Gilliland has collected coincident temperature, salinity, and, in the case of NH Line data, particulate domoic acid. Samples have been run on our IFCB; Gilliland will apply an existing classifier to provide cell counts and biovolumes. In addition, she is developing a protocol to facilitate collection by fisherman of total domoic acid.

A dashboard has been created to host the data. Next steps will be to automate the IFCb run, metadata ingest, posting of data to the dashboard, and notification of fishermen partners for data visualization.
Problems/Delays: Two unavoidable challenges were met with the project. The first was associated with the delayed onset of upwelling favorable winds, which delayed original targeted fishery (Midwater Trawl Cooperative). Those who were going out were following the fish that were distributed away from Heceta Bank off of northern Oregon. However, Gilliland was able to coordinate alternative sampling through the Charter Fishery and Newport Hydrographic Line (which is situated just to the north of Heceta Bank, but within the Heceta/Stonewall complex).

Furthermore, after discussion with Ryan McCabe it was determined that the northern Oregon samples would be equally valuable for modeling P/N transport.

Newton
Status: On Track
Summary: During this reporting period, work was completed using no-cost extension funds from the previous 5-year award. That work was reported in the progress report submitted 30 June 2022. We look forward to conveying our achievements for the new award in a progress report, when appropriate.
Accomplishments/Successes:
Problems/Delays:

Non-core Task 8: *NOAA/NOPP funds for the BIO GO-SHIP pilot on US-supported GO-SHIP cruises [Graff]*
Status: Initially Delayed / On track
Summary: The Bio-GO-SHIP pilot project is on-track and efforts towards field efforts in 2022 are underway. The first field campaign was to take place from January 5 to February 18 on the NOAA Ship Ron Brown in collaboration with the GO-SHIP A13.5 campaign. Original ports for mobilization and demobilization were planned for Cape Town, South Africa and Praia, Cape Verde, respectively. Due to the prevalence of the omicron variant of SARS-CoV-2 in South Africa, ports were altered to include Praia, Cape Verde for mobilization and Recife, Brasil for demobilization. Travel of the science party to Praia began on December 30th.

A second Bio-GO-SHIP cruise, in conjunction with the GO-SHIP P02 expedition Legs 1 and 2, began in April 2022. A port call occurred in Mid-May in Honolulu and the second leg of the expedition is still ongoing.
Accomplishments/Successes: Bio-GO-SHIP successfully completed Leg 1 of the GO-SHIP P02 expedition from Guam to Hawaii, collecting high resolution bio-optical and biological measurements and samples from a custom flow through seawater system and the CTD rosette Niskin bottles. The Bio-GO-SHIP team also contributed to the GO-SHIP team's scientific objectives, assuming the responsibilities for calibration sampling of phytoplankton pigments and particulate organic carbon for autonomous float deployments.
Problems/delays: Logistics in the port of Praia and with the vessel for the GO-SHIP A13.5 expedition, as well as positive cases of Covid within the ship's crew and science party, resulted in delays during mobilization and ultimately a termination of the A13.5 transect.

ESTUARIES

Puget Sound, WA, Profiling Buoys:

- *Maintain 6 Puget Sound estuarine profiling moorings at existing levels [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.
Accomplishments/Successes: Multiple successful maintenance operations, including clearing a fishing net from the mooring in Hansville
Problems/Delays: Some significant profiling downtime was experienced due to aging systems, and external factors. The Hansville mooring, in particular, was offline from January 22 through June 22 due to fishing net entanglement.

- *Deliver data via NVS [Manalang]*

Status: On Track

Summary: Puget Sound profiling buoy data is delivered to NVS.

- *Bring all data QA/QC to meet Certification standards [Manalang]*

Summary: This continues to be an aspiration, and the team continues to work with NANOOS on planning for implementing improved data flow.
Accomplishments/Successes: We have identified a candidate to work with the team on data formatting and QA/QC in 2022-23.
Problems/Delays: Identifying and funding a qualified candidate for dedicated QA/QC work has been an ongoing challenge.

Puget Sound, WA, US ferry-box:

- *Maintain US-Canada ferry-box at existing levels, assuming COVID-19 does not preclude its operation [Krembs]*
- *Deliver data via NVS [Krembs]*
- *Bring all data QA/QC to meet Certification standards [Krembs]*

Status: On-track
Summary: During this reporting period, work was completed using no-cost extension funds from the previous 5-year award. That work was reported in the progress report submitted 30 June 2022. We look forward to conveying our achievements for the new award in a progress report, when appropriate.
Accomplishments/Successes: N/A
Problems/Delays: The Victoria Clipper has not resumed its full ferry schedule due to COVID and high oil prices resulting in continued staff shortages delaying progress in the installation of the sensors.

Columbia River Estuary, OR, Moorings:

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

Status: On track
Summary: The NANOOS supported estuarine stations that are maintained on a permanent or seasonal basis are SATURN-03, SATURN-04, SATURN-07, SATURN-09, CBNC3, Elliott Point and Woody Island. All stations except CBNC3 have real-time telemetry. All but CBNC3, Elliot Point and Woody Island (which currently only measure salinity and temperature, or only temperature in the case of Woody Island) are interdisciplinary (physics and biogeochemistry). Each of the stations is designed to capture specific features of the estuary.

Real time data from SATURN coastal stations are displayed on NVS. CMOP also provides access to SATURN long-term datasets via a recently deployed ERDDAP server. Data is subject to QA/QC, which is included in data submitted to NCEI via NANOOS, and included in the ERDDAP server.

Accomplishments/Successes: SATURN-09 was redeployed in January after servicing. SATURN-07 is on-station after being recovered for servicing in early 2022. The Elliott Point buoy was recovered in May and will be redeployed in summer or fall 2022. Nitrate observations have been successfully restored at SATURN-03, and calibration of existing nitrate data through laboratory analysis of archived water samples is currently being planned. Potential threat from estuarine and coastal hypoxia to Columbia River salmon presented at multiple events. ERDDAP server, including QA information, established at CMOP.
Problems/Delays: The historical station, SATURN-01, maintained from 2010 to 2017), located on the Astoria-Megler bridge platform, has become impossible to reoccupy due to the relocation of a

major cormorant colony to the location, and changes in Oregon Department of Transportation regulations.

South Slough/Coos Bay, OR, Moorings:

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

Status: On-Track

Summary: South Slough Reserve continued operation of a network of moored estuarine water quality observing stations as part of the NERRS System-Wide Monitoring Program with additional support provided by NANOOS that includes four real-time water quality stations in the South Slough estuary with continuous water temperature, salinity, dissolved oxygen, pH, turbidity, and water level measurements every 15 minutes over the period 1/01/22 – 06/30/22. Tom's Creek weather station provided measurements of air temperature, relative humidity, barometric pressure, and wind speed/direction. Telemetry transmissions were continuous for Winchester Arm water quality, and Tom's Creek weather platforms. The Valino Island, Charleston Bridge, and Elliot Creek water quality stations continued data collection, but telemetry is offline in preparation for Turnkey Storm3 telemetry systems. 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 instrument deployments and retrievals, maintenance, and data management were completed for the station network following NOAA NERRS Centralized Data Management Office.

Accomplishments/Successes: Water quality and weather time-series data collected as part of NANOOS/NERRS SWMP programs were incorporated into environmental modeling analyses to characterize drivers of eelgrass declines. The Reserve's current Graduate Fellow (Taylor Dodrill) utilized water quality data for her research on phytoplankton communities and prediction of HABs. The Reserve education and science programs used water quality datasets for outreach programs on tidal marsh metrics for evaluating wetland resilience to sea level rise and are developing a SWMP/NANOOS water quality exhibit for the Reserve's Visitor Center.

Problems/Delays: Water quality station equipment and telemetry systems ordered from Yellow Springs Instruments in March-May 2002 have not arrived yet because of long lead times for products to be made, delayed shipping, and inability to expedite equipment orders due to Covid-19. Covid-19 impacts affected routine SWMP field and laboratory work during the Winter and Spring 2022 due to restrictions for fieldwork, vehicles, boat use, lab space, and housing accommodations.

BEACH AND SHORELINES

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. Continuing to follow COVID-safety precautions, CMAP completed fall seasonal beach monitoring surveys in the Columbia River Littoral Cell (CRLC) in December 2021. Forty-six beach profiles and two surface maps were collected. In March 2022, CMAP conducted winter seasonal CRLC beach monitoring surveys, collecting 50 beach profiles, 5 surface maps, and 52 sediment samples along 11 of the cross-shore profiles. Seasonal beach profile data and contour change plots are made available through

the NANOOS Visualization System.
Accomplishments/successes: In addition to the regular CRLC beach monitoring work, CMAP continues to conduct more detailed surveys in Westport and Ocean Shores, two locations that experienced significant erosion during the winter of 2015-2016, threatening adjacent coastal properties. In December 2021, CMAP collected 7 supplemental profiles in Westport to monitor the dune nourishment area fronting the Westport by the Sea Condominiums. A cobble dynamic revetment was constructed seaward of the dune in this area in January 2022. CMAP collected 7 supplemental profiles and mapped features on the dynamic revetment in January directly after construction and again in March 2022. CMAP also collected 13 supplemental profiles at the south end of Ocean Shores in both December 2021 and March 2022.

CMAP continues to monitor the performance of the dynamic revetment at North Cove. Beach topography surveys were conducted in December 2021 and February 2022, where 48 profiles and a surface map collected during each survey will be used to create a digital elevation model of the survey area and compared for change over time. During the February 2022 survey, individual rocks that were tagged in 2019 with PIT tags were located to track their position through time. 196 of the 544 tagged rocks were found (36%). Photos of the surface sediment were collected at 66 locations along 11 profiles for digital grain size analysis along with 10 samples physically collected from 5 of the same profiles in the same locations for comparison of analysis techniques. Also in February 2022, CMAP downloaded photos from trail cameras that are installed near the southeast end of the North Cove site to monitor beach conditions through photos taken every 15 minutes.

CMAP also continues to collect seasonal beach profiles near Kalaloch at South Beach on the Olympic Peninsula along a natural composite beach as a comparison to the constructed cobble revetment at North Cove. In January and March 2022, 14 profiles were collected and the toe of the cobble berm was mapped. CMAP performed rock tracking at Kalaloch in March 2022, where 51 of the 150 rocks placed in October 2019 were found (34%).
Problems/Delays: None

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 (see dates in Summary)
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, March 2022), along the Clatsop Plains (6 sites, March 2022), the Columbia River south jetty dynamic revetment (28 sites, March 2022), along the Neskowin cell (15 sites, March 2022) and the Netarts littoral cell (25 sites, April 2022). 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 (http://nvs.nanoos.org/BeachMapping).
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 and the public to assess local and regional coastal changes taking place on Oregon beaches. For example, coastal change results are being used in the communities of Manzanita and Seaside to assess both dune grading needs as well as for resource management of beaches and foredunes in those areas. As of March 2022, our monitoring data indicated that some of the highest rates of erosion (~-1 to -2 m/yr) are occurring

along Netarts Spit. Erosion is also prevalent along much of the Neskowin littoral cell. Observations from the northern section of the Neskowin cell at Pacific City indicate that the beach there continued to degrade over the 2021-2022 winter and is now experiencing beach sand volumes not seen in almost 2 decades of monitoring. In particular, beach erosion at Pacific City fully exposed the toe of a major boat launch ramp used by Dory boats in Pacific City, which allowed storm waves to cause some damage to the structure's toe, while causing flank erosion along its sides. In contrast, high rates of accretion (~+1 to +2 m/yr) continue to be observed along much of Bayocean Spit, with rates of accretion increasing to ~+2 to 3 m/yr along parts of Nehalem Spit. Beach change data were recently used in the development of the Pacific Northwest National Shoreline Management Study, a product of the US Army Corps of Engineers National Shoreline Management Study that was led by Co-PI Ruggiero, described below.
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 for the season
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 2021 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 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. 3.0, December 2021): 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, nearshore and beach data were heavily relied upon in the development of the Pacific Northwest National Shoreline Management Study, a product of the US Army Corps of Engineers National Shoreline Management Study. The report, which was released in January of 2022, provides a regional assessment of coastal change and current management actions based on existing available data (i.e., NANOOS supported data) and input from stakeholders and tribal partners. It considers the effects of erosion and accretion on socioeconomics and the environment and provides recommendations and example actions to restore and maintain resilient shorelines. The recommendations of the report are intended to inform the U.S. Congress and other decision-making parties interested in future investments in the nation's coasts. Pacific Northwest National Shoreline Management Study, 2022. Institute for Water Resources Report 2022-R-01, IWR, with support from USACE, CDM Federal Programs Corporation, Eastern Research Group, Inc., and Ruggiero, P., 226 pp. During this time period Ruggiero's group was able to fund (via non NANOOS sources), purchase, and acquire five new GPS receivers and two new Personal Watercraft. While the new equipment will not be ready for

summer 2022, we are in a good position to continue to collect high quality nearshore bathymetric data safely and efficiently with the new equipment in the years to come.
Problems/delays: Our summer 2021 field data collection was again significantly impacted due to the pandemic and therefore we were unable to collect additional data along the Oregon coast during summer 2021.

B. <u>Modeling & Analysis Subsystem</u>:

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, work was completed using no-cost extension funds from the previous 5-year award. That work was reported in the progress report submitted 30 June 2022. We look forward to conveying our achievements for the new award in a progress report, when appropriate.
Accomplishments/Successes: The LiveOcean model continued making reliable daily forecasts for this period. The underlying code framework is a community model widely used by coastal and estuarine oceanographers globally: the Regional Ocean Modeling System (ROMS). During this period, we made preparations to update the version of ROMS being used for LiveOcean, and this involved extensive recoding and testing of the biogeochemical module. We expect the new version to go live in the latter half of 2022. The method for delivery of post-processing extractions to stakeholders was simplified, and is now handled through a public server hosted at UW Applied Physics Lab. The suite of observations used for model validation was extended to the ORCA profiling moorings, with results written in an internal report by MacCready's student Erin Broatch.
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 (for all)
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. During this reporting period we have begun evaluating the implications of the Pacific

model developed under task 12 with the next generation SCHISM model for a new multi-year simulation database and eventual updated forecast.
Accomplishments/Successes: N/A
Problems/Delays: N/A

Non-core Task 7: *NOS funds for "Enhancement of NOS modeling capabilities for the Northern Pacific in support of disaster prevention and safe navigation" [Seaton]*
Status: On track
Summary: Leveraging the existing modeling system and prior work on implementing SCHISM modeling of the estuary, CMOP worked in collaboration with NOAA/NOS/OCS/Coast Survey Development Lab-Coastal Marine Modeling Branch (with joint funding from OCS, IOOS, NGS and CO-OPS transferred through IOOS/NANOOS, for Task 12) on the development of a new SCHISM model for the northern and tropical Pacific Ocean. After initial work on development of a 2D tide model, the focus of development shifted to 3D model development with the potential for trans-Pacific port-to-port modeling of surface currents in support of navigation.
Accomplishments/Successes: Work during this period included continued skill assessment of a 3-D basin-scale simulation, with a focus on the representation of the Oregon and Washington coastal shelf. Results of this task were presented at Ocean Sciences.
Problems/Delays: N/A

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 (for all)
Summary: Computer circulation modeling and forecasting of PNW coastal ocean shelf conditions has been conducted by Zaron's group at OSU. Our Real Time Data Assimilation for Oregon and Washington (RTDAOW) system utilizes the Regional Ocean Modeling System (ROMS) as the forecast model. Along-track altimetry observations from Jason, CryoSat, Sentinel and Altika, ACSPO Global SST from VIIRS (NPP Level 3 uncollated), and surface currents from land-based high-frequency (HF) radars have been assimilated to improve initial conditions for the forecasts, using the assimilation system AVRORA developed at OSU. Results are provided to fishers and the public via the NANOOS Visualization System, e.g., as the Tuna Forecast and SeaCast applications, and through RTDAOW Viewer:
https://ingria.ceoas.oregonstate.edu/rtdavow/index.html
Accomplishments/Successes: During the report period, we continued our real-time operation. We relocated and adjusted the RTDAOW system to a new server. We have added more satellite data from NOAA Star Nesdis (Jason3 and Sentinel 6a) for data assimilation. We incorporated the new product based on finite-time Lyapunov exponents for identification of ocean frontal features for fishers, developed earlier, into the RTDAOW Viewer, referred above, starting June 1 2022.
Problems/Delays: None

C. Data Management & Communications Subsystem:

DATA MANAGEMENT & CYBERINFRASTRUCTURE (DMAC)

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]

Status: On track

Summary: Development of BlueHarvest, a new internal NANOOS DMAC application for harvesting data from a wide range of data providers. The new system is more robust and maintains flexibility to accommodate a wide range of data providers/sources. It still 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 more immediate feedback about data transmission frequency/latency, which enables NANOOS to identify and fix data flow issues more efficiently.

Accomplishments/Success: BlueHarvest assets in process of being updated: PSI, OSU CB-06. New data harvester: Crab pot data

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]*

Status: On track

Summary: Worked with PSI and Crab pot data providers to update/add new harvesting mechanisms for ingesting data streams into NVS.

Accomplishments/Successes: N/A

Problems/Delays: N/A

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: Working to add updated data streams for PSI, OSU CB-06, and crab pot data. Updating creation of OSU ROMs overlays with the addition of depths. Development of new dynamic overlays capability, allowing users to specify colormaps and min/max ranges for overlays. Working to replace existing climatology overlay generation.

Accomplishments/Success: New/updated data streams. Depths added for OSU ROMs overlays. New dynamic overlay capabilities that provide more customization options for users.

Problems/Delays:

- *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, Carini]*

Status: On track

Summary: Steady progress was made to add assets to NANOOS ERDDAP for NDBC harvest.

Accomplishments/Success: No new assets were added to the NANOOS ERDDAP during this reporting period.

Problems/delays: NCEI queue continues to be the bottleneck for getting relevant data nationally archived. Data providers (typically those with one or two platforms) struggle to make their data available in ways that are straightforward (standardized) to harvest

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, Carini]*

Status: On track
Summary: Participated in communication with IOOS regarding QARTOD development.
Accomplishments/Successes:
Problems/Delays:

- *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:
Summary: No activities to report during this period.
Accomplishments/Successes: N/A
Problems/Delays: N/A

USER PRODUCT COMMITTEE (UPC)

Web Site:

- *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: Updates slideshow, documents, and other content.
Accomplishments/Successes: Implemented updates to the NANOOS tsunami evacuation portal. Developed a new "*Snapshot*" tool that allows users to develop customized user views of assets and overlays for areas of interest, and share those views with stakeholders.
Problems/Delays: N/A

Non-core Task 3: *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: N/A
Problems/Delays: N/A

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 [Allan]*

Status: Complete for reporting period, On track overall
Summary: Chaired by J. Allan (DOGAMI) this committee is composed of members from OHSU, UW, OSU, NANOOS E&O, and NOAA. NANOOS UPC chair Allan 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 DMAC and UPC teleconferences. A tri-committee meeting was held in April 2023 that identified the primary tasks and goals for the next year of product development.
Accomplishments/Success: NANOOS continues to modernize its web and data harvesting scripts, centralizing these scripts to the University of Washington. NANOOS implemented several minor improvements to its Tsunami evacuation webapp. We also completed development of a new

"*Snapshot*" tool during this period that allows users to develop customized views of assets and overlays for areas of interest and share those views with other stakeholders. Two examples of this new capability are highlighted for dissolved oxygen and surface wave conditions:
http://nvs.nanoos.org/Explorer?snapshot=187223ffbaf034d5140ef63a09233
http://nvs.nanoos.org/Explorer?snapshot=4447a9bebaf5c9aeeef4a723b88ed
Problems/delays: N/A

EDUCATION & OUTREACH (E&O)

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 (for all)
Summary: During this reporting period, work was completed using no-cost extension funds from the previous 5-year award. That work was reported in the progress report submitted 30 June 2022. We look forward to conveying our achievements for the new award in a progress report, when appropriate.
Accomplishments/Successes: N/A
Problems/Delays: N/A

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 (for all)
Summary: During this reporting period, work was completed using no-cost extension funds from the previous 5-year award. That work was reported in the progress report submitted 30 June 2022. We look forward to conveying our achievements for the new award in a progress report, when appropriate.
Accomplishments/Successes: N/A
Problems/Delays: N/A

Non-core Task 9: *Support execution of OceanHackWeek [Mayorga]*
Status: On track
Summary: Planning for OceanHackWeek 2022 (https://oceanhackweek.github.io/ohw22/) is well underway, with applications opening on May 12 and closing on June 15. OceanHackWeek 2022 will be held on August 15-19, continuing our recent trajectory towards further decentralization and accessibility. It will consist of a global virtual event coordinated with several regional "satellite" events: 3 in-person satellites in the US (including one at the UW), in-person satellites in Australia

and Brazil (in Portuguese), and a hybrid satellite taking place in Spanish. In addition, we're collaborating with the UW School of Oceanography on a pilot undergraduate Summer research experience in ocean data science, where the undergraduate cohort will participate fully in OceanHackWeek. There will be about 90 participants, the largest number yet. As in previous years, OceanHackWeek brings together oceanographers across disciplines and career stages, from the US and internationally, to advance capabilities in data science focused on oceanographic applications and cultivate an open-science and sharing culture. It is being supported by IOOS, NSF, the UW eScience Institute, UW School of Oceanography, Bigelow Laboratory for Ocean Sciences, Australia CSIRO and a lot of volunteer labor from many individuals in the US and abroad (https://oceanhackweek.github.io/ohw22/organizers.html).
Accomplishments/Successes: N/A
Problems/Delays: N/A

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 (for all)
Summary: During this reporting period, work was completed using no-cost extension funds from the previous 5-year award. That work was reported in the progress report submitted 30 June 2022. We look forward to conveying our achievements for the new award in a progress report, when appropriate.
Accomplishments/Successes: N/A
Problems/Delays: N/A

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:

See table for milestones [Newton, Rome, Carini]

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]*

J. Newton (NANOOS Executive Director), 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, N. Rome (NANOOS Program Manager), and R.

Carini (NANOOS Associate) assured progress on the above. Most of Newton's time was covered by the former 5-y NCE award to NANOOS and reported in the June 2022 Progress Report for that award.

Non-core Task 2: *Support for salary for Newton as GOA-ON Co-Chair [Newton]*
During the period, Newton performed duties for GOA-ON such as organizing meetings, connecting with the GOA-ON Secretariat to keep activities functional, and representing GOA-ON at the Our Ocean Conference in Palau as well as attending the GOA-ON Executive Committee meeting in Paris, both in April 2022.

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]*

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.

Project Oversight:
- *Conduct annual all-PI meetings and Tri-Committee meetings, providing clear feedback and direction [Newton, Rome & Carini, UW]*

Newton, Rome, and Carini participated in weekly Tri-Comm calls.
- *Share project evaluation at the annual PI meeting [Newton, Rome & Carini, UW]*

The annual NANOOS meetings are planned for August 2022.

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]*

Newton engaged in all of these activities over the period, supported by Rome and Carini, but most of the activity was covered by the former 5-y NCE award to NANOOS and reported in the June 2022 Progress Report for that award. .

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]*

Progress report and other requests have been fulfilled during the period.

Additional NANOOS coordination and representation included:
- Barth serves on the Oregon Ocean Policy Advisory Council's (OPAC) Scientific and Technical Advisory Committee (STAC) responsible for providing expertise on ocean issues including the implementation and monitoring of Oregon's marine reserves and ocean acidification monitoring efforts. Oregon is preparing for review of their network of marine reserves due in 2023.
- Barth served as the Co-Chair of the Oregon Ocean Acidification and Hypoxia Coordinating

Council, enacted as a state law in fall 2017, through May 23, 2022. Oregon issued its Ocean Acidification and Hypoxia Plan in June 2019 (https://www.oregonocean.info/index.php/oah-action-plan). The OAH Council submitted their second biennial report in September 2020. The OAH Council supported the Oregon Ocean Science Trust in awarding state-supported funds to measure OAH parameters in each of Oregon's five marine reserves and in Yaquina Bay.

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

- Barth participated in the June 15-16, 2022, meeting of the Ocean Networks Canada (ONC) International Science Advisory Board (ISAB) that provides guidance and counsel to the Canadian effort to field, evolve and improve two research-focused ocean observatories (VENUS and NEPTUNE Canada) that simultaneously serve emergent operational societal needs. In this context, Barth provides both scientific expertise as they communicate the U.S. experience with IOOS and operational ocean observing efforts that are part of the unique hybrid nature of ONC.
- Barth is active in the North Pacific Marine Science Organization (PICES, pices.int), reporting on US ocean observing efforts through his membership on the MONITOR Committee and the Advisory Panel on North Pacific Ocean Observing Systems. Barth is the US academic representative to the PICES Governing Council.

F. Presentations & Publications Acknowledging NANOOS Support:

Presentations: underline indicates NANOOS PI

Newton, J., P. MacCready, S. Siedlecki, D. Manalang, J. Mickett, S. Alin, E. Schumacker, J. Hagen, S. Moore, A. Sutton, and R. Carini. 2021. Multi-stressor observations and modeling to build understanding of and resilience to the coastal impacts of climate change. Pp. 86–87 in *Frontiers in Ocean Observing: Documenting Ecosystems, Understanding Environmental Changes, Forecasting Hazards.* E.S. Kappel, S.K. Juniper, S. Seeyave, E. Smith, and M. Visbeck, eds, A Supplement to *Oceanography* 34(4), https://doi.org/10.5670/oceanog.2021.supplement.02-31.

Seaton, C., et al. 'Development of a Basin-To-Port Tidal Baroclinic Model for the Pacific Ocean', Ocean Sciences Conference, Feb 28,2022.

Seaton, C. et al. 'Coastal Margin Observation and Prediction at CRITFC', invited plenary talk at USACE Anadromous Fish Evaluation Program (AFEP) annual review workshop, Jan 10, 2022

Publications: underline indicates NANOOS PI

Pacific Northwest National Shoreline Management Study, 2022. Institute for Water Resources Report 2022-R-01, IWR, with support from USACE, CDM Federal Programs Corporation, Eastern Research Group, Inc., and Ruggiero, P., 226 pp.