Sustaining NANOOS, the Pacific Northwest component of the U.S. IOOS®:
NOAA Award: NA11NOS0120036 Reporting period: 06/01/2012 to 11/30/2012

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. 9-10];
11) Work with POST to improve access to animal telemetry observations [met, E. Mayorga, UW, p 12];
12) Work with the IOOS Program Office to begin development of a national glider plan and glider asset map [met, C. Lee, UW, glider working group member, attended workshop, contributed to draft plan];

13) Support the SOS Reference Implementation Workshop [met, E. Mayorga, UW, attended];
14) Support the Animal Telemetry Network Steering Committee Workshop [met, E. Mayorga attended];
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 p. 2 of Supplemental Report, attached to this 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 coast models	-Maintain modeling & forecasting capabilities at OSU, OHSU, & UW at reduced level and make model output available via the NANOOS web
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), over this period NANOOS funding was used primarily for field operations and costs related to upgrading and maintenance of Cha'Ba surface and NEMO subsurface mooring components of this array. Both were deployed in late May 2012 and remained so for the reporting period. The large surface mooring, Cha'Ba, performed exceptionally well providing real-time data hourly from deployment through October 19th, when real-time data transmission stopped for unknown reasons. Real-time VHF communications for the sub-surface mooring were not functioning, with an unsuccessful attempt to fix the problem by swapping hardware on the small surface telebuoy in August with help from Quileute Natural Resources. With cell service at the mooring location recently becoming available, for future deployments we fabricated a second, improved telebuoy at APL that includes a much more robust cell modem.

Mooring servicing had been planned for early October aboard the R/V THOMPSON, but was canceled due to damage to one of the THOMPSON's Z-drives in August. Attempts were made to recover the moorings in late October from the NOAA vessel SHIMADA, but were unsuccessful due to poor weather. Continued poor weather prevented mooring recovery from APL's R/V ROBERTSON in November.

J. Newton (APL-UW) and this group have worked with NOAA PMEL scientists, Drs. Adrienne Sutton, Simone Alin, and Richard Feely, to maintain pCO_2 and pH datastreams and provide calibration samples. Sensor data have been transmitted to the NOAA OA and PMEL Carbon Programs as well as to NANOOS.

In late November Mickett met with the NERACOOS team (formerly GOMOOS) at the University of Maine, sharing best practices and giving a presentation on the engineering accomplishments and scientific findings to date.

Washington Shelf Glider: The Applied Physics Laboratory, University of Washington, Seaglider group led by Dr. Craig Lee (APL-UW) deployed Seaglider 187 on September 12 from the Olympic Coast National Marine Sanctuary's R/V TATOOSH at the head of Quinault Canyon. The glider continues to operate flawlessly, completing more than 300 successful dives along the 180km –long cross-shelf transect through November. Operating more efficiently than initially anticipated, recovery is now planned for the end of April, 2013. However, this work is not adequately supported by the NANOOS funds provided for WA shelf and will not be continued unless sufficient funds can be identified for additional operations.

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, using a combination of NANOOS, NSF, and private funding (Moore Foundation). 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 Jun 2012 through Nov 2012, we collected a total of 175 glider-days of measurements along 3849 km of track. This included 15,474 vertical profiles and 39 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 mid 2013, hence there is likely to 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. During the summer 2012, the wintertime buoy was redesigned, replacing an aging flotation element on the buoy thereby making the mooring more likely to withstand the harsh winter wave and current conditions.

In October 2012 on a cruise of the RV Oceanus the summertime mooring was recovered. The mooring measured a combination of atmospheric and ocean parameters. Ocean sensors measured temperature, salinity and water velocity at a number of depths. A few sensors measuring CO2, dissolved oxygen, turbidity and chlorophyll fluorescence were also attached. A meteorological package measured wind velocity, air temperature, atmospheric pressure, and incoming solar radiation. Some of these data were transmitted in near real time by a cell modem and delivered online through the NANOOS NVS—all data has been archived and is available. On the same cruise the wintertime mooring was deployed. Preparation is underway for the next deployment in April 2013.

In addition to public access of data we are aware that these data have been used by several graduate students in their thesis research and in scientific presentations at the EPOC conference.

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 is partially funded through the National Science Foundation. These assets are maintained also with support from NANOOS.

Glider operations are planned to be seasonal (April-September) and are driven in part by collaboration with the Quinault Indian Nation, focused on characterizing shelf hypoxia for fisheries management. Since May 2009, we have had 351 days of glider operations. During the reporting period, we replaced the glider lost in late April 2012 (with NSF funds). The replacement glider was tested in laboratory and in-situ conditions, and operational missions will restart in April 2013.

SATURN-02 is also a seasonal station. SATURN-02 was deployed in its full interdisciplinary configuration in June 2012 and returned to its winter configuration (surface CT only; no real-time data transmission) in October. OGI-01 is deployed year-round in "winter configuration" (surface CT, no telemetry), as the deployment of an interdisciplinary suite of sensors–although highly desirable for modeling support–remains unfunded. Deployment of the buoy in minimal configuration satisfies USCG regulations.

Archival data from these platforms, and those from the Columbia River estuary, below, are publicly available. NANOOS NVS functions as the PNW-integration portal, 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 near real-time data and since-inception archival data, besides allowing interactive analysis of data within and across stations through the SATURN Data Explorer (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. Causes of downtime ranged from failure of aging components, such as failing deck batteries and worn winch sprockets and components, to a seemingly bad batch of hydrowire. All efforts were made to expedite troubleshooting and repairs, which sometimes involved long lead times for new parts. Despite the downtime, a total of 6315 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 the Hood Canal Dissolved Oxygen Program, Ecology, Navy, and NSF 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 (C. Sabine, R. Feely) by supplying power to the system and collecting water samples to aid system calibration.

In comparison to previous years, 2012 continued to be a moderate year in terms of bottom water dissolved oxygen concentrations in southern Hood Canal. Oxygen concentrations observed in the bottom water at Twanoh continued to trend at the top of the ranges observed in the previous 7 years, and were similar to those observed in 2009. At both Hoodsport and Twanoh, the values and trends of water temperature observed at 30 meters were also similar to values observed in 2009, with both years

trending significantly below average. However, salinity observations at 30 meters in 2012 were significantly below average, whereas in 2009 values were solidly above average. 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, with the help of collaborative partnerships, operates a network of four mooring stations (six total sensor packages) in Puget Sound and one in Willapa Bay. The deployment locations are primarily designed to capture inter-basin exchange of temperature, salinity, and oxygen. Ecology funded the establishment of the mooring stations and NANOOS funding partially supports technician time for maintenance. 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.

Moorings maintained during this period were located in Admiralty Reach, Shannon Point, Manchester (two depths), Mukilteo (two depths), and Willapa Bay. Data are available via the NANOOS Visualization System as well as from Ecology's web page. Key collaborative partners include University of Washington APL, Western Washington University, and Everett Community College.

During this reporting period from our mooring stations we saw seasonal trend change points in water temperature, salinity, and dissolved oxygen. At Manchester and Mukilteo the trend toward cooler water began in September; the trend toward lower salinity and higher dissolved oxygen levels began at the end of October. All stations were functional except the Shannon Point station during October.

Columbia River estuarine monitoring: CMOP continued to maintain 14 endurance stations in the Columbia River estuary (under the direction of A. Baptista, with a mix of NSF, NANOOS, and regional-stakeholder funding), which anchor CMOP's SATURN observation network. Also integral to SATURN, but not funded by NANOOS, are two freshwater stations: SATURN-06, maintained directly by the USGS, and SATURN-05, maintained by Dr. Joe Needoba with CMOP/NSF and regional stakeholder funding.

Of particular note during the reporting period, we continued to make enhancements aimed in part at better characterizing ocean-induced estuarine hypoxia and acidification, and to begin understanding the role of local production in mitigating these deleterious ocean effects. Specifically:

- We now routinely observe DO from river to plume, and have characterized multiple severe events of estuarine hypoxia, some of which partially mitigated by local production. We have documented substantial inter-annual variability since 2010, and we beginning to understand the role of red water blooms, and controlling river discharges, in mitigating ecologically significant, ocean-driven, oxygen depletion events.
- We began the addition of pH and pCO_2 sensors at three stations along the navigation channel of the estuary. These sensors will allow characterizing estuarine hypoxia and acidification as two coupled process, both driven by coastal upwelling of degraded ocean waters. Two stations (SATURN-03 and SATURN-04) are now fully equipped, and maintenance protocols are being developed with the benefit of lessons learned from the data that is being collected in continuum. The third station is anticipated to have a pCO_2 sensor deployed in the spring/summer of 2013.
- We began adding PAR sensors at multiple plume and estuary stations (SATURN-02, with estuarine stations to follow in 2013), and will add one ACS sensor (SATURN-01 or SATURN-03) in 2013. The goal is to characterize local solar radiation and light attenuation, to provide context for observations of productivity in the lower estuary and to support an emerging suite of ecological models

• We added or re-installed bottom nodes at two permanent stations (SATURN-01 and SATURN-04) and at a seasonal station in the North Channel (NCBN-1), with a third bottom node (SATURN-03) planned for 2013. Bottom nodes have Acoustic Doppler profilers and CT, to better characterize (a) the propagation of acidic/hypoxic ocean waters into the lower estuary, and (b) mechanisms of enhanced estuarine retention that might play a role in mitigating hypoxia/acidification through local production. All bottom nodes except the seasonal (NCBN-1) have real-time telemetry.
• We are progressing towards the adaptive sampling of microbial communities that might play a role in the biogeochemistry of the estuary. Progress has been made towards the deployment of an Environmental Sampling Processor (for short periods) at SATURN-03 and SATURN-04, with an essential cover designed and its fabrication procured. The pilot deployment of the instrument was delayed to early 2013, with scientific operation planned to start in spring/summer 2013.

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 CMOP science initiatives, which address estuarine hypoxia and acidification, plankton blooms, and the biogeochemistry of lateral bays and estuarine turbidity maxima.

Oregon South Slough: Participation by the Oregon Department of State Lands (ODSL) in NANOOS is led by A. Helms (Acting Research 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 real-time weather station as part of the NERRS System-Wide Monitoring Program and NANOOS. The five water quality monitoring stations located along the estuarine salinity gradient provided continuous data over the period June 2012 - November 2012. Four of the water stations and the weather station are now equipped with telemetry systems. The Elliot Creek water quality station involved relocation from the historical site to accommodate telemetry. It began transmitting data on 5/31/12 with low signal strength; this was resolved 8/9/12 and the station was added to NVS on 9/25/12. Working in partnership with the U.S. Coast Guard (USCG), we began installation of telemetry equipment for the real-time Boathouse station at the mouth of Coos Bay. This station involves relocation from a wood piling to a range marker tower (LLNR 8740), which provides access to service the station and telemetry equipment and is located very near the previous piling. On 9/17/12, we received authorization to access the structure for 6 months until the USCG processes our licensing agreement with the Shore Infrastructure Logistics Center. On 10/18/12, we installed the protective ABS pipe to house the datalogger. During the week of 11/12-16/12, we worked with the USCG on mounting logistics and then installing the enclosure and the solar panel. Equipment upgrades over this period included two new dataloggers, conversion of an older instrument, and new weather sensors to replace aging equipment.

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 eelgrass, fecal coliform monitoring and native oyster restoration projects. The new station Elliot Creek serves as a riverine reference site, located in a semi-pristine area of the Sengstacken Arm surrounded by upland forest and undisturbed marshes with no development. In addition, it is nearest the oyster beds run by Qualman. The weather station provides real-time data to assess the short-term effects of local weather on water quality within the estuary. The new Boathouse station will be the first station in Coos Bay proper (as opposed to within South Slough) and the nearest to the mouth of the bay.

- **Shorelines**

Washington Shorelines: NANOOS funds contribute to the Washington State Department of Ecology's Coastal Monitoring & Analysis Program (CMAP) led by G. Kaminsky. CMAP completed seasonal monitoring in the Columbia River Littoral Cell (CRLC) during spring and summer and initiated the fall surveys. CMAP collected 46 profiles and two surface maps during spring. In summer 2012, CMAP collected 50 seasonal profiles and 14 surface maps, as well as ~60 sediment samples from multiple cross-shore locations along 13 profiles. CMAP also collected ~180 additional summer topographic beach profiles to coincide with bathymetry transects collected by USGS and OSU within the CRLC. Data from seasonal CRLC profiles indicate that southern Grayland Plains has accreted with ~2 m gain in beach elevation from summer 2011 to summer 2012 at the southernmost profile, Gelf, which has previously experienced significant retreat. Dune building occurred along much of the Long Beach Peninsula (from ~5 km south of Leadbetter Point to the Seaview area) with growth on the order of 0.5-1 m at the dune crest and toe between summer 2009 and present. The beach just south of North Head, however, has eroded over this period by about the same order of magnitude. The profile just north of the Columbia River North Jetty shows ~0.5 m of beach accretion from summer 2010, likely from the beach nourishment that occurred last year.

CMAP leveraged state funds of WDNR to extend beach and nearshore surveys within the CRLC and northward over the length of the Quinault Indian Nation (QIN). CMAP collected 24 beach profiles between Ocean City State Park and Pt Grenville and ~100 profiles north of Pt Grenville to Queets River. This involved creating a geodetic control network throughout the QIN coast, where CMAP installed 5 monuments, which each required 4-12 hr GPS occupations to determine their precise positions. Expanding its capabilities, CMAP initiated boat-based LiDAR and mulitbeam sonar surveys in Puget Sound and the outer coast using the R/V George Davidson. These developments represent a significant step forward in our ability to monitor coastal bluff shorelines, particularly where steep topography and remote settings preclude data collection using land-based methods.

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 in the Newport Cell and at Beverly Beach (central Oregon coast) during August, and September 2012. Leveraging other funds, the OBSMAP network was expanded over the same period to include 241 new sites in Lincoln County, bringing the total number of monitoring sites in this county to 313 stations; 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://www.nanoos.org/nvs/nvs.php?section=NVS-Products-Beaches-Mapping).

During this period, problems with aging infrastructure continued to occur. For example, our ARGO ATV (now 8 years old) broke on multiple occasions out on the beach, often in precarious locations, requiring

the vehicle to be towed off the beach using either its own winch system or with our state vehicle. In addition, we are currently experiencing issues with our GPS radio system, which will likely require replacement of the radio system. 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. 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: During summer 2012, P. Ruggiero's group at Oregon State University collected 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). Approximately 400 kilometers of nearshore mapping took place within 10 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. In all cases these nearshore bathymetry measurements have been combined with topographic measurement collected by PI Kaminsky's group at Ecology developing complete maps of the nearshore planform.

Also during summer 2012, Ruggiero's group collected nearshore bathymetric data along all of Lincoln County in Oregon. Over 300 individual cross-shore beach profiles were processed from the lower intertidal to ~25 m of water depth (~1500 m from the shoreline). These data have been combined with topographic data collected synoptically by PI Allan's group at DOGAMI, and have been processed from their raw format into deliverable text files and have passed a rigorous quality assurance process.

- **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. The paper by Yu et al. (2012) is one result of that collaboration.

Several HF systems were put back into service after prolonged outage for repair at CODAR. The Cape Blanco system was re-installed on August 1, after factory repairs, a new cell phone modem, and a re-negotiated operating frequency. In November, a large storm caused widespread power outages in the same region; repeated electrical dropouts damaged the receiver, which was sent to CODAR for repair; the unit from Loomis Lake, WA was temporarily installed at CBL to maximize alongshore continuity. Other sites with equipment repairs of significant duration included YHL, YHS, WIN. Site LOO (northern end of the chain) has been out of service as its equipment is used to fill in for the sites undergoing repair. Cell phone modems have been purchased and installed at several sites (including SEA and STV, and anticipated at PSG) to improve reliability of connectivity. All of these actions are in furtherance of reliability and more continuous operation.

We are testing installation of an Automatic Identification System (AIS) receiver at our coastal site near Winchester Bay, Oregon. AIS receivers monitor and display ship location and identification information broadcast by ship traffic. This region is a notable gap in the presently-available AIS coverage, and our HF

coastal stations could provide internet-ready coastal sites for monitoring. The information is useful in marine domain awareness and in maritime safety and navigation.

Extremely noisy power at our WIN site has grown worse, and caused damage to the installed HF equipment. We have designed and installed a power buffering system intended to reduce the very large voltage spikes on the power line to acceptable levels delivered to the equipment, along with power quality monitoring equipment. This investment ($6K) is working so far; the alternative (short of moving) would have been replacing the buried power cables, at a cost of $50-$100K.

In June, we met with visitor Prof. Cho-Teng Liu from Taiwan to answer his questions about HF installation and processing. Among other projects, we are investigating the effects of ideal vs. measured patterns on HF measurements.

Port X-band Radar: Led by M. Haller (OSU), the wave imaging marine radar station at the Newport jetties came back online at the end of October 2012. A new underground electrical conduit was run out to the facility (cost of ~$55K provided through the OSU College of Engineering) and the facility wiring was brought up to code. In early November, the system began pushing single-rotation snapshot images to the NANOOS Visualization System (NVS) website every hour; by the end of the month a spectral plot was added to this hourly image along with week-long time series plots of peak wavelength, period, and wave direction (see http://nanoos.org/nvs/nvs.php?section=NVS-Assets-Radar-OSU-X_Band)

Upcoming efforts for the system will include: 1) continuing to improve system robustness to reduce gaps in the data; improving data processing speed through the use of GPU parallelization; providing the spectrally-derived parameters directly to the NVS system to allow for user navigation of the data through the NVS map pop-up.

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, hourly GOES SST, and surface currents from land-based high-frequency (HF) radars. Assimilation of CryoSat alongtrack altimetry was added during this period. 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. Initial assimilation tests using this system were performed.

- **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). An important step in this effort is to have the operational infrastructure that supplies atmospheric boundary conditions to MoSSea. In the last six months APL-UW developed an agreement with the UW Atmospheric Sciences modeling team for the daily transfer of atmospheric model fields from the UW

Weather and Research (WRF) model. The UW WRF runs every 12 hours, and at two different resolutions (12km and 4km) for the Puget Sound area. The data transfer to APL-UW includes various critical forecast variables such as 2m air temperature, surface pressure, and surface wind. This data transfer system will allow: raw NetCDF access for groups such as MoSSea; data searching, aggregation, filtering; and map tile generation. An added benefit of this effort is the availability of the data for other applications such as NVS and a new boater information app.

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* (VCR). The VCR 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. On-going during this reporting period:

a. The circulation modeling capabilities of the VCR are being used to assist the region in four major issues. Two relate to salmon life cycle, habitat and status under the Endangered Species Act and in relation to hydropower management and climate change, and are continuing from past years. New are studies in support of (a) the Columbia River Treaty Review, a collaboration with the USGS, Army Corps of Engineers, Bonneville Power Administration, Columbia River Inter Tribal Fish Commission and others; and (b) the post-construction assessment of the ecological impact of the Columbia River Channel Improvement Project, a collaboration with the Army Corps of Engineers, NOAA, and a large number of state and federal agencies.
b. The daily forecasts of the VCR now form the foundation of the NOAA PORTS forecasting system for the Columbia River. We continue to collaborate with NOAA in improving the skill of those forecasts.
c. Driven in part by the needs of the above-mentioned projects, we continued to assess and improve the skill of the circulation simulations. Specifically:
    - We further improved the representation of water levels in the estuary and tidal freshwater. We are also addressing specific operational requirements for river flood protection.
    - We are conducting a major effort to improve the representation of the salinity intrusion and stratification in the lower estuary, driven in part by the recognition that stratification thresholds of ecological significance are associated with dam operations. To help address the remaining modeling challenges, we have adjusted assets of the SATURN observation network and conducted specific field observations. We have also created a set of demanding benchmarks, against which model improvements are being systematically assessed.
d. We are expanding the disciplinary scope of the VCR, to be able to address CMOP science questions and emerging ecological concerns in the estuary. Progress was made developing models of estuarine hypoxia, which are approaching a degree of usefulness in interpreting processes (but still lack robust predictive skill). Other recent developments are in the area of the modeling sediment dynamics and biogeochemistry of the nitrogen cycle in the estuary.

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 teams work in an integrated fashion towards the prioritization, development and evaluation of data services and user products. NANOOS is an active collaborator in national IOOS DMAC efforts, including the IOOS SOS Reference Implementation (RI) efforts (Mayorga) and the IOOS DMAC Steering Committee (Uczekaj). ***NANOOS Visualization System (NVS)*** enhancements encompass continuous asset additions and updates: new near-real-time in-situ monitoring assets (EPA & Hatfield Marine Science Center, South Slough NERR, VENUS; Whiskey Creek Shellfish Hatchery), new inventory-mode asset (Olympic Coast

National Marine Sanctuary), and many redeployments and enhancements. The NVS recent-data cache was expanded to 60 days. The adaptation to NVS in-situ data (via NVS data services) of the existing "CMOP Data Explorer" online tool for sophisticated data exploration was released in late July. Following the release of NVS version 2.6 on November 8, 2011, the focus of the NVS development effort has been to enhance the back-end software infrastructure. This will ease the production of more 'app-like' capabilities such as the Tsunami Evacuation Zones tool. These will be based on NVS, but will be tailored to specific uses or users. The next app to be released will be designed for northwest boaters. The effort will leverage an earlier application developed by APL-UW called the Boater Information System (BIS). BIS, funded by Washington Sea Grant, was a popular program for Puget Sound area boaters. The new version will be updated for advances in web technology and expanded to cover the full geographic region of NANOOS.

NANOOS and IOOS DMAC system implementation The NANOOS SOS services were consolidated in late November, enabling DescribeSensor sensor metadata responses for CMOP-OHSU assets. NANOOS continued its strong participation in the IOOS SOS Reference Implementation (RI) working group, including IOOS support to Mayorga for assistance for documentation, template management, vocabulary development (Haines et al. 2012), and coordination and resolution of RI issues.

Biological Data (including animal telemetry) NANOOS, IOOS and their regional, national and international project partners, including the former POST, made steady progress on the IOOS-supported project addressing animal acoustic tracking data. We completed user-needs surveys, documentation of existing system, and draft system design and content standard; conducted project-steering technical and advisory webinars and conference calls; and initiated the final implementation phase.

West-Coast Coastal and Marine Geospatial Data NANOOS continued to coordinate with SCCOOS and CeNCOOS (Patterson et al. 2012) in support of the West Coast Governors Alliance (WCGA) Regional Data Framework project, including Phases 1 and 2 of its work plan and ongoing coordination of the IT working group. Mayorga attended the ESRI Oceans Summit in Redlands in November (Mayorga 2012a), meeting with a wide-ranging community focusing on strengthening the integration of GIS and oceanographic tools and data.

Ocean Acidification (OA) Data NANOOS continued to support OA data management activities (Newton et al. 2012), including participation with NODC in an international workshop in Seattle (Garcia & Mayorga 2012); collaborative activities with NODC and IOOS on OA controlled vocabularies; and support for the California Current Acidification Network, including a workshop in La Jolla (Mayorga 2012b; Newton 2012b) and completion of the first release of the West Coast OA monitoring asset inventory. NANOOS also continued to support the data dissemination and access needs of the regional shellfish aquaculture industry (Mayorga et al. 2012; Newton et al., 2012).

NANOOS Web Portal The NANOOS web portal has been averaging over 205 visits per day in the past six months, with occasional spikes of over 400 visits in a day. Most NANOOS web visits are from computers in the United States (93% of all visits). Also, the NANOOS portal has a high amount of returning users, averaging 57% of visits per month (based on tracking data provided by Google Analytics. AnalyticsSEO, a website dedicated to the study of Google Analytics data, states that a typical website receives less than 35% of return visitors. We view this as evidence that the NANOOS web portal is providing an important service to our users, vice answering one-time search requests from a search program.

In regard to the NANOOS operational IT infrastructure, the addition of the new tile server, added in Nov 2011, has played an important role in meeting growing user traffic. With our old tile server, we were serving a dozen or so map overlays to 50 or so visitors a day and the system would be unresponsive at times. With the new tile server, Coral, we are serving over 700 map overlays to 200+ visitors a day, and are able to keep up with the load. Based on our most frequent audit, we are serving approximately 47,000 tiles a day, and visitors are also requesting ~350+ observation plots from NANOOS assets a day.

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 period included: 1) multiple weekly NANOOS DMAC and UPC teleconferences; 2) annual meeting (Jun 13, 2012) of the NANOOS DMAC-UPC-WEB-E&O Tri-committee members; 3) annual GC and All-PI meeting (Jul 26-27, 2012); and 4) NOAA IOOS summit meeting (Nov 12-15, 2012), Herndon Virginia.

Website: Over the period, we added the CMOP Data Explorer with a NANOOS data link, and we added a Mobile Apps web page. This page includes descriptive information, screenshots, and download links to two NANOOS mobile application products: NVS mobile app (v2.1) and the TsunamiEvac-NW app (v1.1).

NVS: The backbone of the NANOOS RCOOS is the NANOOS Visualization System (NVS) that currently distributes data from a myriad of regional and federal assets. While, it is recognized that a single visualization tool is unable to meet all user needs throughout the NANOOS region, such a tool can still provide the necessary framework on which additional NVS web applications are based and subsequently developed that meet specific user needs. It is this latter approach, which now forms the basis for future enhancements to application development within the NVS platform.
Additional enhancements to NVS during this period included the addition of Washington coast beach and shoreline change data to the NVS beaches web app[1], representing a technology transfer from Oregon to Washington in the form of standardized product code that would produce plots with a consistent look across both states.

Following the NANOOS annual tri-committee meeting in June 2012, the decision was made to begin developing additional "web-apps", targeting two specific user groups: shellfish growers and maritime users. However, to facilitate this shift to more customized web apps, members of the NANOOS DMAC-UPC-WEB-E&O team spent a considerable amount of time discussing the overall look and feel of the primary web interface, where the applications would be based. Following these discussions, an approach was

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

[1] http://www.nanoos.org/nvs/nvs.php?section=NVS-Products-Beaches-Mapping

developed using a consistent nomenclature that will form the basis for all future applications. In addition to such cosmetic enhancements, NANOOS DMAC-UPC-WEB-E&O reached out to a few key stakeholders involved in both the maritime industry and in the shellfish industry in order to solicit their input on the operational capability of the planned products. Following these discussions, white papers were developed that scope out the overall design of the new products. Further development on these products will occur after completion of NVS v3.

Associated with the move towards the development of targeted web-apps, development commenced in mid-year to transition NVS from v2.6 to v3.0 of the Google application programming interface (API). This was deemed to be critical in order to make use of the new Google maps 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 should be publicly released in early 2013 following transition of all existing web-apps to this new format. Enhancements to NVS v3 will include the following: 60 day time series plots (completed); the addition of a timeline capability enabling access to longer time series (scheduled for development in 2013), and redesign of the NVS/West Coast Alaska Tsunami Warning box (in progress).

Mobile Applications*[2]*: Early in 2012, the NANOOS UPC/DMAC sub-working group began working on an updated version of the NVS mobile app (for both Android and iPhone users). This latter enhancement (v3, when released) is designed to reach out to those users who are using smartpad technologies (e.g. iPad etc.). The objective here is to develop an application that utilizes the larger screen area offered by smartpads, while adding additional capabilities that include providing access to geospatial overlays (e.g. WaveWatch III wave models, satellite based products, HF Radar, and surface ocean model results) that are currently not available in the existing NVS smartphone app. Specific enhancements include: iPad support, overlays on iPad, updated graphics for retina display, corrected bug in displaying time icon, updated internal data storage, new UI for iPad.

e) NANOOS Education and Outreach Subsystem:

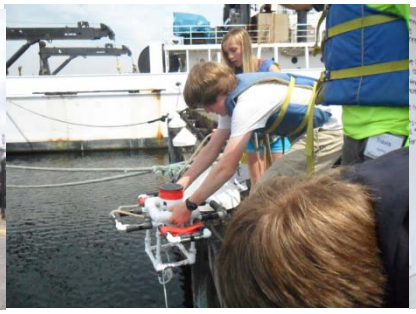
The Education and Outreach Committee, chaired by N. Hunter (Oregon Sea Grant), was sustained during the reporting period. NANOOS E&O staff A. Sprenger and S. Messier (nee Mikulak) continued to work on NANOOS E&O efforts. Messier is an active member of the NANOOS User Products Committee (UPC) and, along with Sprenger and Newton, participates in weekly DMAC/UPC conference calls. NANOOS E&O committee members were well represented at both the NANOOS tri-committee meeting held in June and the NANOOS Governing Council meeting held in July. Sprenger and Messier continued their participation in IOOS-NFRA E&O monthly calls. Messier is a member of the IOOS sub-committee for the IOOS video project; she has provided input and guidance in the development process.

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

- At the National Marine Educators Association annual conference, held in Anchorage in June 2012, AOOS and NANOOS hosted an IOOS/AOOS/NANOOS table in the exhibit hall throughout the conference. On the last day of the conference Molly McCammon, AOOS web development staff and Sprenger co-presented a session attended by 20-25 educators, demonstrating IOOS, AOOS and NANOOS tools and resources available for educators.
- In July, NANOOS partnered with Washington Sea Grant to pilot a student buoy project during NOAA Science Camp. Now in its 10th year, NOAA Science Camp is a WA Sea Grant sponsored 2 week science camp for middle and high school aged students. It takes place at the Western Regional

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

NOAA Campus on Lake Washington in Seattle, and involves many NOAA program offices including PMEL, NWS, NOS, NWFSC, AFSC, and NMFS. Inspired by the BOB project by SECOORA, Sprenger worked with the Junior Leadership Program, the high school aged students at NOAA Science Camp, to design, build and deploy buoys off the NOAA dock in Lake Washington. After touring NOAA PMEL and talking with PMEL staff to see buoys getting ready for deployment, students took on their own buoy building project. Using temperature sensors borrowed from NANOOS PI Kipp Shearman and building materials borrowed from NANOOS member Ocean Inquiry Project, the students investigated temperature at surface and depth at two locations in Lake Washington over a 5 day period. At the end of the project students presented their findings to NOAA staff. The pilot project was very successful and is likely to become a regular piece of NOAA Science Camp. In addition, Sprenger continues to work with NANOOS EOC to seek support to bring the student built buoy project to other interested teachers and programs in the NANOOS region.


- Over the late summer and early fall 2012, Sprenger participated in the Public Education and Outreach Workgroup for the WA State Blue Ribbon Panel on Ocean Acidification. The workgroup determined recommendations for education and outreach which were presented to the Blue Ribbon Panel and subsequently incorporated into the Panel's report to Governor Gregoire. Newton was a Blue Ribbon Panel member. (http://www.ecy.wa.gov/water/marine/oceanacidification.html)
- NANOOS partnered with NANOOS member, Northwest Aquatic and Marine Educators (NAME) to host a booth at the WA Science Teachers Association annual conference in Yakima, WA during October 2012. The conference was attended by 200 educators.

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.

- In late August 2012, a workgroup including Newton, Sprenger, Messier, Tanner, Mayorga with Cathy Angell from Padilla Bay NERR and Dan Cheney from Pacific Shellfish Institute convened to begin work on updating and improving the NANOOS Shellfish Growers Water Quality web site (www.nanoos-shellfish.org) and incorporate it into the NANOOS Visualization System.
- In late September Mayorga presented at the Pacific Coast Shellfish Growers Association Annual conference in Tulalip, WA. Sprenger and Mayorga also staffed a table during the conference where they were able to get initial impressions on an improved data site for shellfish growers as well as gather some volunteer contact info for future focus groups about the site.
- New NANOOS outreach materials created during this period included the Winter 2012 NANOOS Observer (http://www.nanoos.org/documents/key/NANOOS_Observer_Fall_2012.pdf) and one-page handouts that are tailored for targeted end-user groups.
- NANOOS had a booth at the annual Heceta Head conference held in Florence, OR, on October 27 2012, to showcase data products, visualizations and mobile apps of relevance to coastal residents.

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 NFRA calls. Newton is on and participates in the IOOS Association (former NFRA) Executive Committee teleconferences. 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 participated in the annual NSF Site Review of the project on 29 June and Newton directs the UW Education efforts for this multi-institution project.

Newton and Martin ran three NANOOS annual meetings during this period: the Tri-Committee meeting (June 2012, Beaverton, OR), and Governing Council and all-PI meetings held back to back in Vancouver, WA, 26 and 27 July 2012. They coordinated 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.

Newton and Martin participated extensively in the IOOS Summit throughout the period. Newton was a Co-Chair and Martin was a Chapter Lead. As such, they participated in either/both IOOS Summit Co-Chair, Steering Committee and Chapter Lead teleconferences throughout the reporting period. Along with several colleagues from NANOOS (Richard Spinrad, OSU, Jack Barth, OSU, Joe Schumacker, Quinault Indian Nation, Alan Barton, Whiskey Creek Hatchery, Andy Suhrbier, Pacific Shellfish Institute, Jonathan Allan, DOGAMI) they represented NANOOS at the IOOS Summit on 13-16 November 2012 in Herndon, VA. Newton attended the IOOS Association (ex NFRA) meeting on the preceding day.

During the reporting period they also represented NANOOS at national meetings of significance, e.g., MTS/IEEE Oceans 2012 (Martin, October 15-19, Hampton Roads, VA), at regional workshops, e.g., C-CAN Workshop (Newton, 27-28 July, La Jolla, CA) and Pacific Salmon Marine Survival Workshop (Newton, 5-6 November, Bellingham, WA), to Friends of the San Juans on tsunami debris response (Newton, 1-3 June, Lopez, Orcas, and San Juan Islands), and NANOOS briefings to Korean visitors from KORDI (Newton, 25 July, Seattle) and to Admiral Rich's NW Navy-Tribal Council (Newton, 8 Nov, NASWI). Of particular note:

- Newton hosted an international workshop to develop a Global Ocean Acidification (OA) Network at UW in 26-28 June, as described in the DMAC section above, at the request of the NOAA OA Program office, coordinated through our NANOOS grant. The highly successful workshop was attended by 62 scientists from 23 countries. She was asked to moderate a Panel at the Oceans in a High CO_2 World (24-26 September, Monterey, CA) where regional, national, and global perspectives were presented and discussed, including results from this workshop.
- Martin chaired the Ocean Networks Canada (ONC) International Science Advisory Board (ISAB) meeting 27-28 June in Victoria, B.C. and facilitated discussions on ONC's desire to demonstrate the societal utility of VENUS and NEPTUNE Canada observations along the lines of the U.S. IOOS approach.
- Newton, a member of the Olympic Coast National Marine Sanctuary Advisory Council, attended their meetings and hosted one in Seattle on 13 July, with a separate meeting to discuss OCNMS mooring design and implementation. The meetings brought tribal, state, NOAA and UW scientists together.
- Martin presented a Menneken Lecture addressing IOOS efforts to Undersea Warfare and Operational Oceanography students and faculty and participated in operational oceanography discussions at the Naval Postgraduate School on 12-13 July.
- Newton was invited to moderate the West Coast Panel of the First Stewards Conference at the National Museum of the American Indian, 17-20 July, in Washington, D.C. The Panel was composed of tribal elders focusing on climate change. A video is available at: http://firststewards.org/videos/day-2/.

Newton, a member of the Scientific Advisory Committee of the Joint European Research Infrastructure Network for Coastal Observatories (JERICO), was invited to attend their Trans National Access (TNA) Selection Panel meeting, to evaluate proposals, and General Assembly meetings on 1-4 October in Heraklion, Crete, Greece, to present a talk on the future of ocean observing in the U.S. She also discussed with the various European country observing leads the nature of having similar goals but diverse systems, such as U.S. IOOS has with its regional and national footprint.

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 75% complete and we have encumbered or spent 85% of the funds provided ($4,005,007). 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 subawards 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 subawardee invoices are actually paid and indirect costs are actually charged.

The actual invoiced expenditures at the end of this reporting period are $2,618,616, or 56%. This difference (85% vs. 56%) reflects the inherent lags in the posting of expenditures in our institutional budget tracking systems. In summary, we assess that the spend rate is solid and suitable for maintaining robust execution of NANOOS plans to meet our objectives.

Presentations and Publications acknowledging NANOOS support: underline indicate NANOOS PI

Allan, J. C., Martin, D. L., and Newton, J., 2012. Using social networking, mobile apps to distribute tsunami hazard information, in Sea Technology, v53(4), p. 61-64.

Allan, J.C. and Ozkan-Haller, T., in press. Mapping the Wave Climate in the Nearshore Waters of the Pacific Northwest Coast, Sidelights, Council of American Master Mariners, Inc.

Diaz Mendez, G. M., M. C. Haller, R. Pittman, G. Garcia Medina. Monitoreo de oleaje cerca de la costa utilizando radares de navegacion, Memorias de la Reunion Anual de la Union Geofisica Mexicana, GEOS 32(1), pp 232, Puerto Vallarta, Mexico, October 2012.

Feely, R.A., Klinger, T., Newton, J.A., M. Chadsey. 2012. Scientific Summary of Ocean Acidification in Washington State Marine Waters. NOAA OAR Special Report. https://fortress.wa.gov/ecy/publications/SummaryPages/1201016.html

Garcia, H. and E. Mayorga. 2012. "Issues and Guidelines for Data Integration, Management, QA/QC and Product Development. International Workshop to Develop an Ocean Acidification Observing Network of Ship Surveys, Moorings, Floats and Gliders," Seattle, WA, Jun. 26-28, 2012.

Haines, S., V. Subramanian, E. Mayorga, D. Snowden, R. Ragsdale, C. Rueda and M. Howard. 2012. "IOOS vocabulary and ontology strategy for observed properties." Proc. MTS/IEEE Oceans 2012, Hampton Roads, VA, Oct. 14-19, 2012.

Krembs, C. 2012 "Eyes Over Puget Sound - Mooring Observations and Trends" (Jun – Nov 2012 editions), Washington State Dept. Ecology http://www.ecy.wa.gov/programs/eap/mar_wat/surface.html

Mayorga, E. 2012a. "Position paper on GIS and oceans data." ESRI Oceans Summit, Redlands, CA, Nov. 7-8, 2012.

Mayorga, E. 2012b. "Ocean Acidification Network Data Issues, Challenges, Opportunities." California Current Acidification Network Workshop, La Jolla, CA, Aug. 27–28, 2012.

Mayorga, E., J. Newton and C. Angell, 2012. "NANOOS - Shellfish Growers Partnerships: Real-Time Data Access to Increase Understanding of Ocean Acidification." Annual Pacific Coast Shellfish Growers Association Meeting, Tulalip Reservation, WA, Sep. 24-28, 2012.

McCammon, M. and A. Sprenger, 2012. "Eyes on the Ocean: Resources for Educators from the Integrated Ocean Observing System." National Marine Educators Association Annual Conference, Anchorage, AK, June 23-29 2012.

Mickett, J., M. Alford, J. Newton and A. Devol, 2012. "The NANOOS Northwest Enhanced Moored Observatory: A Novel Three-Tiered Approach to Observations on the Washington Coast" Presentation to the University of Maine, November 2012, Orono, ME, INVITED.

Newton, J., 2012a. "Preparing for the Arrival of Japanese Tsunami Debris on our Shorelines: *A collection of information*" A series of invited weekend talks on 3 islands, Friends of the San Juans, Lopez, Orcas, and San Juan Islands, WA, 1-3 June, 2012.

Newton, J., 2012b. "West Coast IOOS Regional Associations and Ocean Acidification" California Current Acidification Network (C-CAN) Workshop, La Jolla, CA, Aug. 27–28, 2012.

Newton, J., 2012c. "U.S. Ocean Observing." Joint European Research Infrastructure Network for Coastal Observatories (JERICO) General Assembly Meeting, Heraklion, Crete, Greece, 2 October, 2012.

Newton, J., 2012d. "NANOOS: An overview of the Northwest regional ocean observing and how it is creating customized information and tools for Washington, Oregon and Northern California in the areas of maritime operations, ecosystem assessment, fisheries and biodiversity, coastal hazards and climate." Invited presentation by Admiral Mark Rich to the Northwest Navy-Tribal Council, Naval Air Station, Whidbey Island, WA, 8 November, 2012.

Newton, J., D. Martin, E. Mayorga, A. Devol, R. Feely, S. Alin, B. Dewey, B. Eudeline, A. Barton, A. Suhrbier, A. Baptista and J. Needoba. 2012. "NANOOS partnerships for assessing ocean acidification in the Pacific Northwest." Proc. MTS/IEEE Oceans 2012, Hampton Roads, VA, Oct. 14-19, 2012.

NOAA Coastal Services, 2012. Accessing information on tsunami zones in Oregon and Washington to help residents better prepare, in Coastal Services, v15(3), p. 6-7, and 11.

Patterson, J., J. Thomas, L. Rosenfeld, J. Newton, L. Hazard, J. Scianna, R. Kudela, E. Mayorga, C. Cohen, M. Cook, M. Otero and J. Adelaars. 2012. "Addressing ocean and coastal issues at the West Coast scale through regional ocean observing system collaboration." Proc. MTS/IEEE Oceans 2012, Hampton Roads, VA, Oct. 14-19, 2012.

PSEMP Marine Waters Workgroup. 2012. Puget Sound Marine Waters: 2011 overview. S.K. Moore, R. Runcie, K. Stark, J. Newton and K. Dzinbal (Eds). Puget Sound Partnership Report. http://www.psp.wa.gov/downloads/psemp/PSmarinewaters_2011_overview.pdf

Risien, C., M. Levine, and P.M. Kosro, 2012. "The annual cycle of temperature on the Oregon shelf at NH10." 59th Annual Eastern Pacific Ocean Conference (EPOC), Mt. Hood, Oregon. Sept 21, 2012.

Ruggiero, P., 2012. "Interannual nearshore morphodynamics of high energy dissipative beaches: a decade + of observations in the US Pacific Northwest." Delatares/OSU/USGS workshop, June 2012, Delft, the Netherlands, ~20 participants, INVITED.

Stevens, A.W., Gelfenbaum, G., Ruggiero, P., and Kaminsky, G.M, 2012, Southwest Washington littoral drift restoration—Beach and nearshore morphological monitoring: US Geological Survey Open-File Report 2012-1175, 67 p.

Washington State Blue Ribbon Panel on Ocean Acidification. 2012. Ocean Acidification: From Knowledge to Action, Washington State's Strategic Response. H. Adelsman and L. Whitely Binder (eds). Washington Department of Ecology, Olympia, Washington. Publication no. 12-01-015. https://fortress.wa.gov/ecy/publications/SummaryPages/1201015.html

Yu, P., A.L. Kurapov, G.D. Egbert, J.S. Allen, P.M. Kosro, 2012. Variational assimilation of HF radar surface currents in a coastal ocean model off Oregon. Ocean Modeling, v49-50, 86-104, doi: 10.1016/j.ocemod.2012.03.001.

Zarnetske, P.L., S.D. Hacker, E.W. Seabloom, P. Ruggiero, J.R. Killian, T.B. Maddux, and D. Cox. 2012. Biophysical feedback mediates effects of invasive grasses on coastal dune shape. Ecology 93:1439–1450. http://dx.doi.org/10.1890/11-1112.1

Sustaining NANOOS, the Pacific Northwest component of the U.S. IOOS®:
NOAA Award: NA11NOS0120036
December 2012 Progress Report Annual Supplemental
(The information request from IOOS Program office is underlined and in quotes)

- **Products and Services**

"The number and brief description of contributions to new or improved regional products or services, and national products or services:"

NANOOS offers 4 flagship new or improved regional products/services (#1-5, briefly described below) and 1 national product (#6, briefly described below) from this last year's effort. In addition, NANOOS and our partners offer 19 additional data products, listed below these in alphabetical order, all of which are accessible at http://www.nanoos.org/data/products/products.php unless otherwise noted.

1. NANOOS Visualization System: The backbone of the NANOOS RCOOS is the NANOOS Visualization System (NVS) that currently distributes data from a myriad of regional and federal assets, providing easy access to data. NVS gathers data across a wide range of assets such as buoys, shore stations, and coastal land-based stations, as well as model forecasts. Never-before-available downloads and visualizations are provided in a consistent format. You can access plots and data for almost all in-situ assets for the previous 30-day period. This tool provides a framework on which additional applications are based and can subsequently be developed to meet specific user needs. A major, critical upgrade towards a new version (v. 3.0) was initiated in mid 2012 facilitate future development of targeted and well-integrated web-apps, and transition to v3.0 of the Google application programming interface. Major redesign and rebuilding of NVS v3 is now complete and should be publicly released in early 2013 following the transition of all existing web-apps to the new framework. Additional enhancements to NVS v3 will also include the following: 60 day time series plots (completed); the addition of a timeline capability enabling access to longer time series (scheduled for development in 2013), and redesign of the NVS/West Coast Alaska Tsunami Warning box (in progress).
2. Tsunami Evacuation Portal: The current version of the Pacific Northwest Tsunami Zones app was released within NVS 2.6 to considerable public fanfare in March 2012. The Pacific Northwest Tsunami Evacuation Zones web application includes existing information on tsunami evacuation zones for the PNW coast, markers (representing the locations of critical facilities), and added the capability to create user defined places, and store those in their MyNANOOS account. v1.0 of TsunamiEvac-PNW app released for iPhone/Android smartphones was released at the same time, and updated to v1.1 (March 2012).
3. NVS Beaches app: Also within NVS 2.6, recent enhancements to this app included the addition of Washington coast beach and shoreline change data to the NVS beaches web app, representing a technology transfer from Oregon to Washington in the form of standardized product code that would produce plots with a consistent look across both states.
4. Mobile apps: NANOOS offers mobile versions of two popular web data products:

a) NVS (NANOOS Visualization System) Assets App (Apple, Android): The NVS Assets App is a mobile version of the NVS Assets Web App that provides easy access to data while you are on-the-go in the field or on the water. The NVS Assets App displays data from a diversity of providers, including federal, tribal, state, academic, industry and non-profit organizations, who operate a wide variety of observing assets such as buoys, shore stations, sea-bed and coastal land-based stations. This composite view provides a more comprehensive view of ocean conditions.

b) TsunamiEvac-NW App (Apple, Android): The TsunamiEvac-NW App is a mobile version of the NVS Tsunami Evacuation Zones Web App that provides easy access to tsunami hazard areas on the Oregon and Washington coasts. TsunamiEvac-NW provides you an at-a-glance view of where the tsunami hazard

zones are along the Oregon and Washington coast, and allows you to map whether your home, work, school, etc. is located in a tsunami evacuation zone or not. To help you develop and plan your own evacuation routes, TsunamiEvac-NW enables you to save your current position or points of interest via GPS or address look-up.

5. CMOP Data Explorer with NANOOS data: This application enables users to generate and combine different kinds of plots using multiple sites and variables (e.g. winds, waves, temperature) measured from the past 60 days. It is a collaborative effort between CMOP and NANOOS, adapting the CMOP Data Explorer tool to Pacific NW data distributed via the NANOOS Visualization System (NVS). This NANOOS application complements NVS by providing greatly enhanced functionality for displaying data from NVS in-situ assets. Using data extracted directly and dynamically from NVS, users will be able to interactively pick the assets, variables and time range of interest, create multi-panel plots, show more than one asset on the same plot, create property-property plots, etc. This functionality is being deployed by leveraging existing capabilities: the CMOP Data Explorer application developed by CMOP to serve its assets, and the NVS "light-weight JSON data services" already in place and used by the NVS smart phone apps. This sophisticated plotting capability will be of interest to technical users, including academic scientists, grad students, and scientific staff at agencies. It will also be useful for college and high-school marine science classes.

6. The U.S. IOOS Program Office, NANOOS and SECOORA collaborated with the European Environment Agency (EEA) and ESRI to develop a pilot presentation of IOOS data subsets on the EyeOnEarth online platform developed by EEA (http://www.eyeonearth.org). Released in Nov. 2012, this pilot application provides an international audience enhanced access to U.S. data and information on marine and coastal environmental conditions. The IOOS Program Office led the overall project and provided support for NANOOS and SECOORA to lead the technical design and implementation components.

7. BIS - Puget Sound Boater Info: The Boater Information System (BIS) delivers the data Puget Sound boaters asked for: wind speed and direction (no longer available), water temperature (no longer available), currents, and tides. Boaters can display multiple weather and oceanographic products concurrently to study the interactions among the data. Funded primarily by Washington Sea Grant Program, APL-UW employed the disciplines of Cognitive Engineering and Human Computer Interaction to give boaters this decision making tool.

8. CMOP - Center for Coastal Margin Observation & Prediction: The data center is a resource for you to access information about the Columbia River estuary, near plume, and coastal margins of Oregon and Washington. This includes access links to physical and biogeochemical data (near real-time) from SATURN endurance stations in the Columbia River estuary, glider data, forecast Surface Ocean Conditions for the Pacific Northwest and the Columbia River estuary, and climatological maps of the Columbia River estuary.

9. Coastal & Marine Spatial Planning Information NANOOS Web Theme Page: Coastal & Marine Spatial Planning (CMSP) provides a public policy process for society to better determine how these areas are sustainably used and protected - now and for future generations. Successful management of the marine environment needs to be based on the best available science and will require continual information gathering to establish baselines, monitor ecosystems, and evaluate the efficacy of marine spatial plans.

10. Columbia River Climatological Atlas: The Climatological Atlas is a scientific project designed to offer insights into multiple scales of variability of the contemporary Columbia River coastal margin, via statistics of an extensive set of indicators. The focus of the Atlas is on indicators for the estuary and plume, but indicators of external forcing are also included for context.

11. Data Explorer for River and Ocean Data: The Data Explorer is a tool that allows users to visualize and explore river and ocean data. It allows easy access to CMOP's cruise, glider, and endurance station data and the ability to plot and compare data from different platforms in a user-friendly way.

12. Forecast Information and Data Products for Tuna Fishers: Information and data products oriented towards commercial and recreational albacore tuna fishing communities.

13. Lack of Oxygen?: Hypoxia in Pacific Northwest Marine Waters NANOOS Web Theme Page: Since 2000, fish and crab kills in the Puget Sound and the Oregon coast shelf have become more common and frequent occurrences.

14. Nowcast/Forecast Coastal Currents and Water Temperatures: The experimental nowcast and forecast fields are produced by a computer model of the Oregon coastal ocean circulation. These forecasts are updated daily.

15. Ocean Acidification is on the Rise NANOOS Web Theme Page: NOAA is studying the growing problem of increased carbon dioxide (CO2) in the ocean by collecting real-time data through a variety of efforts to determine what's happening to seawater chemistry due to ocean acidification and its impact on organisms that live in the ocean as well as the possible social and economic effects.

16. Ocean Currents Mapping Lab: Daily average ocean surface currents off the Oregon coast. These surface currents are measured with a radio transmitter and receiver using an instrument, the SeaSonde, made by CODAR Ocean Sensors.

17. Oregon Beach and Shoreline Mapping: The development of a comprehensive beach and shoreline change observing network along the Oregon coast provides scientists, coastal managers, the geotechnical community, and the public at large with the necessary information to understand the impacts of storms on the coast, and the potential future impacts associated with climate change. This program monitors coastal erosion.

18. Oxygen Watch for the Columbia River and WA Shelf: Oxygen Watch monitors oxygen levels on the WA shelf and the Columbia River estuary. Each watch includes (a) automated near real-time (when instrumentation is deployed) and archival graphical representations of prevailing conditions and (b) event-driven annotations on an 'oxygen blog'.

19. ProbCast - Probability Weather Forecasting: ProbCast brings probabilistic weather forecasting information of winds, water temperature, and precipitation from the University of Washington's Atmospheric Sciences Department to the public. You'll find useful visualizations with a minimum of the complexity of the underlying science. By probabilistic information we mean the probability of an expected weather event. ProbCast was funded by NSF.

20/21. Puget Sound Networked Profiling Buoys and Puget Sound ORCA buoys: We feature here data from the first Networked Profiling Buoy (NPB) built from this project. The buoy is located at Point Wells, south of Edmonds, in the Main Basin of Puget Sound. The sensor package measures a depth profile of oceanographic variables every hour from the sea surface to the sea bed. Oceanic Remote Chemical Analyzer (ORCA) measures the physical parameters of water temperature and salinity to obtain density, and measures the biological parameters of dissolved oxygen, phytoplankton chlorophyll fluorescence, and nutrient concentrations at five other locations.

22. Puget Sound Regional Synthesis Model (PRISM) Cruise Data: Processed PRISM cruise data from 1998 to 2011 at numerous Puget Sound locations. Data types include fluorescence, salinity, density, water temperature, transmissivity, and oxygen.

23. Southwest Washington Coastal Mapping: Southwest Washington coastal mapping was initiated to examine the coastal evolution, processes, geology, and hazards of the Columbia River littoral cell (CRLC). The study area extends approximately 160 km along the United States' Pacific Northwest coast between Tillamook Head, Oregon and Point Grenville, Washington. This program monitors coastal erosion.

24. Water Quality Data for Shellfish Growers: Real-time Water Quality Data for Shellfish Growers. This is a pilot project between NANOOS and the National Estuarine Research Reserve System, displaying water quality data in a format designed by shellfish growers.

- **Data Management**

"The Progress towards a standards-based foundation for DMAC capabilities:
-Demonstrated progress towards: open data sharing; provision of data to WMO GTS; implementation of a service-oriented architecture; use of common vocabularies and identifiers; improved use of metadata conventions; and data storage and archiving.
-On-going program-level participation in: data management planning and coordination; and IOOS maturity levels and certification standards."

NANOOS has made great progress towards a standards-based foundation for its DMAC capabilities, and has played a leading role in the development of national capabilities, in collaboration with the US IOOS Program Office, IOOS RA's and other cross-regional programs.

Through NVS and the data services built on it, NANOOS has openly made available to IOOS and all users a large range of local data and modeling resources that include both assets supported by IOOS and ones maintained independently by local partners, many of which have become available nationally via open and standards-based services only through collaboration with NANOOS; a prominent example of the latter is the network of industry and non-profit monitoring sensors supporting the shellfish aquaculture industry. Many NANOOS assets have been made available to NDBC, which in turn provides them to WMO GTS; these include select assets from UW, OHSU/CMOP, OSU and other NANOOS partners.

NANOOS has deployed a multi-faceted Service-Oriented Architecture. Information about updates to assets integrated by NANOOS into NVS (new deployments, enhancements, and failures) is part of this system and is available on NVS (e.g., http://www.nanoos.org/nvs/nvs.php?path=NVS-Assets&infoWindow=action::auto_open||asset_class::siso||tab::details||asset_id::OSU_NH10) and as services. NANOOS standardized web services are registered with IOOS and accessible on the IOOS Catalog. Data from all U.S.-based, in-situ, fixed-location NVS-integrated assets (buoys, pier sensors, etc) are available via an SOS service in the IOOS CSV data format, using the CF controlled vocabulary for observed properties, with corresponding SensorML metadata (http://code.google.com/p/ioostech/wiki/NANOOSNVSPythonSOS). To avoid duplication at IOOS, this service currently excludes assets otherwise available via non-NANOOS services such as NDBC. The provision of assets with SensorML responses was recently (Nov. 2012) expanded to OHSU/CMOP assets, and the SensorML response will be enhanced in early 2013 to incorporate all IOOS-approved controlled vocabularies and asset-identifier schemes.

NVS in-situ observation data and metadata are also available via custom, light-weight JSON web services that are parallel to the SOS service and support data re-use by other NANOOS and non-NANOOS regional applications.

Expanded observation and model data are available via THREDDS/OPeNDAP for select assets from OHSU/CMOP (http://data.stccmop.org:8080/thredds/catalog.html) and OSU (http://ona.coas.oregonstate.edu:8080/thredds/catalog/ and http://agate.coas.oregonstate.edu:8080/thredds). Select NANOOS asset and geospatial data are also available via OGC WMS, OGC WFS and other web services provided by the GeoServer software; an expansion and enhancement of the GeoServer environment is currently under way and will be released in early 2013.

NANOOS has played a leading role in the development of IOOS DMAC policies, standards and web services. NANOOS participates in all annual IOOS RA DMAC meetings, and actively helped organize and steer discussions at the Feb. 2012 IOOS SOS Reference Implementation workshop in Baltimore, MD.

NANOOS Co-Chair Stephen Uczekaj is a member of the IOOS DMAC Steering Committee. NANOOS DMAC Co-Chair Emilio Mayorga has been a leading member of the IOOS SOS Reference Implementation working group, and is one of the administrators and most active contributors to the IOOS DMAC *ioostech* Google Code wiki (http://code.google.com/p/ioostech/), the associated SOS XML template repository, *ioostech_dev* Google group, and IOOS vocabularies hosted at the Marine Metadata Interoperability Project (http://mmisw.org/ont/ioos). NANOOS has also strongly contributed to activities on ocean acidification data management (cross-regionally, nationally and internationally), discussions on IOOS certification, climatology common product development, irregular-grid modeling and data issues, biological data activities, and West Coast coastal and marine geospatial data partnerships, and IOOS international data integration activities.

- **Observing Assets**

"A list of 'platforms of opportunity' that are being used to support monitoring of ocean acidification:"

NANOOS led an effort requested by the California Current Acidification Network (C-CAN) to provide an Ocean Acidification inventory of observing assets from the three contiguous West Coast RA's (NANOOS, CeNCOOS, and SCCOOS). An interactive map format of this inventory can be found here: http://habu.apl.washington.edu/mayorga/nvs/WCIOOSRAs_CCANinventory.html. The C-CAN OA inventory spreadsheet is not available from that site, but it and a text file describing the inventory are available upon request. The inventory is also described and referenced on the C-CAN web site: http://c-can.msi.ucsb.edu/resources/links-to-california-current-environmental-data/c-can-asset-inventory.

"Current inventory of all regional observing assets:"

An inventory of NANOOS Observing System Assets, both those funded by NANOOS and those funded by other parties but served through our system, is part of our NANOOS Visualization System (NVS) live feed as the "NVS Asset List." It is accessed live at: http://www.nanoos.org/nvs/nvs.php?section=NVS-Assets. Simply go to the URL and then click on the "List" button on the top bar, at the center. This list is pulled directly from NVS database. It currently shows a subset of all the metadata information found on the NVS database. Note the sorting and filtering functionality, and the "History" column on the right, which displays the asset status history.

NANOOS has other means of generating asset inventories. Emilio Mayorga, NANOOS DMAC Co-chair participated in the IOOS "Non-federal asset inventory" tiger team in mid 2011, led by Sam Walker. At the time, Mayorga put together a comprehensive document ("NANOOS Asset Inventorying Efforts_2011April.doc") about NANOOS asset inventory resources, efforts, and "policies". A few details are out of date, but for the most part it is still very relevant and applicable. It is available upon request. Asset inventory information is also accessible through the NANOOS/NVS SOS service, deployed in Nov. 2011 and documented at http://code.google.com/p/ioostech/wiki/NANOOSNVSPythonSOS. Its GetCapabilities and DescribeSensor responses include much of the asset inventory and latest-status information available on NVS. This service is limited to *in-situ* assets at fixed locations having functioning near-real-time data streams within the previous several months.