Sustaining NANOOS, the Pacific Northwest component of the U.S. IOOS®:
NOAA Award: NA11NOS0120036 Reporting period: 12/01/2012 to 5/31/2013

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 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 this FY12 period (= Y2 of award; Y6 of NANOOS RCOOS operations) our specific objectives were to:
1) **Maintain NANOOS as the PNW IOOS Regional Association:** Sustain our proven role for regional coordination, administrative infrastructure, and stakeholder engagement.
2) **Maintain surface current and wave mapping capability.** Maintain existing HF-radar foundational capability providing a portion of critical national capacity, and continue investment in wave mapping at a critical port.
3) **Sustain existing buoys and gliders (with reduced glider deployment in WA) in the PNW coastal ocean, in coordination with national programs.** Maintain these essential assets providing regional observations, with focus on hypoxia, HABs, ocean acidification, climate change detection and modeling input.
4) **Maintain observation capabilities in PNW estuaries, in coordination with local and regional programs.** Maintain these to aid sustainable resource management, water quality assessment and sub-regional climate change evaluation, with high priority new feeds.
5) **Maintain core elements of beach and shoreline observing programs.** Contribute to hazard mitigation by providing essential observations and decision support tools for coastal managers, planners and engineers, as resources allow.
6) **Maintain NANOOS' Data Management and Communications (DMAC) system for routine operational distribution of data and information.** Sustain the DMAC system NANOOS has built, including the NANOOS Visualization System (NVS), for dynamic and distributed data access and visualization for IOOS.
7) **Contribute to a community of complementary numerical regional 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 EEZ in both OR and WA.
8) **Deliver existing user-defined products and services for PNW stakeholders.** Continue to provide meaningful and informative data products that will connect with user applications and serve society.
9) **Sustain NANOOS education and outreach efforts.** Foster ocean literacy and facilitate use of NANOOS products for IOOS objectives, the core task for which the entire NANOOS RCOOS is constructed, via existing approaches for engaging users.

Consistent with the new tasks outlined in our FY12 de-scope letter from the IOOS Program Office, NANOOS has the following additional tasks during FY12, with our progress/status noted in brackets:
10) Enhance our level of HF radar operation and maintenance for existing stations in Oregon, consistent with the IOOS Program Office and HF Radar Plan directives [ongoing, M. Kosro, OSU, see p. 12 & 22];
11) Work with POST to improve access to animal telemetry observations [met, E. Mayorga, UW, see last period's report];

12) Work with the IOOS Program Office to begin development of a national glider plan and glider asset map [met, C. Lee, UW, and J. Barth, OSU, glider working group members, attended workshop, contributed to draft plan, see p. 21];
13) Support the SOS Reference Implementation Workshop [met, E. Mayorga, UW, attended];
14) Support the Animal Telemetry Network Steering Committee Workshop [met, NANOOS supported Jim Bolger, POST, to attend];
15) Support collection of OA measurements on our La Push mooring, working with NOAA PMEL and the NOAA OA Program Office [ongoing, J. Newton and M. Alford, UW, see p. 4];
16) Be a technical consultant to US IOOS on work with Microsoft and European Environmental Agency regarding input of US IOOS info on water/beach quality, citizen science to the Eye on Earth application [completed E. Mayorga and J. Newton, UW, see last reporting period's supplemental report].

2) Progress and Accomplishments

During the project period, NANOOS accomplished or made substantial progress on all 16 of the 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 allows.

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 progress for following: a) observing systems (shelf, estuaries, shorelines, and currents); b) modeling (estuaries and shelves); c) Data management and Communications (DMAC); d) User Products; e) Education and Outreach; and, f) Administrative.

Table 1. NANOOS Milestones for FY 12:

Area	**Y2 Award = Y6 NANOOS**
Observations	
Shelf:	-Maintain La Push, Newport, and Columbia R. buoys and deliver NRT datastreams via the NANOOS Visualization System (NVS) -Support collection of OA data from La Push buoy (new) -Maintain WA and OR glider transects (except funds are insufficient for maintaining La Push, WA glider) and deliver these datastreams via the NVS -Work with the IOOS Program Office to begin development of a national glider plan and glider asset map (new) -Transition Newport, OR glider to Crescent City, CA, if the NSF-funded OOI Newport glider is on-line. (Depends on OOI schedule, see p. 4 for update)
Estuaries:	-Maintain Puget Sound, Columbia R., Willapa and South Slough moorings and deliver these datastreams via the NVS
Shorelines:	-Maintain shoreline observations in WA and OR and deliver these datastreams via the NVS
Currents:	-Maintain OR HF radar sites and X-band radar site and deliver these datastreams via the NVS -Maintain OR Priority-One HF surface current mapping radar sites to the national operations standard, and deliver the data via NVS and the National HF Radar system (new)
Modeling	
OR/WA estuaries and	-Maintain modeling & forecasting capabilities at OSU, OHSU, & UW at reduced level and make model output available via the NANOOS web

coast models	
DMAC	
Web Site Improvement	-Enhance NANOOS help section
Tailored Product Development	-Focus on Ecosystems and Climate change (OA), as resources permit, to produce a new product for posting on a NANOOS web "theme page". -Work with POST to improve access to animal telemetry observations (new) -Work with IOOS Office, EEA, and SECOORA re suitability of "Eye on Earth" for Citizen Science data in IOOS (new)
Education and Outreach	
Networking	Maintain existing and build new relationships with NANOOS priority area users and the education community
Product Development	Work with DMAC, User Products Committee on Tailored Product Development, as per above schedule, and in Tri-Committee meetings
User Engagement	Conduct trainings to select user groups as resources permit
Administration	
Meetings	Represent NANOOS at all NOAA IOOS, NFRA, and national meetings of significance (e.g., Oceans 2012) -Support the SOS Reference Implementation workshop -Support the Animal Telemetry Network Steering Committee Workshop
Project oversight	Conduct regular PI meetings, annual Tri-Committee meeting, and assist with evaluations, as scheduled
Coordination	Conduct annual Governing Council (GC) meeting Conduct sub-regional, and user-group specific workshops (e.g., for CMSP; ocean acidification, etc) as resources allow Coordinate with West Coast RAs and other RAs to optimize and leverage capabilities and assure consistencies, but with no travel and at reduced level
Accountability	Submit required IOOS progress reports, assessments, and performance metrics and seek certification as a member of US IOOS once certification standards and processes are determined

a) NANOOS Observing Sub-system: Data from all assets reported here are served via NANOOS NVS.

- ***Shelf***

Washington Shelf Buoy:

Led by M. Alford and J. Mickett, Applied Physics Laboratory, University of Washington (APL-UW), this reporting interval was an exceptionally active period for Washington coast mooring operations. After a canceled fall mooring maintenance cruise because of R/V Thompson propulsion system problems and an attempted recovery cruise aboard the NOAA ship B. M. Shimada in late October that was thwarted by weather, the NEMO moorings were successfully recovered aboard the R/V Thompson on January 17th. With both releases on the subsurface mooring failing to operate (subsequently discovered to be due to severe corrosion of release parts) the team successfully carried out a complex recovery using a ROV (see http://www.apl.washington.edu/project/project.php?id=nemo). Although Cha Ba lost several instruments due to fishing activity and sustained some damage due to seawater ingress into the well, the moorings collected the most extensive dataset to date for this mooring array, with some measurements, including full-depth velocities, extending from deployment in late May 2012 until mooring recovery in January. The data, still being analyzed, reveal interannual differences (Fig. 1) that

will be published in “Puget Sound Marine Waters: 2013 Overview” by NOAA and the Puget Sound Partnership for its role in providing boundary conditions for understanding Puget Sound water quality.

In addition to routine maintenance and data processing, following mooring recovery the team worked to implement a host of upgrades to both moorings, including replacing all Cha Ba external well connectors with improved wet-pluggable type, installing a charging system for the Cha Ba ADCP to allow rapid sampling, integrating a cell modem into the NEMO-Subsurface telebuoy and re-designing the NEMO-Subsurface release system. The NEMO-Subsurface mooring deployment was delayed to allow upgrade and replacement of failed profiler parts, with deployment anticipated for early July.

Re-deployment of Cha Ba was during a highly-successful cruise aboard the R/V Thompson from April 22-26th, with ship time again generously provided by UW School of Oceanography. Thanks to the efforts of J. Newton, A. Sprenger, S. Messier and others, this cruise was also a highly-successful education and outreach effort, with more than a dozen educators, students and volunteer citizens participating in the cruise (see http://www.apl.washington.edu/project/project.php?id=wa_shelf_science_cruise).

J. Newton (APL-UW) and this group have continued to work with NOAA PMEL scientists, Drs. Jeremy Mathis, Adrienne Sutton, Simone Alin, and Richard Feely, to maintain pCO_2 and pH datastreams and provide calibration samples, with C. Peacock of the PMEL OA Lab attending the April deploy cruise. Sensor data have been transmitted to the NOAA OA and PMEL Carbon Programs as well as to NANOOS.

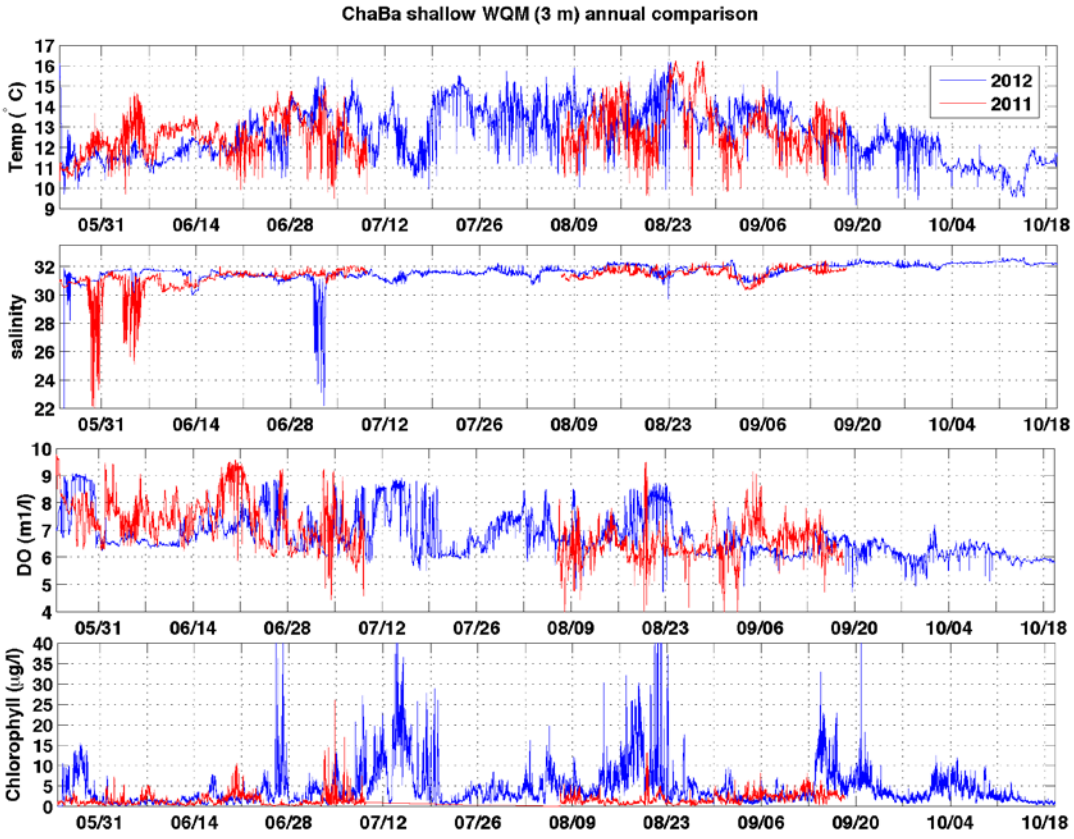

Figure 1. Comparison of 2011 and 2012 shallow observations (3 m) measured from Cha Ba buoy, showing differences in the timing of Columbia Plume events (salinity panel, second from top) and large differences in chlorophyll concentration between the two years (bottom panel).

Washington Shelf Glider: An Applied Physics Laboratory, University of Washington, team recovered Seaglider 187 for Dr. Craig Lee (APL-UW), Seaglider lead and soon to be NANOOS PI, on 24 April 2013 from the University of Washington's R/V THOMPSON during the Cha'Ba deployment cruise. The glider operated flawlessly, completing more than 800 successful dives and 12 legs of the 180km – long cross-shelf transect, starting in September 2012. The glider power system is presently being upgraded to enable year-long deployments, with plans to deploy the glider in late September 2013. NANOOS will be supporting this operation in a way that allows for analysis of the data starting with Y3 funds.

Oregon Shelf Glider: The Oregon State University (OSU) glider group led by J. Barth and K. Shearman continued deployments of autonomous underwater gliders off Newport, Oregon. The Newport Hydrographic Line was sampled from about the 20-m isobaths out to 300 km offshore using a combination of a Slocum 200-m glider on the inshore part of the line and a 1000-m Seaglider on the offshore part. During Dec 2012 through May 2013, we collected a total of 155 glider-days of measurements along 3387 km of track. This included 11,018 vertical profiles and 27 cross-margin vertical sections. Both NSF and private funding that provided the majority of the Newport Line glider work have ended. The transition to glider operations on the Newport Line funded by NSF's Ocean Observatories Initiative (OOI) is not anticipated until the end of 2013, hence there may be a gap in Newport Line glider time series.

Oregon Shelf Mooring: Led by M. Levine (OSU), a mooring about 10 miles off Newport, Oregon, in 80 m of water (site NH-10) has been maintained since mid-2006, primarily through support by NANOOS. Ship time to enable the mooring recoveries and deployments has been funded by the NSF CMOP Science & Technology Center. About every six months the mooring is recovered and a refurbished mooring is deployed.

The overall duration of the time series of ocean observations at NH-10 is impressive. The task of keeping the instrumentation working continuously is a real challenge. Wintertime deployments are especially difficult given the extreme wave events that sometimes occur off Oregon. Unfortunately, for the first time in 8 winters, we lost a mooring without a trace (so far!). Other moorings have broken free, but were always recovered. Nonetheless, the latest deployment in April 2013 is fully operational, sending a suite of data back in near-real time. We are carefully monitoring the dissolved oxygen which has shown near hypoxic conditions close to the bottom for days at a time.

One of the important reasons for maintaining this time series is the significance of this site to the Ocean Observing Initiative (OOI). The OOI Endurance Array is planning to deploy impressive long-term moorings near NH-10 in a few years. It is scientifically important to have as complete a temporal context as possible for this new mooring. Our mooring is also providing useful background data to assist in the design and siting of the OOI mooring.

Northern Oregon to Central Washington shelf: Led by A. Baptista (OHSU), the Center for Coastal Margin Observation & Prediction (CMOP) maintains glider operations and two offshore buoys (SATURN-02 and OGI-01). The operation and maintenance of the glider and SATURN-02 are seasonal, and partially funded through the National Science Foundation. Glider operations are coordinated with the Quinault Indian Nation (QIN). Progress during the reporting period:

- Glider: The glider was deployed May 8 – May 31, and is planned for redeployment in late June. A QIN fishing vessel recovered the glider, after it became trapped under an unexpected lens of low-density water and we had to abort the mission.
- SATURN-02: This buoy will in 2013 be deployed from late June through October.

- OGI-01: We are considering to officially discontinuing this legacy buoy. While its location (in ~100m water depth, south of the mouth of the Columbia River) would recommend maintaining the buoy and expanding its sensor package, the required funding is neither available nor anticipated.

Of note (Fig. 2):

- The glider data suggests the occurrence of extensive hypoxia along the Washington shelf in May 2013 (top panel). Scientifically, it will be useful to place this seemingly early onset of coastal hypoxia in an inter-annual context. From a resource management perspective, the QIN Department of Natural Resources is assessing implications of the hypoxia on this year's fisheries.
- The need to abort the mission was attributed to the glider being trapped by a surface lens of fresher water, extending unusually far North along the WA coast. The presence of this lens was confirmed both through the glider data (bottom panel) and is also suggested by daily forecasts of circulation (not shown); modeling suggests that the source of the freshwater was the Columbia River.

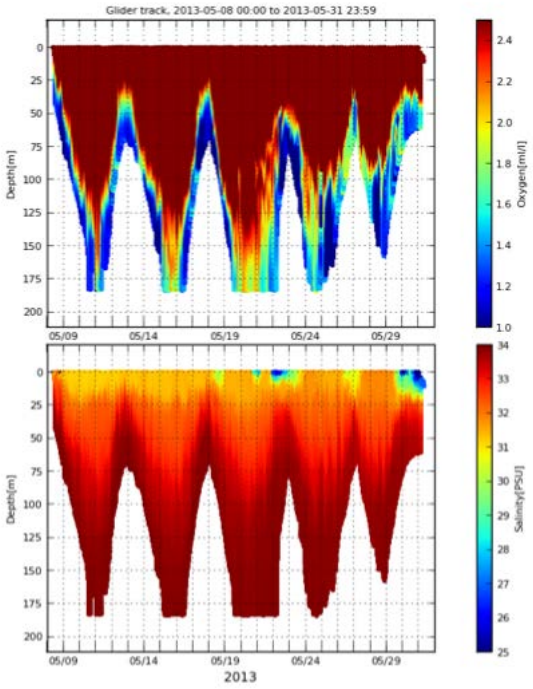

Figure 2: Glider data from the May 2013 deployment, off the Washington coast (for location and other data, see http://www.stccmop.org/datamart/observation_network/glider). The top panel shows the occurrence of strong hypoxia (color scale is capped at 2.5 ml/l, for better definition in the low oxygen concentrations). The bottom panel shows the development near the coast, especially in late May, of the lens of fresher water that ultimately trapped the glider, forcing the mission to be aborted. For

The NANOOS NVS functions as the PNW-integration portal for the glider and SATURN-02, displaying real-time data and allowing downloads of recent data; it also contains links to the CMOP SATURN website, which offers access to both the real-time data and since-inception archival data, and allows interactive analysis of data (http://www.stccmop.org/datamart/observation_network/dataexplorer).

- **Estuaries**

Puget Sound, ORCA Buoy program: Led by A. Devol and J. Newton (UW), during this report period the ORCA (Oceanic Remote Chemical Analyzer) group had three buoys in operation in Hood Canal (Twanoh, Hoodsport, and Dabob Bay), one near Admiralty Inlet (Hansville), one in Puget Sound (Pt Wells), and one in south Puget Sound (Carr Inlet). There were periods of downtime at all the buoys at different times during the report period, and all efforts were made to expedite troubleshooting and repairs with available funds. Despite the downtime, a total of 658 profiles were collected from the buoy system during the report period.

We continued to make all buoy data available in real-time on the NANOOS website. These buoys were built with and maintenance is partially leveraged with Ecology National Estuary Program funding. The Dabob Bay work was leveraged by a grant from the State of Washington to monitor surface water acidity and water column conditions as they might relate to shellfish hatchery failure. We also continued to provide support and power to the pCO_2 system operated at Dabob Bay and Twanoh in

collaboration with NOAA PMEL (R. Feely) by supplying power to the system and collecting water samples to aid system calibration.

Moderate conditions for bottom water dissolved oxygen concentrations in southern Hood Canal continued through the beginning of 2013. Salinity trended with the average at both Hoodsport and Twanoh; temperature trended with the average at Twanoh, but at the higher end of the average at Hoodsport. In contrast, both temperature and salinity at Carr Inlet were higher than the previous two years. Some of the differences in water column dynamics between southern Hood Canal and Carr inlet are associated with freshwater input. The Skokomish River discharge in southern Hood Canal contributes to strong freshwater stratification, which inhibits mixing; Carr Inlet has no significant freshwater sources. These observations are important for State efforts to assess water quality and habitat.

Washington State estuarine monitoring: Participation by the WA State Department of Ecology (Ecology)'s Marine Waters Monitoring Program is directed by C. Maloy (Marine Monitoring Manager), led by C. Krembs (Senior Oceanographer) and coordinated by D. Mora (Mooring Coordinator). Ecology operates a network of four mooring stations in Puget Sound - Admiralty Reach, Shannon Point, Manchester (two depths), Mukilteo (two depths) - and one in Willapa Bay. The deployment locations are primarily designed to capture inter-basin exchange of temperature, salinity, and oxygen and to determine the dynamic and exchange of Puget Sound water with Washington coastal waters. We contribute to regional estuarine *in situ* observations by maintaining our monthly-calibrated moorings, providing quality controlled data, compiling monthly reports, and reporting on anomalies. Key collaborative partners include University of Washington APL, Western Washington University, and Everett Community College. During this reporting period, all stations were functional except for Willapa Bay which was down while we were in the process of replacing the mooring I-beam.

From our mooring station data, we saw a shift in Puget Sound-wide water conditions that broke a two year anomaly of colder water temperature, lower salinity, and higher dissolved oxygen that temporarily improved water quality. A trend toward warmer water began in March; the trend toward higher salinity and lower dissolved oxygen levels began in May. The trend could lead Puget Sound again into a phase of lower water quality.

We finished data quality review of 2012 mooring data including our Willapa Bay mooring. The Willapa mooring successfully captured data from January through October with intermittent coverage for December. We saw high salinity levels periodically during the summer indicative of upwelled water entering the bay that we can relate to ocean boundary conditions. During periods of incoming tides, chlorophyll levels increased temporarily, confirming the coastal ocean import of phytoplankton biomass and subsequent consumption and drawdown by filter feeders within the bay.

Puget Sound observations that the Department of Ecology is currently exploring:

- Counter to the expectation that the ocean is keeping us warmer in the winter, heat appears to be continuously exported from Puget Sound throughout the year at Admiralty Reach. Even during the coldest months, winter average monthly water temperature was warmer on the ebb tide than on the flooding tide water, suggesting that colder water has been persisting north of Admiralty sill.
- Compared to monitoring data from the last two winters, water temperatures are again trending toward warmer water; an observation which is consistent with Ecology's region-wide monthly monitoring program collecting vertical profiles.

- Admiralty Reach mooring data revealed that events of intrusions of dense, low DO water are related to strong estuarine exchange which occur during conditions of minimal tidal mixing. This is coincident with the maximum diurnal inequality and neap tides that occur during equinoxes, phases of prolonged upwelling and a stronger river discharge driving estuarine flow.

Columbia River estuarine monitoring: Under the direction of A. Baptista, CMOP continues to maintain an extensive observation network (SATURN, Fig. 3) in the Columbia River lower estuary, with endurance stations and mobile platforms supported through a mix of NSF, NANOOS, and regional-stakeholder funding. Also integral to SATURN, but not funded by NANOOS, are three river stations (SATURN-05, 06 and 08) maintained under the direction of Dr. Joe Needoba, with NSF and regional-stakeholder funding.

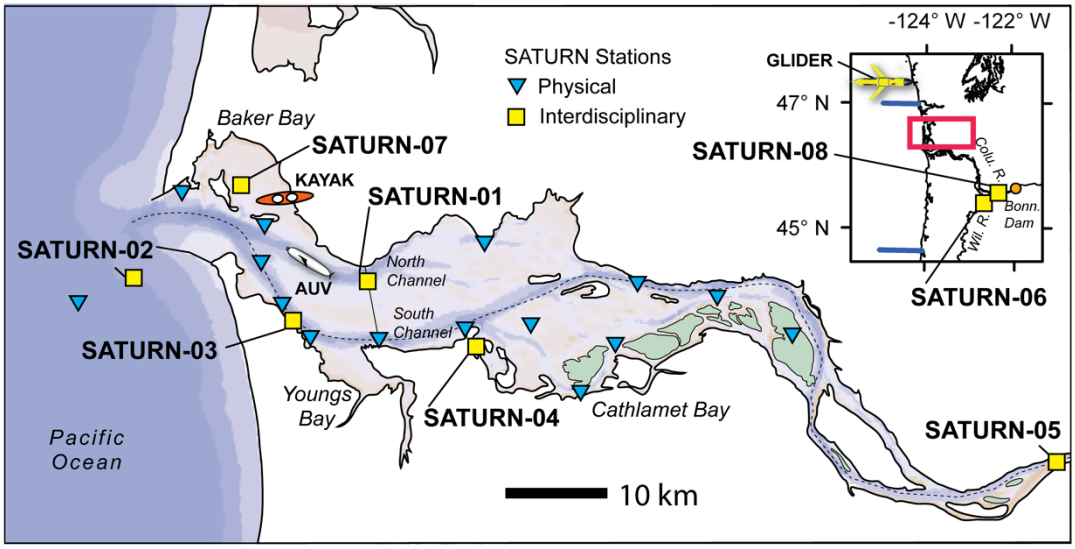

Figure 3: The Columbia River lower estuary, in geographic context. The South (or Navigation) and North channels, shown in darker blue, are dominant features. Yellow squares and cyan triangles represent stations of the SATURN observation network. Illustrative symbols represent areas of typical deployment of mobile platforms (kayak, gliders, and autonomous underwater vehicles). Extracted from CMOP 2013.

Of note during the reporting period:

- Our analysis of recently deployed pH and pCO_2 sensors at SATURN-03 shows that summer upwelling drives the co-occurrence of ocean-driven estuarine acidification (elevated pCO_2 and reduced pH) and hypoxia (Fig. 4). We had already demonstrated the occurrence of summer estuarine hypoxia (Roegner et al. 2011). We have now also shown that summer red water blooms mitigate upwelling-driven hypoxia and (potentially) acidification. We are now investigating the implications of these findings on the ecosystem services of the estuary.
- We populated (or re-populated) three stations (SATURN-01/03/04) with Acoustic Doppler Profilers, to characterize estuarine circulation and assess the skill of the "Virtual Columbia River" (see Modeling, p. 13) in representing

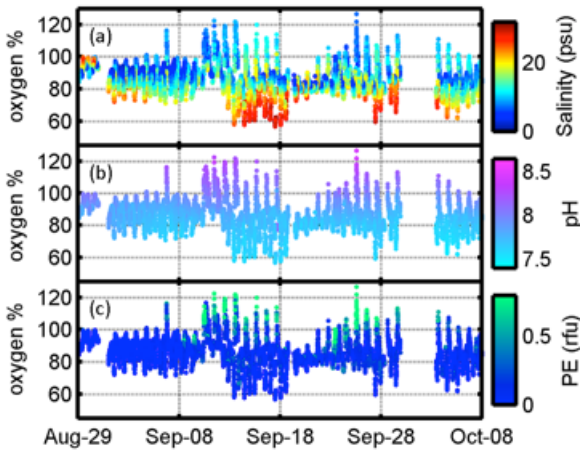

Figure 4: Oxygen saturation at SATURN-03 during the 2012 upwelling season. Oxygen data is colored by salinity, pH and phycoerythrin in the top, middle, and bottom panels, respectively. The lowest oxygen saturations are associated with the ocean end-member entering the estuary. Low pH co-occurs with low oxygen. The highest oxygen saturations are associated with the co-occurring red water blooms in the surface water of the estuary. Extracted from CMOP2013

circulation and transport processes in the estuary.

- In a successful pilot experiment, we used an Environmental Sampling Processor at SATURN-04 to demonstrate the feasibility of adaptive sampling of microbial communities that might play a role in the biogeochemistry of the estuary.

SATURN observations are used extensively in support (directly or via data-informed modeling) of regional management and decision making associated with ESA biological opinions, salmon restoration, navigation improvements and hydropower operations. These observations are also integral to the four signature science initiatives of CMOP (CMOP2011), which address estuarine hypoxia and acidification, plankton blooms, and the biogeochemistry of lateral bays and estuarine turbidity maxima.

The NANOOS NVS functions as the PNW-integration portal for the endurance stations of the SATURN network, displaying real-time data and allowing downloads of recent data; it also contains links to CMOP's SATURN website, which offers access to both the real-time data and since-inception archival data, and allows interactive analysis of data (http://www.stccmop.org/datamart/observation_network/dataexplorer).

Oregon South Slough: Participation by the Oregon Department of State Lands (ODSL) in NANOOS is led by A. Helms (Estuarine Monitoring Coordinator) and A. DeMarzo (Estuarine Monitoring Assistant) at the South Slough National Estuarine Research Reserve (SSNERR).

South Slough NERR continued operating a network of moored observing stations and a weather station as part of the NERRS System-Wide Monitoring Program and NANOOS. The five real-time monitoring stations (4 water, 1 weather) located along the estuarine salinity gradient provided continuous data over the period December 1, 2012 – May 31, 2013. During this period, we replaced the tube which protects the water quality instrument at one station (Charleston Bridge; soschwq) because the bolt which keeps the sonde at a fixed height rusted out, we increased the number of holes in the tube to ensure accurate Dissolved oxygen measurements, and we also made modifications to accommodate a prototype pCO_2 sensor from Xylem (formerly Yellow Springs Instruments, Inc.) at this station, which we plan to deploy this summer. We began troubleshooting mounting logistics for equipment at a fifth water quality station (Boathouse; sosbhwq). The Boathouse station tube, attached to the range marker tower (LLNR 8740), was sheared off during the winter and requires additional mounting straps; we will be diving on this site to resolve this issue. In the spring, we began working with the Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw Indians (CTCLUSI) to determine telemetry equipment mounting strategies on their water quality station in lower Coos Bay (North Spit BLM Boat Launch; sosnswq; Fig. 5). Funds from this period were used to partially support a technician.

The water quality stations provide real-time data access for shellfish growers (North Bend and Coos Bay Oyster Cos., and Qualman Oyster Farms) to monitor environmental conditions, and water quality data trends for understanding rising pH trends in the South Slough estuary, quarterly eelgrass monitoring (completed Feb, May 2013), monthly fecal coliform monitoring, and native oyster restoration projects. In order to address questions related to the rising estuary pH trends in South Sough, we acquired a Sunburst Sami pCO_2 sensor through NOAA's Ocean Acidification Program and NERRS Estuarine Reserves Division; we are currently working with our partners and other researchers to determine the best location and deployment and maintenance procedures for the sensor, which we plan to deploy this summer. The weather station provides real-time data to assess the short-term effects of local weather on water quality within the estuary. The CTCLUSI/SSNERR North Spit station will be the first real-time station in Lower Coos Bay. The new Boathouse water quality station will be the second real-time station in Coos Bay and the nearest to the mouth of the bay.

Figure 5. CTCLUSI's North Spit BLM Boat launch site: First image shows the general site looking south, Coos Bay. The sonde is deployed at the second metal piling from the left (north) in the second image.

- **Shorelines**

Washington Shorelines: NANOOS funds contribute to the Washington State Department of Ecology's Coastal Monitoring & Analysis Program (CMAP) led by G. Kaminsky. In December 2012, CMAP finished the fall seasonal monitoring surveys in the Columbia River Littoral Cell (CRLC) that were started in November. In total, 46 profiles and two surface maps were collected. In March 2013, CMAP completed winter CRLC seasonal monitoring surveys. During this survey, 46 seasonal profiles were collected as well as 5 additional profiles on the south side of the Columbia River East Jetty for the U.S. Army Corps of Engineers. CMAP also collected 5 surface maps and 53 sediment samples from multiple cross-shore locations along 11 of the seasonal profiles. Also in March, CMAP worked with the USGS to collect 135 beach and nearshore profiles at the Elwha River mouth, with some additional nearshore profiles extending the routine survey area east toward Ediz Hook. Data compared to previous surveys shows there has been significant accumulation of sediment in the nearshore: > 1 million m^3 since the removal of the two dams began.

With Marine Spatial Planning funds leveraged from the Washington Department of Natural Resources (WDNR), CMAP extended beach surveys to selected stretches of the Olympic Peninsula ocean coastline. Survey areas were chosen in coordination with Steve Fradkin of the National Park Service, who performs ecological surveys of both sandy and rocky beach sites throughout the Olympic National Park. In total, CMAP collected 137 beach profiles at 100-m intervals along ~13.6 km of the Olympic coast, including Shi Shi Beach (3.9 km), south of Sand Point (2.7 km), near the Cedar Creek campground (1.8 km), Second Beach (2.2 km), and between Beach 3 and the Kalaloch Ranger Station (3.0 km). Additional beach profiles will be collected in June at Rialto Beach, First Beach, and Ruby Beach. In order to perform these RTK-based surveys, CMAP created a geodetic control network of 21 monuments throughout the Olympic Peninsula ocean coast, 13 of which were made of marine-grade epoxy affixed to a rock or headland, 6 made with stainless steel rods pounded into the ground to refusal depth, and 2 made by drilling a divot into a manhole cover and a guardrail post. Each monument required 2-6 hr GPS occupations to determine their precise positions, overlapping 2-3 occupations at a time to obtain a co-processed solution.

This spring, CMAP performed several boat-based LiDAR and multibeam sonar surveys in Puget Sound, Strait of Juan de Fuca, and the Columbia River using the R/V George Davidson. CMAP also mobilized to

conduct both a foot-borne topography and boat-based LiDAR survey of the large Ledgewood Beach landslide on Whidbey Island that occurred in late March.

Oregon Shorelines: Leveraging NANOOS, the Oregon Beach and Shoreline mapping Analysis Program (OBSMAP) efforts are led by J. Allan and V. McConnell of the Oregon Department of Geology and Mineral Industries (DOGAMI). As part of DOGAMI's commitment to NANOOS, the OBSMAP network continues to be sustained, with surveys of beach observation sites having been undertaken in the Rockaway and Neskowin littoral cells, and along the Clatsop Plains. Surveys were completed in late December 2012 and in January 2013 (Fall survey), and again in March and April 2013 (Winter survey). Leveraging other funds, the OBSMAP network was resurveyed along the entire length of the Lincoln County cell (241 transect sites) between February and April 2013, and in the Gold Beach cell (~50 sites); future monitoring of these latter stations will be dependent on funding. Data for the OBSMAP monitoring sites are available through the NANOOS Visualization System, (http://nvs.nanoos.org/BeachMapping). In addition to the existing plots presently available through NVS, DOGAMI recently implemented a new "Trends" plot, which depicts the inter-annual to complete 16 year time series shoreline trends at multiple sites in Tillamook County and on the Clatsop Plains

Data from the OBSMAP beach monitoring continues to be used by agencies such as the Oregon Parks and Recreation Department to help guide permitting for engineering structures, by local community groups in Neskowin and Rockaway to help guide their understanding of changes taking place along their beach, and by Geological consultants (e.g. new housing starts proposed along several empty lots near Lincoln City). Finally, the combined beach observation dataset now available for Lincoln, Tillamook and Clatsop Counties are being used to assess 1% (100-year) coastal flood and erosion risk along the shorelines of both counties for the purposes of developing updated FEMA flood insurance rate maps.

Nearshore Bathymetry: P. Ruggiero's group at Oregon State University completed processing nearshore bathymetry data along the four sub-cells of the Columbia River littoral cell (CRLC). Over 200 individual cross-shore profiles were collected during summer 2012 extending from the lower inter-tidal to ~12 m of water depth (~2000 m from the shoreline). These data have been processed from their raw format into deliverable text files and have passed a rigorous quality assurance process. In all cases these nearshore bathymetry measurements have been combined with topographic measurement collected by Ecology developing complete maps of the nearshore planform.

Ruggiero's group also completed the processing of nearshore bathymetric data within Lincoln County in Oregon. Over 300 individual cross-shore beach profiles were processed from the lower intertidal to approximately 25 m of water depth (~1500 m from the shoreline). These data have been combined with topographic data collected synoptically by DOGAMI, and have been processed from their raw format into deliverable text files and have passed a rigorous quality assurance process.

These nearshore bathymetric data continue to provide a critical source of information for improving coastal hazard mitigation along the coastlines of the Pacific Northwest. During this reporting period, NANOOS funded nearshore bathymetric data has supported the US Army Corps' Regional Sediment Management at the Mouth of the Columbia River, FEMA flood mapping activities in Clatsop, Tillamook and Lincoln Counties, Oregon, as well as basic research on coastal hazards, morphodynamics, and the impacts of climate change (resulting in publications and student theses). In particular, NANOOS funded nearshore bathymetric data is being incorporated in a coastal hazards decision support tool supported by NOAA's Climate Program Office Coastal and Ocean Climate Applications (COCA) program.

- **Currents**

Coastal Currents: The HF surface current mapping program at Oregon State University (PI M. Kosro) continued to operate the system of HF surface current mapping radars along the coast of the Pacific Northwest, providing hourly measurements of surface current maps via NANOOS NVS, and through the national network to NDBC, USCG, and other interested agencies. We work with our modeling partners (Kurapov group) to provide data for assimilation into ocean circulation model forecasts, and to examine model results.

We operate six long-range sites and five standard-range sites; all are priority 1 except for 3 standard-range sites (YHS, WLD, WSH). For the reporting period, our returns are indicated in Figure 6.

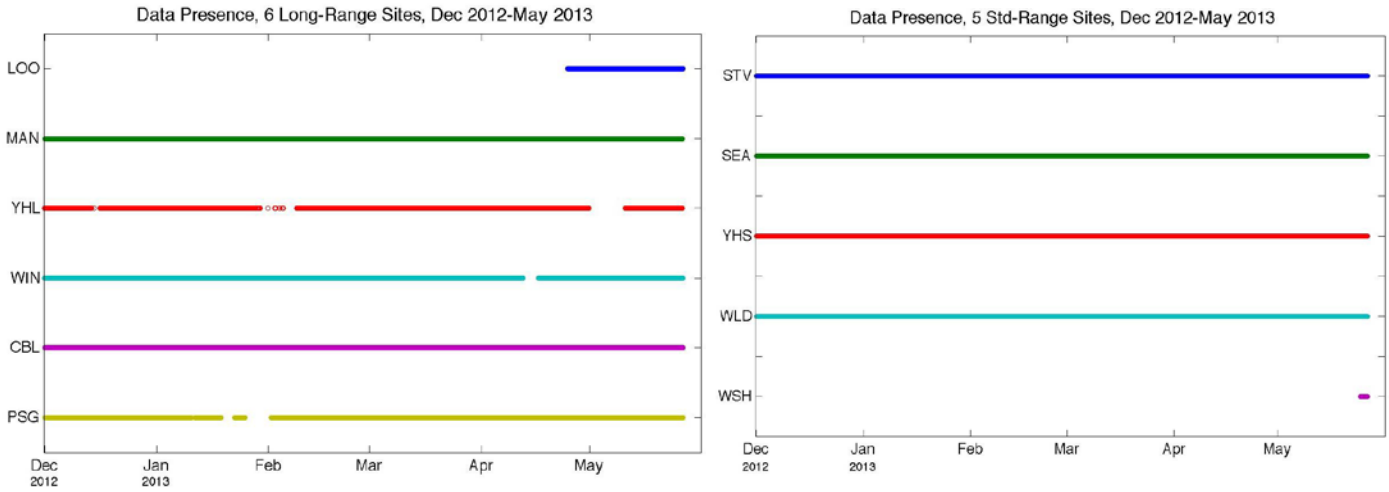

Figure 6: Each hourly radial file retrieved from each site is indicated by a circle, for the 6-month reporting period. Sites are arranged from north-to-south in each panel, with long-range sites on the left and standard-range sites on the right. Most sites show nearly continuous coverage. During several outages at "interior" sites, equipment from "end" site LOO was moved to replace them, maintaining the most continuous along-coast coverage. Extended outage at WSH1, a priority 2 site, was due to the equipment being at the manufacturer for repair.

After long-service as a substitute for other systems undergoing repair, our northernmost system at LOO was onsite and operational again in late April. We also re-installed our priority-2 system at WSH in May, following an extended service call at the manufacturer.

We have begun a campaign to obtain updated "walking patterns" at our long-range HF sites, where geography allows. These new patterns have been obtained at LOO, MAN, YHL, and WIN during the reporting period. These represent a bow to practicality – it was becoming very difficult to schedule jet-ski-based patterns (multiple drivers for safety, long travel, safe vehicles and small waves all required). An upgraded GPS receiver was purchased for these measurements.

In a paper just published in *Harmful Algae*, we analyzed HF data to show quantitatively for the first time that a retentive region off central Oregon (Heceta Bank) can be a southern source for toxic *Pseudo-nitzchia* cells detected in the spring off of southern Washington, in addition to the known northern source from the retentive region of the Juan de Fuca eddy off northern Washington (Fig. 7; Hickey et al., 2013).

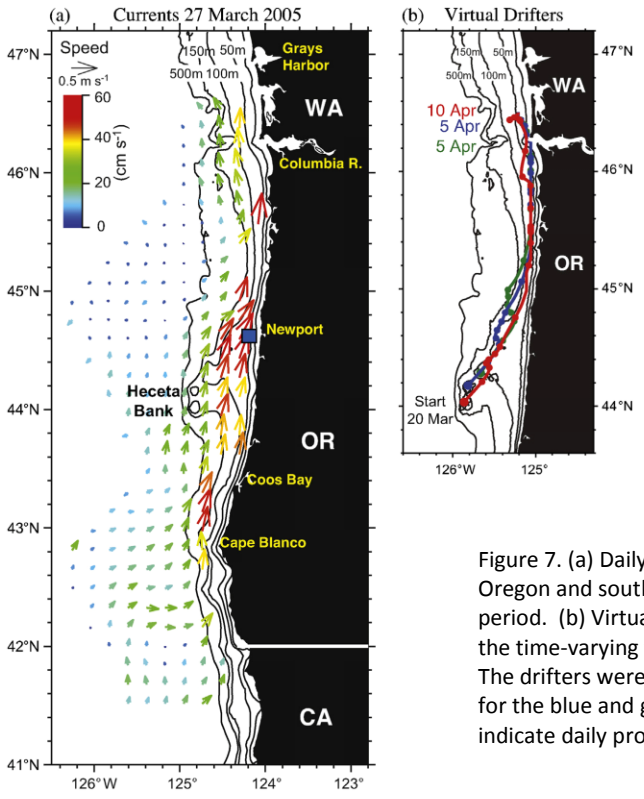

Figure 7. (a) Daily averaged surface currents from a coastal HF Radar for the Oregon and southern Washington coasts on 27 March 2005 during a storm period. (b) Virtual drifters released from 3 locations on Heceta Bank into the time-varying field of HF surface currents, starting on 20 March 2005. The drifters were tracked until they reached latitude 46.58 N—on 5 April for the blue and green tracks and on 10 April for the red track. Solid dots indicate daily progress. (Hickey et al., 2013).

Port X-band Radar: Normal operations have been maintained at the wave imaging marine radar (WIMR) station at Newport, OR (PI: M. Haller). Hourly snapshot images, directional spectra, and wave parameter time series are available in real time at the NVS site: http://nvs.nanoos.org/Explorer?action=oiw:remote_sensing:OSU_XBand_01:plots:t_imagery:img_snap_int and archived on our OSU site at http://research.engr.oregonstate.edu/haller/Newport_radar_archive.htm.

Upcoming efforts will involve: 1) refurbishing the radar receiver, which is getting noisy, 2) operationalizing our bathymetry estimates for South Beach, and 3) improving data processing speed through parallelization.

We would also note that we have established another station (temporarily) at the Mouth of the Columbia River under other funding (Office of Naval Research). Initial data returns are very exciting and we look forward to sharing at a later date.

b) NANOOS Modeling Subsystem:

- **Shelf:** Computer circulation modeling of PNW coastal ocean shelf conditions has been conducted by A. Kurapov's group at OSU, which produces daily updates of 3-day forecasts of ocean conditions, including currents, temperatures and salinities through the water column (at 3-km horizontal resolution). The system has assimilated along-track altimetry from Jason-1, Jason-2, and CryoSat, hourly GOES SST, and surface currents from land-based high-frequency (HF) radars. Results are provided to fishermen and public via the NANOOS Visualization System. Via the OpenDAP server, forecast currents

are also provided to the NOAA Office of Response and Restoration Lab in Seattle, where they can be used with the tools for oil spill mitigation.

Currently, the forecast model is extended to 40.5-47N in the alongshore direction and is focused on the OR coast. We also developed and tested (without assimilation) a 2-km resolution model in an extended domain (40.5-50N), which includes both the WA and OR coasts. Forcing of this model includes tides and the Columbia River fresh water discharge. Solutions with and without the Columbia River have been compared. It has been found that the river plume, turning toward the Oregon coast in summer, influences the sea surface temperature. In the area of the plume, where atmospheric heat flux is attenuated in a shallower surface layer, waters are generally warmer. In response to upwelling-favorable southward winds, waters inshore of the river plume may be relatively colder than in the case without the Columbia River. Including the river discharge in the forecast model is planned, to potentially improve accuracy of forecasts.

At the end of 2013, Dr. Peng Yu who had been in charge of data assimilation using our variational system, accepted a position at the University of Maryland. Dr. Svetlana Erofeeva has joined our project to help support everyday operation of this system. The forecasts have been obtained without any interruptions. Tools have been developed for routine pre-assimilation quality control of the data and post-assimilation quality control of the model outputs.

- **Estuaries**

Puget Sound: Overseen by D. Jones, APL-UW has continued to collaborate with Drs. Parker MacCready (UW School of Oceanography) and Neil Banas (UW Joint Institute for the Study of the Atmosphere and Ocean) with the goal of creating an operational version of the Salish Sea Model (MoSSea). In the past 6 months MacCready's group has been building the software architecture to enable launching a pre-operational Salish Sea model in the near future. We have been archiving daily 12km and 4km WRF forecasts, and have restructured most the code used for making model forcing so that it will work for daily forecasts. Because of continued success and regional need for a Salish Sea model for a variety of user groups, MacCready will be the NANOOS PI for this element in Y3.

Columbia River: With a mix of NSF funding, regional stakeholder funding, and modest NANOOS funding, CMOP maintains an extensive modeling system for the Columbia River coastal margin, denoted *Virtual Columbia River*. The Virtual Columbia River is operated under the direction of A. Baptista, but it is a multi-institutional collaboration involving modelers and non-modelers, in academia and across regional, federal and tribal agencies. Of major note during the reporting period:

- We participated in preparatory studies for the renegotiation of the 1964 U.S.-Canada Columbia River Treaty, with funding from the U.S. Army Corps of Engineers and in partnership with the United States Geological Survey. This treaty is an essential regional framework. Its revision addresses hydropower, flooding and ecosystem health, and might have drastic economic, environmental and operational implications for the Columbia River system. By leveraging the Virtual Columbia River, we developed strategies to model–over a 70-year reference period–the response of the estuary and plume to alternative Treaty scenarios (Fig. 8). We demonstrated that the estuary and plume are measurably sensitive to those scenarios, which led to impacts on these ecosystems to remain a consideration in Iteration 3 of the Review. We are now beginning Iteration 3 studies, where a refined set of scenarios will be investigated.

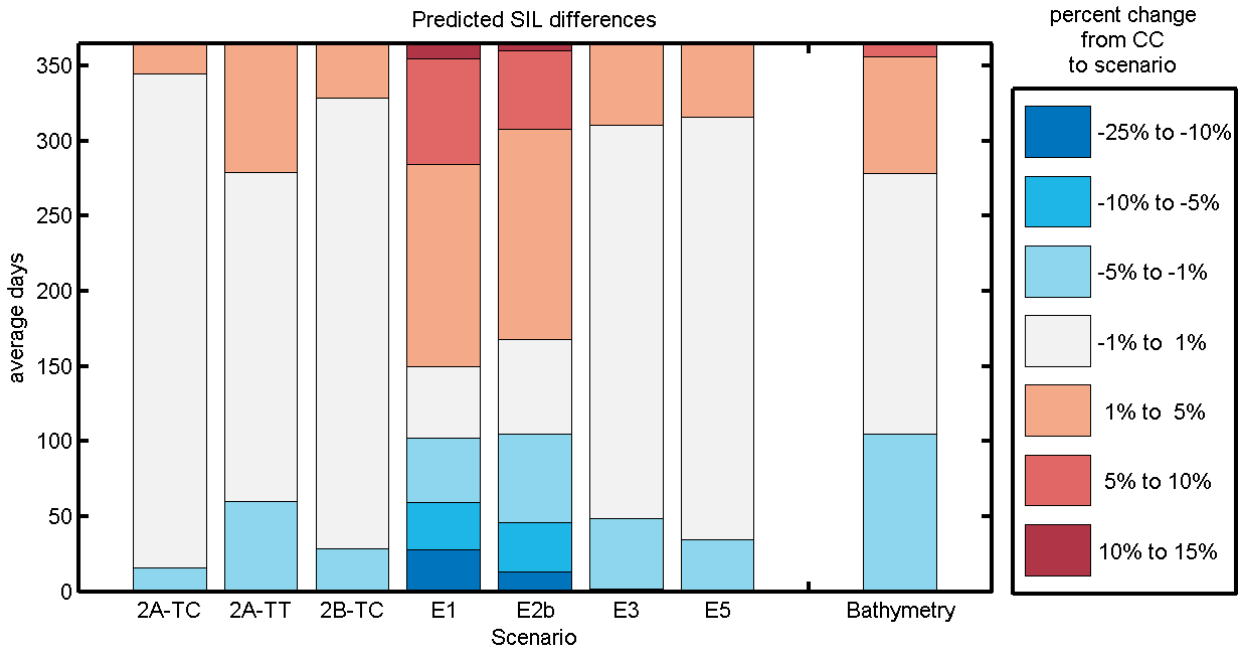

Figure 8: Seven Columbia River Treaty scenarios–each changing river discharge regimes– are compared to a "current conditions" scenario, using 70 years of predictions based on salinity intrusion length (SIL) vs. discharge correlations. For reference, the effect of bathymetric changes between 2012 and 2003 are also shown. For the Treaty scenarios, the SIL increases for greater discharges and decreases for reduced discharges. For the bathymetry change, decreased SIL is seen at low discharges and increased SIL at high discharges. Extracted from CMOP2013

c) Data Management And Communications (DMAC) Subsystem:

Co-chaired by E. Mayorga (APL-UW) and S. Uczekaj (Boeing), this committee is composed of members from Boeing, CMOP-OHSU, DOGAMI, OSU and UW. The DMAC and User Products (UPC) teams work in an integrated fashion on the prioritization, development and evaluation of data services and user products. NANOOS is an active collaborator in national IOOS DMAC efforts, including the SOS Reference Implementation efforts (Mayorga) and the IOOS DMAC Steering Team (Uczekaj). Team meeting activities for this period included: 1) participation (Uczekaj) in the IOOS DMAC Steering Team meeting (Feb 27-28); 2) annual joint meeting of the NANOOS DMAC-UPC-E&O committees (Apr 18-19) in Seattle; 3) Webex NVS presentation to NOAA (May 15); 4) weekly NANOOS DMAC-UPC teleconferences. ***NANOOS Visualization System (NVS)*** enhancements encompass continuous asset additions and updates: a new NOAA-NOS near-real-time in-situ monitoring asset, greatly improved presentation of X-Band radar data (OSU), inclusion of NOAA Navigation Charts, and ongoing asset redeployments. NVS 3 (described in more detail in the UPC section below) was released March 4, 2013, representing a major update that was the result of an extensive requirements gathering and development process. The primary focus was on overhauling the backend software infrastructure to support across-the-board usability improvements and facilitate the development of tailored NVS-based applications. DMAC-relevant enhancements included improvements to the overlay tile server, exposure on in-situ data plots of the previously expanded (to 60 days) NVS data cache, and a generalized mechanism for presenting geospatial (static) map layers. Other significant enhancements initiated in this period to be released in the next six months include an NVS backend database refactoring that will improve scalability, and user-friendly map layers showing consistently aggregated in-situ data, such as daily near-surface water temperature and salinity averages; this “situational awareness” functionality is being developed in collaboration with the Encyclopedia of Puget Sound and the NOAA ERMA team, and the map layers will be available on ERMA via OGC Web Mapping Service (WMS), as well as on NVS.

NANOOS and IOOS DMAC system implementation NANOOS tested and implemented a new virtual machine (VM) scheme for deploying application environments at APL-UW that can be managed more flexibly. A VM was deployed supporting new, up-to-date instances of GeoServer and ERDDAP used for both operational and pilot applications serving data via standards-based web services. This VM approach will be expanded in the next 6 months. APL-UW and CMOP-OHSU worked together to rebuild NVS data harvesters for CMOP in-situ data, to leverage the standards-based THREDDS server deployed by CMOP; in May, this effort resulted in Python code that generates a web-accessible, light-weight JSON data structure reflecting the THREDDS catalog and netcdf file metadata, which will be shared with the IOOS community soon. NANOOS also continued its participation in the IOOS SOS Reference Implementation working group, focusing on vocabulary development and documentation and on review of the SOS XML templates and issues arising from them. In addition, NANOOS finalized the IOOS-supported collaboration with SECOORA, the IOOS Program Office, ESRI, and the European Environmental Agency (EEA) towards a pilot inclusion of IOOS near-real-time data on the EEA "EyeOnEarth" platform; this project was featured in the Dec 2012 IOOS Association News (Mayorga, 2012), and discussions about follow-up work with SECOORA and the IOOS Program Office were carried out Jan-Mar, 2013.

Biological Data (including animal telemetry) NANOOS, IOOS, the Ocean Tracking Network (OTN) and their regional, national and international partners advanced this IOOS-supported project addressing animal acoustic tracking data, bringing the content standard and pilot service implementations (in ERDDAP and GeoServer) to their near-final form at the end of May. A final demonstration workshop was scheduled for June 13, to bring together all partners and the wider community; all deliverables will be compiled soon after.

West-Coast Coastal and Marine Geospatial Data NANOOS continued to coordinate with SCCOOS and CeNCOOS in support of the West Coast Governors Alliance Regional Data Framework (WCGA RDF) initiative, serving in leadership roles in the WCGA RDF. Mayorga also initiated a joint supporting role with The Nature Conservancy in a WA Marine Spatial Planning data project led by state agencies.

Ocean Acidification (OA) Data NANOOS continued to support OA data management activities, advancing the data dissemination and access needs of the regional shellfish aquaculture industry and coordinating West Coast strategies with the WCGA and the California Current Acidification Network (C-CAN).

d) User Products Committee (UPC):

The UPC operates in concert with and is informed by both the DMAC and Education & Outreach subsystems. The objective of the NANOOS UPC is to guide the conceptual development of the data/analysis products (i.e. observations, time series, models, applications, etc.) identified by NANOOS stakeholders, and guide the development of appropriate graphical formats and lines of communications for product dissemination. Critical to this process has been the recognition that the UPC works closely with other NANOOS committees, most importantly the DMAC and Education/Outreach teams to ensure product concepts are effectively developed and tested prior to their release.

Chaired by J Allan (DOGAMI) this committee is composed of members from Boeing, OHSU, UW, OSU, NANOOS E&O, OR Sea Grant, and NOAA. NANOOS UPC chair Allan participates in weekly "tag-up" calls with a smaller sub-group comprised of members from DMAC, UPC, E&O, and Web development in order to facilitate consistent work efforts, synergy across the committees, and improvements to product development and enhancements. Activities for this 2012/13 period included: 1) multiple weekly NANOOS DMAC and UPC teleconferences; 2) annual meeting of the NANOOS DMAC-UPC-WEB-E&O committee (Apr 18-19, 2013) in Seattle, Washington; 3) Webex presentation to NOAA on May 15th 2013; 4) Presented a seminar on NVS (May 22nd) in the Department of Civil and Environmental Engineering,

Portland State University; 4) Participated as a panelist in a meeting hosted by the Tillamook Estuaries Partnership to examine effects of climate change on coastal hazards, including sea level rise.

NVS: The backbone of the NANOOS RCOOS is the NANOOS Visualization System (NVS[1]) that currently distributes data from a myriad of regional and federal assets. Two major enhancements to the NVS platform occurred during the past 6 months. First, the release of NVS v3.0 and second the shift towards more focused web-based applications ("web-apps") targeting specific user groups (Fig. 9).

Figure 9. NANOOS web-app button interface available in NVS v3.0.

Associated with the move towards the development of targeted web-apps, development commenced in mid-2012 to transition NVS from v2.6 to v3.0. This major undertaking reflected a major change in the Google application programming interface (API), which necessitated a complete re-build of the NVS platform. This was deemed to be critical in order to make use of the new Google maps (v3) API, and in order to facilitate easier development of future web-apps planned for NVS. Major redesign and rebuilding of NVS v3 is now complete and was publicly released on 4th March 2013 following transition of all existing web-apps to this new format. Aside from the complete re-design of the NVS software architecture, enhancements to NVS v3.0 included the implementation of new "App" buttons accessible from within any of the web-apps. This enhancement enables users to more easily switch between the various applications without having to visit the products page (the format previously). Other enhancements included: standardizing the button groupings (e.g. Models, Remote Sensing (includes satellite and HF/X-band radar), and Mobile platforms (includes gliders and cruise data) in v3.0), a re-design of the map layers to facilitate easier integration of other geospatial map layers, new 60 day time series plots, redesign of the NVS/West Coast Alaska Tsunami Warning box, three new web-apps (Maritime Operations, HF Radar, and Tuna Fishers), and the addition of a timeline capability enabling access to longer time series. This latter functionality is currently still in beta testing mode and is scheduled to be released in July 2013. A complete listing of all v3.0 changes is provided in NVS version history[2].

In addition to releasing NVS v3.0, NANOOS also released a brand new web-app targeting the maritime community. The Maritime Operations web-app provides easy access to a suite of existing datasets (observations and model overlays and tools) that are deemed to be of significant importance to the maritime/fishing community. Of these, climate and ocean conditions are the most important needs identified by this community… "*The Maritime Community needs real time data and accurate forecasts of waves, wind, tides and currents*..." (Capt. Dan Jordan, CR Bar pilots). With this in mind, the Maritime Operations web-app includes new high resolution WaveWatch III wave forecasts virtual wave stations spaced 1km apart along the 25m isobath, NDBC and NOS wave and tide gauge stations, and integration of the Newport OR X-band port radar directly into NVS. The latter station provides real-time radar measurements of wave conditions (wave length, frequency and direction) at the mouth of Yaquina Bay and immediately offshore providing ocean users with critical information about conditions adjacent to

[1] http://nvs.nanoos.org/Apps
[2] http://nvs.nanoos.org/VersionHistory

the estuary mouth. A new X-band radar site has been installed at the mouth of the Columbia River and these data will soon be integrated and disseminated through NVS.

Mobile Applications[3]: The NANOOS UPC/DMAC sub-working group is responsible for the release and maintenance of mobile applications that can access and display data from NANOOS data sources. Currently there are 2 such mobile applications, ***NVS*** and ***Tsunami Warning NW*** that are available to the general public on both Android and iOS platforms. During this period, significant enhancements to both applications on all platforms were made.

NVS Mobile: NVS mobile app (Fig. 10) has under gone a major upgrade focused primarily on large form factor devices such as iPad and Android tablets. The objective here is to enhance the application to utilize the larger screen area offered by tablets to effectively display additional NANOOS data sources in the form of geospatial image overlays. These data sources include both model results and remote sensing assets such as WaveWatch III wave models, satellite based products, HF Radar, and surface ocean model results. In addition, metadata displays for data assets were reconfigured to take advantage of a richer set of metadata provided by the NVS data services. Additionally, the Android NVS application received significant rework to bring the app in line with more traditional Android functionality. Native Android UI elements were used so that the application navigation and functionality is natural to android users. All versions of a given NANOOS mobile application now behave as expected by the users of their chosen platform. This was a significant change resulting in a version 3.0 major release. NVS mobile application was downloaded for iOS 734 times in 2012 and 168 times in 2013. Update download statistics will be available when the upgrade is released by Apple on the app store.

Figure 10. Screen capture of NVS Mobile.

Tsunami Warning NW: The underlying data services used by all mobile applications were updated with NVS 3.0 web application. This caused a few compatibility problems with older versions of the tsunami warning application. A minor revision to the application was performed to correct these problems. The Tsunami application was downloaded for iOS 2976 times in 2012 and 789 so far in 2013. In addition the Tsunami application was upgraded a total of 3349 times in the same period.

e) NANOOS Education and Outreach Subsystem:

The Education and Outreach Committee, chaired by N. Hunter (Oregon Sea Grant), was sustained during the reporting period. NANOOS E&O staff A. Sprenger and S. Messier continued to work on NANOOS E&O efforts. Messier, Sprenger and Newton participate in the weekly DMAC/UPC conference calls.

Summary of Education Accomplishments: NANOOS education efforts have continued to focus on connecting with Pacific Northwest educators and partnering with local and regional ocean science

[3] http://www.nanoos.org/mobile_apps/index.php

education efforts. In early February 2013, Sprenger, along with colleagues from Washington Sea Grant, NOAA NWFSC and Seattle Aquarium, jointly presented on regional marine education programs at the Soundwaters Conference on Whidbey Island. Later that same month Sprenger was invited to present on NANOOS and its education resources at the Olympic Coast National Marine Sanctuary and Seattle Aquarium's "Monitoring Ocean Change in the Classroom" teacher professional development workshop for middle and high school science teachers from coastal WA school districts. Sprenger presented the "Well, well, well" classroom activity on monitoring upwelling and downwelling off the OR/WA Coast and demonstrated NVS.

In March, Sprenger worked with COSEE OLC post doc Tansy Clay and WA Sea Grant Citizen Science Specialist Kate Litle to put together a one-day workshop for Puget Sound boat based education programs. The workshop focused on water quality monitoring and featured NANOOS partner WA Dept of Ecology's Marine Monitoring Program staff Dr. Christopher Krembs. Educators learned more about water quality monitoring and how to support WA DOE's efforts, while WA DOE staff were able to connect with the boat based programs to explore opportunities for collaboration on sample collection and data dissemination.

Sprenger worked with Education staff from the Sanctuary and Seattle Aquarium to recruit teachers and volunteers to join NANOOS PIs, UW graduate students and NANOOS E&O staff on a 5 day cruise to re-deploy the Cha'ba (La Push) mooring off the WA Coast, collect the WA Coast SeaGlider and conduct other scientific investigations. Two classroom teachers – Tom Armentrout from Bainbridge High School and Michael Kenney from Lake Quinault Middle School, as well as 2 OCNMS Sanctuary volunteers and 1 Seattle Aquarium volunteer/pre-service teacher joined the April 22-26 research cruise (Figure 11). The cruise, with its focus on education and its timing which coincided with Earth Day, provided opportunity for outreach and publicity by IOOS, NANOOS and UW Applied Physics Lab.

IOOS media release:
http://www.ioos.noaa.gov/ioos_in_action/stories/teachers_makesplash_apr2013.html
NANOOS cruise blog:
http://www.nanoos.org/education/events/nemo_cruise/nemo_cruise_blog.php
UW APL cruise page and video:
http://www.apl.washington.edu/project/project.php?id=wa_shelf_science_cruise

Paul Williams, shellfish biologist with the Suquamish Tribe also joined the cruise. Williams has been an integral member of the Education and Outreach workgroup of the WA State Governor's Blue Ribbon Panel on Ocean Acidification and is using grant funds to help move forward on the education action items identified in the Blue Ribbon Panel report. Williams' grant to Suquamish tribe covered the substitute teacher costs for the classroom teachers joining the cruise. In return, Williams, Sprenger and the educators worked together during the cruise to review K-12 ocean acidification curriculum resources for alignment with WA State Science Standards.

Sprenger is continuing to work with Williams and WA Sea Grant's Ocean Acidification Specialist Meg Chadsey to implement teacher workshops this summer to provide OA curriculum and materials to WA State middle and high school teachers. Sprenger is also preparing, for the 2nd year in a row, to work with the high school junior leaders attending this summer's NOAA Science Camp to complete a student research project using student built buoys to investigate Lake Washington waters.

Figure 11. Left: OCNMS volunteer Ilse Werdermann, Bainbridge High School teacher Tom Armentrout, and OCNMS volunteer Susan Griffiths process chlorophyll samples onboard R/V Thompson after receiving training from Newton (not in picture). Right: Bainbridge High School teacher Tom Armentrout discusses harmful algal blooms with NOAA NWFSC research scientist Dr. Stephanie Moore.

Summary of Outreach Accomplishments: NANOOS outreach efforts have been focused on engaging with target user groups, including fishers, coastal community residents, scientists, and shellfish growers, and supported the continued development of the NANOOS Visualization System.

- On 17 April 2013, NANOOS held a focus group for shellfish growers to gather feedback on how best to update and improve the NANOOS Shellfish Growers Water Quality web site (www.nanoos-shellfish.org will be discontinued July 1) into a new and incorporate it into the NANOOS Visualization System Shellfish Growers web app. Eight shellfish growers from around Puget Sound attended the focus group hosted by Little Skookum Shellfish in Shelton WA (Fig. 12). The focus group was led by Cathy Angell from Padilla Bay NERR.
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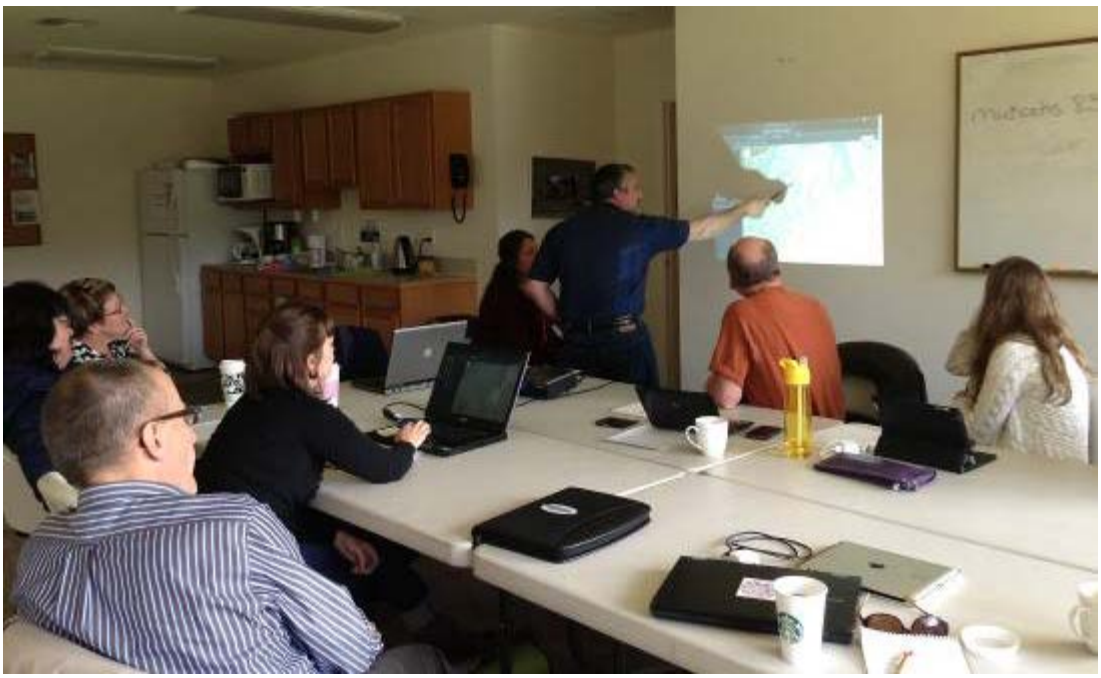

Figure 12. Paul Harris (Seattle Shellfish) provides feedback on the NANOOS Visualization System web interface as Dave Steele (Rock Pt Oyster, PCSGA president), Bill Dewey (Taylor Shellfish) and others look on.

- New NANOOS outreach materials created during this period include video tutorials for both the NANOOS Visualization System Data Explorer web app and Tuna fisher web app. The videos can be viewed on the NANOOS Youtube channel here: http://www.youtube.com/user/NANOOSpnw

- NANOOS was invited to present a "OneNOAA" webinar on the NANOOS Visualization System. On 15 May 2013, NANOOS ED Newton, UPC Chair Allan and DMAC member Blair gave the presentation that was very well received. As follow-up, one of the organizers of the seminar series, Tracy Gill, suggested NANOOS be nominated for a "Bold Award" for government effectiveness. Nominations for both NANOOS and IOOS were submitted.

Other notable outreach to various communities:

- **Regional Science:** Newton was invited to provide NANOOS data overview at a workshop "Future of Pacific Northwest Seagrasses in a Changing Climate" January 23-24, 2013 at Friday Harbor.

- **Science and Management:** Newton and Baptista were invited to give talks at the Northwest Power and Conservation Council's "Ocean Science Workshop – Management Implications" in Portland, OR on 14 February. Both talks highlighted NANOOS data. At the conclusion of the meeting, participants agreed that the Council should become a NANOOS member and advocate for its services.

- **Student Educators:** Newton was invited to give a talk on ocean acidification to the "Salish Sea Expeditions Student Symposium Reception" on 31 May in Seattle. Afterwards, she gave a digital version of her presentation to the Salish Sea Expedition teachers for their future use in explaining ocean acidification to their students.

- **Public**: Newton was invited to give an Arthur Whitely Lecture on San Juan Island on "Ocean Acidification." The public lecture was on 31 Jan 2013 with 56 people attending.
- The Skagit County Beach Watchers 2013 Public Lecture Series invited Newton to present "The Fukushima Tsunami and the Pacific Gyre: What happens to all the debris and why" to explain ocean circulation, observations, and modeling associated with the marine debris from the event. It was held in Anacortes, WA on 8 February 2013 with 121 people attending.

- **Shellfish Growers**: Newton manned a table for NANOOS at the annual Washington Sea Grant Shellfish Conference on 11 March 2013 in Union, WA. There she interacted with numerous shellfish growers, engaging some of them to participate in our NANOOS shellfish app review (noted above).

- **Managers**: Newton hosted a NANOOS table at the "Tools Café" of the Washington Sea Grant Working Waterways and Waterfronts Symposium on 27 March. There she interacted mostly one-on-one with over a dozen participants, from NOAA, natural resource agencies, and others.
- Newton was invited to speak about ocean acidification at the San Juan County Marine Managers Workshop on 28 Feb 2013. She included material on how NANOOS avails data on OA over our web.

f) NANOOS Administration:

D. Martin (NANOOS Board Chair) and J. Newton (NANOOS Executive Director) continued to provide leadership to NANOOS operations. They and M. Kosro (NANOOS Board Vice Chair) participate in regular IOOS and IOOS Association (former NFRA) calls. Newton is member of the IOOS Association Executive Committee and participated in those teleconferences during the reporting period.

A specific task requested by the U.S. IOOS office was for Drs. Craig Lee and Jack Barth to work with the IOOS Program Office to begin development of a national glider plan and glider asset map. This task was completed during this reporting period.

Newton coordinated NANOOS operations with other West Coast RAs, following the intent of our mutual MOU, as well as several other RAs to optimize and leverage capabilities and assure consistencies within IOOS. Also, the West Coast RAs interacted with the West Coast Governors Alliance, per our MOU detailed in the Supplemental Report attached to this report.

On 6-8 March, Martin and Newton participated in IOOS Program Office, IOOS Association, and other ocean observing meetings in Washington, D.C. Both participated in meetings with PNW congressional staff dealing with IOOS and NANOOS matters.

Martin and Newton used the NANOOS EXCOM to obtain input and approval of the NANOOS budget for Y3 funds. Newton, using input from the Governing Council on priorities and having consulted with all NANOOS PIs, drafted a budget and distributed this to the EXCOM. Martin, as Chair of the NANOOS Board, ran the NANOOS budget approval EXCOM meeting on 19 April 2013. After discussion, there was unanimous agreement to adopt the budget. There was solid participation, with most all in attendance.

During the reporting period Newton, Martin, Kosro, and A. Baptista (NANOOS Board) all represented NANOOS at a variety of venues, as listed in the Outreach section above, and as listed below in venues with a more of programmatic nature.

Throughout the reporting period, Martin and Newton remained deeply involved with a complimentary research ocean observing effort in the Pacific Northwest, the NSF-funded Science and Technology Center (STC) for Coastal Margin Observation and Prediction, which NANOOS leverages heavily in the areas of DMAC and Education and Outreach. Martin serves as Co-Director for the Center and Newton directs the UW Education efforts for this multi-institution project.

From December 2012 through March 2013, Martin participated on the Research Task Force for the UW College of the Environment and conveyed the need for both research and operational ocean observing efforts to be included in this study of how the University can best meet the environmental needs of our region and the country.

For CY 2013 Newton continues to serve on the Olympic Coast National Marine Sanctuary Advisory Board. She chaired a working group who developed moorings recommendations, ending with a letter to the Sanctuary Superintendent confirming good practices OCNMS currently uses, the value of the data, and recommendations for future improvements.

Newton was an Invited Speaker at the AGU session “Ocean Observing Systems: Challenges and Successes” to talk about NANOOS at the San Francisco, CA, meeting on 15 December, 2012.

Newton gave a well-attended talk in the “Sensor Networks in Aquatic Systems: Research and Education” session of the ASLO meeting in New Orleans, LA, held February 2013, entitled “NANOOS-IOOS observation and visualization of estuarine ocean acidification: making a difference.”

Martin participated in the semi-annual meeting in March 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, Martin provides both scientific expertise and as well as serves to communicate the U.S. experience with IOOS and operational ocean observing efforts that are part of the unique hybrid nature of ONC.

Kosro attended the IOOS HF Steering Team meeting held in Boulder, CO, during 17-18 April.

Kosro was invited to present NANOOS operations and products at the Newport Ocean Observing Conference 2013 in Newport, OR, on 30 April, as part of a panel on Ocean Observing.

Baptista was invited to co-chair "Developing a Science Plan for Estuarine Observing Systems: A National Workshop," organized and to be hosted by the FAU Harbor Branch Oceanographic Institute in Fort Pierce, Florida in October 2013.

Newton attended National Water Quality Monitoring calls during the period and is on a Communications Sub-group, with the task to raise awareness of this effort and to better integrate it with IOOS. She is working with Bernice Smith (NWQMN) and Josie Quintrell (IOOS Association) to arrange webinars with IOOS and the IOOS RAs.

Newton was invited to provide input on indicators at the workshop "Ecosystem Indicators on Washington's Pacific Coast, part of the California Current Integrated Ecosystem Assessment" on 13 May in Montesano, WA.

Newton provided input, some from NANOOS observations, to the National Climate Assessment via contributions to the coastal chapter (Spencer Reeder, lead author) of the regional report: Climate Change in the Northwest: Implications for Our Landscapes, Waters, and Communities (Mote, Editor, Island Press).

Newton was asked to be a reviewer of OCNMS report on Climate Change, reviewing chapter sections on Ocean Temperature; Ocean Acidification; Upwelling; and Hypoxia. The full report is: Miller, I.M., Shishido, C., Antrim, L, and Bowlby, C.E. 2013. Climate Change and the Olympic Coast National Marine Sanctuary: Interpreting Potential Futures. Marine Sanctuaries Conservation Series ONMS-13-01. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries, Silver Spring, MD. 238pp. http://sanctuaries.noaa.gov/science/conservation/cc_ocnms.html

Newton, a member of the Scientific Advisory Committee of the Joint European Research Infrastructure Network for Coastal Observatories (JERICO), was invited to provide review of their Trans National Access (TNA) proposals for 2013.

3) Scope of Work

There were neither current nor anticipated changes in scope of work, aside from downtime for various observing assets detailed above, due to weather, aging infrastructure, lack of sufficient funding support or other matters beyond our control. NANOOS succeeded in meeting our milestones for this period.

4) Personnel and Organizational Structure

There were no changes in key scientific or management personnel for this period.

6) Budget Analysis

At the end of this reporting period, the project period for the NANOOS RCOOS Yr1-2 award was 100% complete and we have encumbered or spent 98% of the funds provided ($4,621,640). In this context, "encumbered" refers to funds that are dedicated to specific planned expenditures in the UW Financial Systems where they are treated as funds already spent though they are not invoiced until actually spent. For example, all of the sub-awards are encumbered and thus not available to be spent for any other purpose. Indirect costs are also encumbered. However, encumbered amounts are NOT listed as actual expenditures until sub-awardee invoices are actually paid and indirect costs are actually charged.

The actual invoiced expenditures at the end of this reporting period are $4,143,340, or 88%. This difference (98% vs. 88%) reflects the inherent lags in the posting of expenditures in our institutional budget tracking systems. In summary, we assess that the spend rate was appropriate and well planned to allow for robust and effective execution of NANOOS plans to meet our objectives.

Presentations and Publications acknowledging NANOOS support:
(underline indicates NANOOS PI; **bold indicates peer-reviewed journal articles**)

Baptista, A.M. "Managing to timing, thresholds and change - a view from estuarine and plume physics." Ocean Science Workshop, Northwest Power Planning Council, Portland, OR, 14 February 2013.

Baptista, A.M. "Predicting and steering environmental change - A global health challenge." 10th Annual Western Regional Health Conference, Portland, OR, April 5, 2013.

Baron, H.M, and Kaminsky, G.M. "Mobile laser scanning and multibeam sonar for coastal zone mapping and resource management." U.S. Hydro Conference, New Orleans, LA, 25-28 March 2013.

Barth, J. A., F. Chan, K. Adams, S. D. Pierce, R. K. Shearman, A. Y. Erofeev, and Z. Kurokawa. "Hypoxia in the Northern California Current System." Symposium on "Microbial Ecology and Biogeochemistry of Oxygen-deficient Marine Waters," Santa Cruz, Chile, 18-22 March 2013.

CMOP (Baptista A.M. et al.) "Integrated Research Plan of the NSF Science and Technology Center for Coastal Margin Observation and Prediction." 2011.

CMOP (Baptista A.M. et al.) "Annual Report of the NSF Science and Technology Center for Coastal Margin Observation and Prediction. June 2013.

Harris, K.E., M.D. DeGrandpre and B. Hales, 2013. Aragonite saturation state dynamics in a coastal upwelling zone, Geophys. Res. Lett., 40, 1-5.

Hickey, B.M., V.L. Trainer, P.M. Kosro, N.G. Adams, T.P. Connolly, N.B. Kachel, S.L. Geier, 2013. A springtime source of toxic Pseudo-nitzschia cells on razor clam beaches in the Pacific Northwest, Harmful Algae, Volume 25, May 2013, p1-14,doi:10.1016/j.hal.2013.01.006.

Kaminsky, G.M., and Baron, H.M. "Boat-based LiDAR mapping of the Elwha and Dungeness bluffs and beaches." Elwha Nearshore Consortium Workshop, Port Angeles, WA, 27 February 2013.

Kosro, M. "Northwest Association of Networked Ocean Observing Systems (NANOOS)" Ocean Observing Panel, Newport Ocean Observing Conference, Newport OR, 30 April 2013.

Kurapov, A.L. "Ocean circulation forecasts along the coasts of the US Pacific Northwest region." GODAE Coastal Ocean and Shelf Seas Task Team workshop, Lecce, Italy, February 2013.

Kurapov, A.L., P. Yu, J.S. Allen, R.K. Shearman, M. Kosro. "The Columbia River effects on near-surface oceanic fields." Fall AGU meeting, San Francisco, OS21D-1793. 4 December 2012.

Kurapov, A.L., P. Yu., R.K. Shearman, and J.S. Allen. "SST variability in the upwelling region off Oregon influenced by the Columbia River." Gordon Research Conference on Coastal Ocean Circulation, Biddford, Maine, 10-14 June 2013.

Mayorga, E. Feature Article: "IOOS, NANOOS and SECOORA DMAC Project Advancing IOOS International Partnerships." IOOS Association National and Regional Coastal and Ocean Observing News, December 2012.
http://archive.constantcontact.com/fs181/1103098301442/archive/1111350108903.html

Newton, J., D. Martin, M. Kosro. Invited talk: "NANOOS, the Northwest Association of Networked Ocean Observing Systems: a regional Integrated Ocean Observing System (IOOS) for the Pacific Northwest." Fall AGU meeting, San Francisco, OS51F-03. 7 December 2012.

Newton, J.A. "Emerging Ocean Issues: Hypoxia and Ocean Acidification." Ocean Science Workshop, Northwest Power Planning Council, Portland, OR, 14 February 2013.

Newton, J. "The Fukushima Tsunami and the Pacific Gyre: What happens to all the debris and why." Skagit County Beach Watchers 2013 Lecture Series, Anacortes, WA, 8 February 2013.

Newton, J. "Ocean Acidification." Arthur Whitely Lecture, San Juan Island, WA, 31 January 2013.

Newton, J. "NANOOS-IOOS observation and visualization of estuarine ocean acidification: making a difference." Sensor Networks in Aquatic Systems: Research and Education session, 2013 ASLO Meeting, New Orleans, LA, 20 February 2013.

Ralston, C., A. Sprenger, and M. Sullivan. Invited talk: "Education Resources Available to Environmental Educators of Home Schoolers, Pre-K, and Grades 1-12." Soundwaters Conference, Oak Harbor, WA, 3 February 2013.

Roegner, G.C., J.A. Needoba, and A.M. Baptista, Coastal Upwelling Supplies Oxygen-Depleted Water to the Columbia River Estuary. PLoS ONE 2011. 6(4).

Seabloom, E., P. Ruggiero, S. Hacker, J. Mull, P. Zarnetske, 2013. Invasive grasses, climate change, and flood risk in coastal ecosystems. Global Change Biology, doi:10.1111/gcb.12078.

Sprenger, A. Invited talk: "Real Time Ocean Data Resources from the Washington Coast." Monitoring Ocean Change in the Classroom Teacher Workshop, Forks, WA, February 2013.

Strub, P.T., A.L. Kurapov, D. Foley. "Partnerships in the use of GOES SST in the continental US." NOAA Science Week, Madison, Wisconsin, August 2012.

Sustaining NANOOS, the Pacific Northwest component of the U.S. IOOS®:
NOAA Award: NA11NOS0120036

June 2013 Progress Report Annual Supplemental

The reporting period for this annual supplemental is 6/1/2012-5/31/2013.

- **Regional Ocean Governance Organization activities**

The West Coast Ocean Observing Systems (NANOOS, CeNCOOS and SCCOOS) and the West Coast Governors Alliance on Ocean Health (WCGA) signed a Memorandum of Understanding in October 2012 to advance the effective management of coastal and ocean resources on the West Coast.

"The WCGA and OOS have a shared interest in the effective management of coastal and ocean resources for the benefit of current and future generations. Further, we have a common geographic focus that includes the ocean and coastal resources along the West Coast states of California, Oregon, and Washington as well as shared priority theme areas, including harmful algal blooms, ocean acidification, surface current mapping, and a regional data network. As such, we have a strong interest in collaborating with each other in these areas, and leveraging human and financial resources to benefit our shared ecosystem."

NANOOS, along with CeNCOOS and SCCOOS have been interacting with WCGA in a variety of ways. NANOOS has continued to coordinate with SCCOOS and CeNCOOS in support of the West Coast Governors Alliance Regional Data Framework (WCGA RDF) initiative, serving in leadership roles in the WCGA RDF. Emilio Mayorga, NANOOS DMAC Chair, led web-ex meetings of the IT group to guide important technical decisions. Mayorga also initiated a joint supporting role with The Nature Conservancy in a WA Marine Spatial Planning data project led by state agencies.

NANOOS is working with CeNCOOS and SCCOOS towards defining and securing WCGA RDF funding for a fellow to work with all 3 RA's to directly advance WCGA goals. The proposed fellow will develop oceanographic data products for the West Coast that directly inform management questions being asked by the WCGA's Action Coordination Teams (ACTs). We anticipate that the fellow's work will address the issues of marine debris and ocean acidification, and that he or she will consult with the relevant ACTs and other experts in these areas. The products developed will be based on IOOS Data Management and Communication interoperability systems and guidelines, making them broadly accessible and usable. They will feed directly into the RDF Data Registry, providing the RDF's stakeholders with access to oceanographic information in new and useful ways on a West Coast scale. We are currently reviewing the position description that will be the basis for a call for applications that will be distributed by the participating Sea Grant office. The draft was put together by Todd Hallenbeck from the WCGA RDF, Mayorga, and Chris Cohen (SCCOOS), with input from the OR and CA Sea Grant offices. We will also be sending a letter of intent from the three RA Directors to the WCGA Executive Committee to officially communicate the West Coast OOS intention to host a fellow funded by the WCGA RDF.

NANOOS is also actively working with the California Current Acidification Network (C-CAN) and their alignment with the WCGA efforts.

- **Efforts to leverage IOOS funding**

NANOOS is substantially leveraged in every aspect of its effort. None of NANOOS' assets or teams is supported by 100% IOOS funds. Maintaining the sources of the current leverage, in times of budget cuts and shrinking funding levels affecting all sectors of NANOOS, represents a major commitment of time. NANOOS leadership, Newton and Martin, as well as all of its PIs, actively engage to leverage and build capacity for our existing systems. We can honestly say leveraging activities permeate daily practice throughout NANOOS.

A couple of noteworthy examples include:

Newton was asked to submit letters of collaboration by four different investigators submitting proposals to Washington and Oregon Sea Grant competitions. None of these opportunities for collaboration were solicited; in each case the PI sought NANOOS. This has not happened before and is testament to the regional status of NANOOS and desire to build the system more.

NANOOS was invited to be a funded partner in a NOAA Fisheries and the Ecosystem (FATE) program project called JISAO-Seasonal Coastal Ocean Prediction of the Ecosystem (J-SCOPE). NANOOS is a partner with NOAA Northwest Fisheries Science Center and the UW-NOAA Joint Institute for the Study of Atmosphere and Oceans (JISAO). J-SCOPE is one of the first projects to produce a 6-9 month seasonal forecast of the ecosystem and ecosystem indicators identified by the California Current Integrated Ecosystem Assessment (IEA) on a regional scale. This ecosystem forecasting project links atmospheric and basin scale models with NANOOS PI MacCready's regional model as operated by JISAO post doc Samantha Siedlecki. We hope results will directly inform the IEA process and the ongoing dialogue with the Pacific Fishery Management Council. In addition, we will work to make the forecasts useful to other groups and organizations NANOOS will reach out to. Using this funding, NANOOS designed a website to communicate forecasts that will be deployed July-August 2013.

The Puget Sound Institute funded E. Mayorga to create a "situational awareness" map layer using NANOOS data on PSI's Encyclopedia of Puget Sound. It will be released in the next month. This utilizes the PNW version of ERMA.

The Puget Sound Partnership through National Estuary Program funds has committed additional support for operation of six buoys in Puget Sound (Devol/Newton) that are part of the NANOOS network.

Building on previous success during year 2, the NOAA Ocean Acidification Program will be sending their year 3 funds through IOOS to NANOOS to partially support the Cha'ba buoy off La Push, WA and (newly in Y3) the NH-10 buoy off Newport, OR, both of which are part of NOAA's National OA Program. This success is witness to substantial conversations and collaborations involving NANOOS, IOOS, and within sectors of NOAA to coordinate this activity.

- **Update to NANOOS membership and Board of Directors**

NANOOS gained the following new members: U.S. Army Corps of Engineers; Olympic National Park. We are working to get NOAA PMEL, Suquamish Tribe, and WA Dept of Natural Resources as formal members, though we have substantial interaction with each of these already.

Our Board members have not changed during this period and they have stayed engaged. Per IOOS Supplemental Report guidance, we confirm that the NANOOS Governing Council Board affiliation types represented in the IOOS template is accurate and up to date: http://www.ioos.noaa.gov/regions/ra_membrshp_govern_template.xlsx.

- **Governance activities and accomplishments**

For 2012, Newton and Martin ran three NANOOS annual meetings: the Tri-Committee meeting, held June 2012 in Beaverton, OR, and Governing Council and all-PI meetings held back-to-back in Vancouver, WA, on 26 and 27 July 2012. At these meetings, NANOOS reviews progress made to date, priorities for

going forward, and tends to the business of NANOOS. At the Governing Council meeting, the following Board members were elected to 3 year terms:

Academic:
David Martin, Governing Council Board Member for University of Washington
Mike Kosro, Governing Council Board Member for Oregon State University
Antonio Baptista, Governing Council Board Member for Oregon Health and Sciences University
State:
Carol Maloy, Governing Council Board Member for Washington State Agencies
Vicki McConnell, Governing Council Board Member for Oregon State Agencies
Tribes:
Paul McCollum, Governing Council Board Member for Tribes
Joe Schumacker, Governing Council Board Member for Tribes
Federal:
John Stein, Governing Council Board Member for Washington Federal Offices
Andy Lanier (acting), Governing Council Board Member for Oregon Federal Offices
Industry:
Casey Moore, Governing Council Board Member for Industry
Steve Uczekaj, Governing Council Board Member for Industry
NGO:
Fritz Stahr, Governing Council Board Member for Non-Governmental Organizations
Jody Kennedy, Governing Council Board Member for Non-Governmental Organizations
At Large:
Rich Chwaszczewski, SAIC, Governing Council Board Member At-Large
Chris Mooers, Portland State University Governing Council Board Member At-Large

Per our NANOOS MOA, the elected Board, plus the Chairs from the DMAC, User Products, Education and Outreach Standing Committees plus the Executive Director comprise the NANOOS EXCOM. Martin and Newton used the NANOOS EXCOM to obtain input and approval of the NANOOS budget for Y3 funds during early 2013. Newton, using input from the Governing Council on priorities established at the 2012 meeting, and having consulted by phone with all NANOOS PIs in early 2013, drafted a budget that was responsive to NANOOS priorities and reflected realistic operations. Newton distributed this to the EXCOM. Martin, as Chair of the NANOOS Board, ran the NANOOS budget approval EXCOM meeting on 19 April 2013. After discussion, there was unanimous agreement to adopt the budget. There was solid participation, with most all in attendance.

For 2013, J. Allan, User Products Committee Chair, organized the Tri-Comm meeting, held at UW 18-19 April. Newton has scheduled the all-PI and Governing Council meetings for 19-20 August in Vancouver, WA. A new structure to the meetings will allow for greater PI discussion of issues on day 1, rather than report outs; an overlapping meeting with PI and GC on morning of day 2 for NANOOS and IOOS updates; and a GC session on afternoon of day 3 for Council matters.

- **Education and Outreach Activities & Training and Education Activities**

Per IOOS Supplemental Report guidance, we confirm that the NANOOS outreach and engagement activity information in the IOOS Education, Outreach and Training web tool is current and up-to-date and that the additional spreadsheet has been filled in and uploaded to the gmail site.