Progress Report for the Enhancement of the:
Northwest Association of Networked Ocean Observing Systems (NANOOS)
Regional Coastal Ocean Observing System (RCOOS)

1) Award Information: Provided as a separate Cover Sheet. Period:

2) Project Summary

NANOOS is engaged, through NOAA funding, in an active, and proactive, process to develop, implement, and integrate various in-water and land-based systems that will constitute a fully robust and user-driven Regional Coastal Ocean Observing System (RCOOS) for the Pacific Northwest (PNW). This includes all necessary sub-systems to provide PNW, west coast, and national stakeholders with the ocean data, tools, and knowledge they need to make responsive and responsible decisions appropriate to their individual and collective societal roles. Our ongoing knowledge of prioritized issues and user needs is gained through proactive NANOOS interactions with a wide range of PNW stakeholders.

To attain the goals of this project, we are:

- **Maintaining existing surface current mapping capabilities and evaluating the use of additional HF radar sites in the PNW.** This tool is a fundamental foundation block for building an observing system for the coastal ocean and serves a multitude of disparate users – regrettably, reductions in anticipated NANOOS funding have to this point prohibited additional HF sensors.
- **Maintaining and (should additional funds be available) expanding observation capabilities in PNW estuaries.** The NANOOS objective in this arena is a federated real-time observation network across Oregon and Washington estuaries to address PNW societal needs.
- **Strategically maintaining coverage and range of observations in the PNW shelf, in coordination with emerging national programs.** We have targeted the use of fixed (buoys) and mobile (glider) assets to provide advanced information on hypoxia/anoxia and HABs, which are major regional concerns affecting ecosystem and human health, fisheries, and coastal economies – funding limitations have greatly limited our success in this effort.
- **Maintaining and <u>slightly</u> expanding core elements of existing beach and shoreline observing programs in Oregon and Washington.** This will improve coastal hazard mitigation by providing better decision support tools for coastal managers, planners, engineers, and coastal hazard mitigation decision makers.
- **Evaluating the creation of a federated system of numerical daily forecasts of PNW ocean circulation.** Our intent was to extend operational models from the head of tide of estuaries to the outer edges of the exclusive economic zone (EEZ). This NANOOS vision remains credible but reductions in anticipated funding have substantively reduced our options – details below.
- **Commenced development of state of the art cross-shore profile change models and probabilistic shoreline change models.** Such models will be used by coastal managers to assist with predicting future coastline positions.
- **Bolster ongoing Data Management and Communications (DMAC) activities to support routine operational distribution of data and information.** The NANOOS DMAC design mandates a collaborative, dynamic distributed system of systems that provides a wide range of products, tools, and services to regional user communities while allowing unfettered access to the IOOS national backbone and national information infrastructure.
- **Building from and strengthening ongoing NANOOS education and outreach efforts.** We are conducting these in coordination with other regional efforts (e.g., NSF-funded STC and COSEE projects), to foster ocean literacy and facilitate use of NANOOS products in the PNW by stakeholders, decision makers, and the general public.

The above summation points delineate a specific NANOOS focus on high-priority PNW user-driven applications of:**: a) maritime operations; b) ecosystem impacts including hypoxia and harmful algal blooms; c) fisheries; and, d) mitigation of coastal hazards** as as these issues represent applications

having the greatest impact on PNW citizenry and ecosystems and, we believe, are amenable to being substantively improved with the development of a PNW RCOOS.

3) Progress and Accomplishments

NANOOS reports in this section in the fashion it adopted in the original proposal; specifically, we divide our progress report into sections of : a) our efforts in observing systems (further divided because of our coastal environment into shelf, estuaries, shorelines, and currents); b) modeling (again divided further into estuaries, shelves and a (now unfunded) integrative synthesis section; c) Data management and Communications (DMAC); and finally, d) Education and Outreach. We list specific accomplishments in bullet form in each of these areas below and follow in Appendix 1 with a tabular representation of progress to toward our milestones at this point:

a) Observing System efforts

- **Shelf**

1. Washington:

Efforts have focused on designing and purchasing equipment/instrumentation associated with the planned Washington Coast Real-time Mooring Network. Mechanical and electronics design are now nearly complete, and most instrumentation (meteorological, watercolumn and buoy hardware) has been purchased. The Olympic Coast National Marine Sanctuary has also loaned the project an additional 300-KHz ADCP. This summer, the system will be assembled and deployed for trials in Puget Sound. Deployment at the planned location roughly 20 km west of La Push, Washington will occur spring 2010. As of December 2008 work on this project and the purchase of additional equipment has been suspended due to budget limitations and will resume when Y3 funding becomes available.

2. Oregon:

Glider operations off the Oregon coast, led by J. Barth and K. Shearman (OSU) are scheduled to begin this spring along the Newport Hydrographic Line, with partial support by NANOOS. These measurements will provide multiple cross-sections of water properties, including temperature, salinity and dissolved oxygen, with depth and longitude.

- **Estuaries**

1. Puget Sound:

Puget Sound ORCA Buoy program:

Through the efforts of Devol (UW Oceanography) and Newton (UW-APL), during the report period the ORCA (Oceanic Remote Chemical Analyzer) group had four buoys in operation in Hood Canal, Puget Sound (see http://orca.ocean.washington.edu for buoy locations). Each buoy measured vertical profiles of temperature, salinity, dissolved oxygen, chlorophyll fluorescence, and meteorological data. Additionally, some buoys also measured currents, nitrate, PAR (photosynthetically active radiation) and turbidity. The Twanoh and Hoodsport buoys operated continuously throughout the period; the Duckabush and North buoys both had intermittent down time due to various winch problems. The Duckabush mooring is back up and profiling; we are working to resolve the North Buoy winch problems and get it up and profiling again as well. Sampling frequencies were decreased through-out the fall as available solar power decreased; the winter sampling frequency was 1 profile per day. All buoy data was made available in near real time on the NANOOS website. These observations are leveraged against the Hood Canal Dissolved Oxygen Program (HCDOP) and NSF.

Data indicate that 2008 was an anomalous year; average bottom water temperatures were lower than previous years by as much as 0.5 degrees, and a later than normal fall flushing brought an intrusion of oceanic water that was colder than previous years by approximately 0.5 degrees C. The bottom water temperature slowly increased through-out the fall, and by December, the bottom water at the southern end of Hood Canal was within 0.2 degrees C of the previous year. Bottom water temperatures in 2009

have started out colder than normal, and oxygen concentrations are relatively average compared with the previous 3 years. We again saw a February bloom at all three southern moorings, with chlorophyll concentrations higher than 2008.

We conducted a series of experiments to quantify variability length scales and time scales in Hood Canal. This involved spatial surveys around several of the buoys to get a synoptic view of the spatial scales of variability, as well as high frequency sampling at a given depth. Analysis of the data for all buoys show high frequency variability for nearly all variables measured on a two to three hour time scale. Two experiments were conducted in 2008 to look at even higher frequency variability—on the order of minutes—in the variables temperature, salinity and dissolved oxygen, and this was observed. The surveys around the buoys showed characteristic length scales for many variables on the order of 100 to several hundred meters. It is likely that tidal advection of this spatial heterogeneity is what gives rise to much of the high frequency variability observed at any particular buoy. This indicates that to get a realistic estimate of the spatial mean at any given point we need high frequency profiles (on the order of hours) to average out spatial variability.

Newton, with Devol and 5 other HCDOP scientists, presented results before the Hood Canal Coordinating Council, composed of the County Commissioners and the Tribal Chairs of the three local counties and two tribes. The presentation and Q&A session was at the Port Gamble S'Klallam Tribe Long House on 18 March, 2009.

Over the next 6 months we plan work that includes maintaining the 4 ORCA moorings and data streams, and ramping up to 12 profiles a day at all moorings for the summer. We plan to conduct more spatial surveys to further characterize spatial variability in southern Hood Canal. We are also collaborating with NOAA to add a pCO2 sensor to the Twanoh mooring, and possibility a pH meter as well.

Presentations:

Devol, A.H., J. Newton, M. Kawase. (2008) Understanding fish kill dynamics in Hood Canal. 55th annual Eastern Pacific Ocean Conference, September 23-26, Stanford Sierra Camp, California.

Devol, A., W. Ruef, J. Newton, J. Richey. (2008) Anthropogenic Contributions to Hypoxia in Lower Hood Canal, Washington State. AGU Fall Meeting, December 15-19, San Francisco, California.

Newton, J., Devol, A., W. Ruef. (2008) Insights into Hood Canal hypoxia from NANOOS real-time data. 55th annual Eastern Pacific Ocean Conference, September 23-26, Stanford Sierra Camp, California.

Newton, J., A. Devol, M. Kawase, M. Alford, M. Warner, J. Mickett, W. Ruef, C. Bassin. Fish Kill Dynamics in Hood Canal (Washington State, USA) as revealed by real-time data and integrated modeling. AGU Fall Meeting, December 15-19, San Francisco, California.

Newton, J., A. Devol, J. Richey, M. Kawase, B. Simmonds, S. Parker-Stetter. Hood Canal Dissolved Oxygen Program's Integrated Assessment and Modeling Study: What we did, what we learned, and why it matters. 2009 Puget Sound Georgia Basin Ecosystem Conference, February 8-11, Seattle, Washington.

Newton, J., J. Richey, M. Kawase, A. Devol. Watershed and marine modeling used to assess hypoxia for the Hood Canal Dissolved Oxygen Program's Integrated Assessment and Modeling Study. 2009 Puget Sound Georgia Basin Ecosystem Conference, February 8-11, Seattle, Washington.

Ruef, W., J. Mickett, A. Devol, J. Newton, M. Alford. (2008) Factors Affecting Inter-Annual Variability of Hypoxia in Hood Canal. AGU Fall Meeting, December 15-19, San Francisco, California.

Ruef, W., C. Bassin, A. Devol, J. Newton. (2009) Spatial Variability in Hood Canal. 2009 Puget Sound Georgia Basin Ecosystem Conference, February 8-11, Seattle, Washington.

2. Washington State estuarine monitoring:

- *Progress to date* – In light of the Washington statewide spending and hiring freezes and gradual staff reduction, Washington State's Department of Ecology (Ecology) continues to demonstrate our commitment and interest in contributing to regional estuarine observations by maintaining monthly-calibrated moorings in Willapa Bay and South and Central Puget Sound. This work is led by Carol Maloy and Christopher Krembs (WA Ecology). The moorings continue to deliver indispensable information on environmental conditions, as evidenced by ongoing data requests from government, academic, tribal, and private entities for projects ranging from shellfish growing to fish migrations to hydrodynamic models.

- In Puget Sound, Ecology operates two near shore, fixed mooring stations located in Manchester/Clam Bay and Squaxin Passage. The moorings are maintained with assistance from volunteers from Ecology's Manchester Lab and NOAA. Each station records data from the near-surface (water temperature, salinity, chlorophyll fluorescence, and turbidity) and near-bottom (water temperature, salinity, pressure, and dissolved oxygen). The dual approach allows us to draw inferences from water column stratification, which is of particular interest to our collaborator Vera Trainer and the Marine Biotoxins Group at NOAA for investigating the development of harmful algal blooms. The near-bottom devices are configured for telemetry, and data are available in real-time on the web at http://www.ccalmr.ogi.edu/nanoos/.

- Historically, Ecology maintained three exploratory near-bottom CTDs in Central Puget Sound. The Budd Inlet mooring at the Port of Olympia was removed in September 2008 to help compensate for a severe staff shortage. We have suspended plans to redeploy the Budd Inlet mooring until the budget for the next biennium is finalized and/or the statewide hiring freeze is lifted. The low environmental dynamic over the last three years in the harbor and its position at a strategic inferior site (little water exchange) guided us in our decision making.

- On the Washington coast, Ecology has been operating four mooring stations to measure near-surface water temperature, salinity, and chlorophyll fluorescence in Willapa Bay since 1997. We have recently scaled back our monitoring efforts to focus and expand on the station at Bay Center (see section 4 A) due to its strategic significance. In August 2008, the installation of real-time data delivery capability was completed at the Bay Center mooring using a Bluetooth transmitter linked to a broad spectrum radio. Unfortunately OHSU stopped receiving the real-time data approximately two weeks after installation, most likely because of antenna malfunction exacerbated by frequent adverse weather conditions in Willapa Bay. The previous mooring coordinator left the agency in August 2008; in her absence, Ecology lacks the staff resources and expertise needed to restore Bluetooth telemetry.

- *Expected activity for next 6-month period* - We are committed to continuing measuring all variables at our three remaining moorings in WA estuaries through innovative approaches. We will continue to maintain and service the Manchester and Squaxin Passage sites by working with volunteers from Ecology's Manchester Lab and the Marine Biotoxins Group at NOAA. At the same time we are actively working towards a new mooring location (Boeing peer/Port of Everett) to capture the lateral exchange of dissolved oxygen (DO) between the main basin and Whidbey Basin through a joint collaboration between the Port of Everett, Everett Community College and Ecology.

- Due to the harsh environment and scour on the mooring and observed failure of the blue tooth link in Willapa Bay, we are currently exploring and testing alternatives to providing more reliable means to deliver real-time data to the internet. It is our goal to increase data coverage and volume in Willapa Bay by using Sea-Bird and Hydrolab sensor packages deployed in parallel. This approach capitalizes

on performance strengths of both sensor and reporting systems (Sea-Bird's high precision and accuracy and Hydrolab's reliable telemetry) and provides additional sensor redundancy for independent sensor evaluation and failure. Ecology is currently conducting a test and evaluation period of Hydrolab's sensor performance on the pier of Manchester Labs. Since March 2009, the sensor package has been recording and transmitting temperature, salinity, pressure, chlorophyll fluorescence, turbidity, and dissolved oxygen data side by side with the existing Sea-Bird 16+ CTD mooring. We plan to complete the side by side analysis of Hydrolab and Sea-Bird sensor systems in May 2009. If the instrument performs adequately, we will proceed to deploy complimentary Sea-Bird and Hydrolab sensor packages in Willapa Bay. The approach of a dual senor package combines the needs of real time information relevant to e.g. oyster growers and high quality data and reliable coverage by researchers and agencies.

- Recently, several shellfish growers and researchers have expressed interest in DO measurements in Willapa Bay. We will address these needs at the Bay Center mooring by installing a fixed near bottom DO sensor.

3. Columbia River and plume:

- Coordination of the OHSU participation in NANOOS has been conducted by Antonio Baptista, who serves in the NANOOS Executive Committee, and provides scientific guidance to the OHSU modeling, field and DMAC teams.
- A 3-person field team, based in Astoria and led by Michael Wilkin, provides the primary OHSU contribution to the collection of NANOOS observations. Charles Seaton, a staff based in Portland, conducts monthly quality control of the data. All staff is supported through a combination of the NSF core CMOP grant, NANOOS and regional stakeholders. Data collection is focused on the Columbia River estuary (most stations) and near-plume (two stations).
- During the reporting period, the field team continued the maintenance of a NANOOS- and stakeholder-supported network of physical stations, historically denoted CORIE. CORIE is now a sub-system within the SATURN inter-disciplinary observation network for the Columbia River estuary and plume.
    1. CORIE stations include: Jetty A, Desdemona Sands, Fort Stevens Wharf, Hammond Basin Tansy Point, Astoria-Meglar Bridge pier 169, City of Astoria waste water outfall, Grays Point, Mott Basin, Cathlamet Bay North Channel, Eliot Point, Woody Island range light, Tenasillahe Island dock, Ocean buoy 'ogi01', Ocean buoy 'ogi02'.
    2. Variables: Most stations measure salinity and temperature at a single level. Selected stations measure water levels (in most cases through pressure sensors). Selected stations measure velocity profiles.
    3. Data management: Data is stored at a CMOP central database in near real-time, graphically displayed on the web in near real-time, and made available monthly via the web after quality control. Web site: http://www.stccmop.org/datamart/observation_network.
    4. Data quality control: Data quality control is conducted monthly (see protocol at http://www.ccalmr.ogi.edu/CORIE/data/publicarch/methods_meanings.html)
    5. Noteworthy: Several of the CORIE stations date back to the mid-late 1990's, offering a unique temporal context for the variability of the Columbia River estuary-plume system.
    6. Maintenance: The set-up of CORIE/NANOOS stations is being progressively modified, to reduce dependency on diving operations. This has emerged as a priority, as diving operations are limiting in the complex environment of the Columbia River estuary. During the reporting period, Tansy Pt. was modified for maintenance from the surface, via a winch system.
    7. Usage: Data is used by a range of regional stakeholders, several of which (e,g., NOAA Fisheries Science Center, Corps of Engineers, City of Astoria, Bonneville Power Administration) fund elements of the network. Data is also used to provide skill assessment for the CORIE/SATURN

modeling system, and for scientific analyses of Columbia River processes. Data is being used in conjunction with data assimilation strategies to explore optimal configurations of the network.

- During the reporting period, the field team maintained and expanded the sensor packages at two experimental inter-disciplinary stations of the NSF-supported SATURN network, which data is contributed to NANOOS. The growing suite of sensors requires specialized scientific supervision, which is provided by several CMOP investigators and students (currently: Joseph Needoba, Tawnya Peterson, Nirzwan Bandolin).
  1. Stations: Pt Adams Packing pier (SATURN-03), Astoria-Meglar Bridge pier 11 (SATURN-01). Additional inter-disciplinary stations (SATURN-02/04) are in preparation, for deployment at the near plume (replacing OGI02) and in a lateral bay (replacing Mott Basin).
  2. SATURN01: Located at Astoria Meglar Bridge pier 11, this station is designed to actively profile the water column with an inter-disciplinary suite of instruments. Variables include: salinity, temperature, fluorescence, turbidity, nitrate, and, added during the reporting period, CDOM. Several new sensors expected during next reporting period.
  3. SATURN03, located at Pt Adams Packing Pier. This station too has a multi-disciplinary instrumentation package. Leveraging a covered shack and the availability of utility power, we set up a pumping port that brings water to a suite of instruments on top of the pier. The final design calls for multiple sampling ports, at different depths. Variables are the same as for SATURN-01, plus sediment concentrations from a LISST-100.
- Though NSF core funding to CMOP, the field team maintains a SWAP2 telemetry network in the Columbia River (with equivalent capabilities maintained in Yaquina Bay by OSU)., This network supports internet availability to UNOLS and other vessels visiting Newport and Astoria, provides telemetry for the fixed stations in the Columbia River and telemetry links for CODAR coastal radar in Newport.

4. Oregon South Slough:

These efforts were led and coordinated by Steve Rumrill (Oregon Dept of Lands) who also leads the South Slough National Estuarine Research Reserve (NERR). Staff members from the South Slough NERR, Alicia Helms and Adam DeMarzo, attended a technical training workshop hosted by the NERRS Centralized Data Management Office (University of South Carolina, Baruch Marine Laboratory, Myrtle Beach (SC) 9-12 Feb 2009). The workshop provided instruction on working with software and hardware upgrades to the YSI-6600 water-quality dataloggers and their electronic probes, and on troubleshooting problems with operation of the Sutron SatLink2 data telemetry systems that are used to relay digital datastreams via the Geostationary Operational Environmental Satellite system. Posting of the datasets generated by the South Slough NERR to various websites has been periodically interrupted due to a weak satellite signal strength, and many technical adjustments have been made throughout the winter and spring to increase reliability of the transmissions of the near real-time datasets.

The South Slough NERR continued ongoing operations for the following moored observing stations as part of the NERR/SWMP/NANOOS network: (1) Oregon Institute of Marine Biology – Boat House, (2) Charleston Pier, (3) Valino Island, (4) Winchester Arm, and (5) Sengstacken Arm. These moored monitoring stations have been established along the estuarine gradient of the South Slough estuary where they provide characterizations of the marine (euhaline), marine-dominated (polyhaline), mixing (mesohaline), and riverine (oligohaline) hydrographic regions of the estuary. The time-series measurements generated by three of the monitoring stations are available in near real-time from several websites including NANOOS (http://www.nanoos-shellfish.org/ and http://www.ccalmr.ogi.edu/nanoos/), NOAA / Hydro-Meteorological Automated Data System (www.weather.gov/oh/hads), the NOAA/NERRS (http://www.nerrs.noaa.gov/monitoring/water.html) and via the website operated by the NERRS Centralized Data Management Office (http://cdmo.baruch.sc.edu/QueryPages/Stationmap.cfm Site ID=SOS). Each of these monitoring stations is equipped with a YSI-6600 multi-parameter datalogger with the array of electronic sensors

located 50 cm above the bottom of the estuarine tidal channel. Each of the monitoring stations was in continuous operation throughout the period of 10/01/2008 to 03/31/2009, and the dataloggers were retrieved, downloaded, recalibrated, reprogrammed, and redeployed on a monthly basis during the fall, winter, and spring seasons. Each datalogger records measurements of the following parameters every 15 minutes: water level, temperature, conductivity, salinity, pH, dissolved oxygen, turbidity, and fluorescence.

Staff members from the South Slough NERR continued to interact directly with the commercial oyster growers in Coos Bay to provide technical assistance with access to water-quality data, and to further promote utility of the NANOOS Data Product (Real-Time Water Quality Data for Shellfish Growers in the Pacific Northwest). In addition, the NERRS Centralized Data Management Office has assisted with identification of the programming changes required to allow near real-time measurements of fluorescence to be displayed on the NANNOS website. Along with measurements of water temperature and salinity, the time-series measurements of fluorescence are of primary interest to the local oyster shellfish growers because they provide an indicator of the concentration of phytoplankton available in the estuarine water column as food for the filter-feeding oysters.

- **Shorelines**

1. Washington:

The Washington State Department of Ecology's Coastal Monitoring & Analysis Program (CMAP), whose coordination with NANOOS is led by George Kaminsky, continued to maintain a beach and shoreline monitoring effort in the Columbia River littoral cell (CRLC) at a reduced scale during Year 2. This effort also supported the Coastal Profiling System (i.e., nearshore bathymetry survey platform) in collaboration with Oregon State University. The monitoring program performs beach profile surveys on a quarterly basis and performs beach surface mapping on a semiannual basis. These field campaigns serve the ongoing monitoring project that is now in its 11th year of operation.

- CMAP collected geospatial data on transects at 46 locations in the CRLC twice during this semiannual period. In addition, 7 surface maps were collected (2 in fall, and 5 in winter) each containing an average of 10,000 data points over a distance of 3 to 4 kilometers alongshore. These data have been processed from raw format into deliverable text files and have passed a rigorous quality assurance process that continues to be refined over time. The text files are organized and cataloged into onsite network drives with accompanying FGDC metadata.

Monitoring data informs management decisions that regulate development (Grays Harbor County)

CMAP analyzed shoreline data to document a growth of an incipient beach plain near Moclips. The Grays Harbor County planning department requires new development to have appropriate setbacks from the defined land boundary. CMAP created a time series of historical shoreline positions from 1950 to present and quantified the movement of the shoreline for this period. While mobilized in the field, the CMAP survey team collected data on the current position of the land boundary. A GPS survey provided data for an elevation model of the beach immediately in front of a site proposed for development. These data were compared to adjacent profiles to show similar characteristics and infer the geomorphic history at the development site. Specifically, CMAP validated observations of a seaward migration of the beach plain. This informed the County that larger beach-plain setbacks, rather than the smaller bluff-environment setbacks, applied to the development site.

Monitoring data documents severe erosion (Pacific County)

Quarterly monitoring of the coastline between the Grays Harbor and Willapa Bay entrances allowed CMAP to document severe erosion events.

- A recent event permanently closed a public beach-access road near North Cove and future erosion may threaten a State Parks facility.

- In the last 100 years, more than 100 homes and a mile of beach have been lost to the south of Warrenton Cannery Road.
- Erosion is now causing a reorientation of the coastline to the southwest. The eroded sand is migrating north toward Westport, where condominiums and more homes are at risk.

CMAP would like to add more profile locations in this area to resolve alongshore variability and answer the questions:

- Will the sand move north fast enough to prevent loss of development around Westport?
- How is the northward rate of the sand mass changing?

Accurate answers to these questions are integral to the County and landowners making informed management decisions in the future.

Monitoring data documents benefits of sand fence stabilization of beach berm (US Army Corps)

After the U.S. Army Corps placed 125,000 cubic yards of dredged material to create a sand berm on an eroded and washed-out dune area adjacent to the Columbia River North Jetty in August, 2008, CMAP installed sand fences on the sand berm in September 2008. Since then, CMAP's quarterly beach monitoring program has documented a net sand-volume increase on the beach berm due to the sand fences. The fences are trapping sand that would otherwise be blown into the Columbia River navigation channel. The accumulation of sand in the fenced area will reduce impacts of flooding and may reduce the rate of beach erosion.

Monitoring data used in modeling to strengthens Critical Areas Ordinance (City of Long Beach)

CMAP's monitoring data provided calibration for a model that Peter Ruggiero (OSU) used to predict shoreline change to 2020 along the Long Beach Peninsula. The City needed this information to comply with the Growth Management Act. The Act was amended to require counties and cities to include the best available science in developing policies and development regulations to protect the functions and values of critical areas. Shoreline change prediction is considered under "Geologic hazard areas – Lands or areas characterized by geologic, hydrologic, and topographic conditions that render them susceptible to significant or severe risk of landslides, erosion, or seismic activity."

Monitoring data supports sustainable sand removal practices to benefit Cranberry Growers (State Parks)

CMAP's monitoring of the Long Beach Peninsula has provided data that is to minimizing the impact of sand removal on the environment, adjacent lands, and the public. CMAP used current and historical beach profile data to analyze shoreline change and identify optimal sand extraction locations and volume regulations. The information allowed State Parks to designate only highly accreting areas for sand removal for cranberry production. Sanding of cranberry bogs is used to stimulate growth of roots and new shoots. It also serves as a natural pest control by burying weed seeds, reducing the need for fertilizers and pesticides. The practice of using locally-removed sand in cranberry bogs is both environmentally and economically sustainable. It decreases the use of transportation resources, which in turn reduces costs to the growers and enhances benefits the environment.

2. Oregon:

In Oregon, leveraging NANOOS funds, the Oregon Beach and Shoreline mapping Analysis Program (OBSMAP) efforts are led by Jonathan Allan and Vicki McConnell (DOGAMI). Monitoring was undertaken at 119 sites on several occasions between October 1, 2008 and March 31, 2009. Beach cross-section surveys were carried out in December 2008 (fall survey), January 2009 (fall survey, and pre- and post-storm survey), and March 2009 along the Neskowin and Rockaway littoral cells and along the

Clatsop Plains, and in October 2008 (post-summer survey) along the Newport cell (Yachats to Otter Rock). These

The beach surveys involved the conventional approach of re-measuring the existing transect sites using RTK-DGPS surveying technology developed for PNW beaches. Results of the profile measurements and contour excursion plots (time stack plots that show contour changes near the dune toe (e.g. the 6.0 m and 5.0 m contour) and lower down the beach face near the Mean High Water mark (e.g. the 3.0 m contour)) have been disseminated via the OBSMAP website (http://www.oregongeology.org/sub/Nanoos1/index.htm) and linked through the NANOOS website. These data are now being actively used by State Agencies, Geotechnical consultants and the public for assessing coastal stability and hazard risk.

Shoreline variability continued to be measured as part of the OBSMAP beach monitoring effort. The approach used involves re-measuring the Mean High Higher Water (MHHW) contour located at an elevation of ~2.5 m above MLLW, a tidally-based proxy for the position of the shoreline, along each of the littoral cells. These data are now being used on an annual basis to assist the Oregon Parks and Recreation Department with identifying potential erosion "hotspot" sites prior to the ensuing winter.

Outreach efforts in the form of public presentations were presented at the Heceta Head coastal conference (October), to the community of Neskowin (November) and Rockaway (March). Summary information describing the state of the beach monitoring effort and results were published by the Oregon Department of Geology & Mineral Industries in an open-file-report (Allan, J.C. and Hart, R., 2008. Oregon beach and shoreline mapping and analysis program: 2007-2008 beach monitoring report. Open file report O-08-15, Oregon Department of Geology and Mineral Industries, Portland.).

3. Nearshore Bathymetry:

- In summer 2008, Peter Ruggiero's group at OSU successfully completed the collection of nearshore bathymetry along the Columbia River littoral cell in close collaboration with the Washington State Department of Ecology and the US Geological Survey. Over 200 individual cross-shore profiles were collected in the cell extending from the lower inter-tidal to approximately 12 m of water depth (~2000 m from the shoreline). Approximately 400 kilometers of nearshore mapping took place within 12 days of field data collection. In all cases these nearshore bathymetry measurements are being combined with topographic measurement collected by Ecology to develop complete maps of the nearshore planform.
    - These data have been processed from their raw format into deliverable text files and have passed a rigorous quality assurance process.

- Ruggiero's group, in close collaboration with DOGAMI and Ecology, planned and executed the first nearshore bathymetric data collection within the Rockaway littoral cell in Oregon. Over 70 individual cross-shore beach profiles were collected from the lower intertidal to approximately 20 m of water depth (~1500 m from the shoreline). These data are being combined with topographic data collected synoptically by DOGAMI.
    - These data have been processed from their raw format into deliverable text files and have passed a rigorous quality assurance process.

- Ruggiero delivered nearshore bathymetry data from the Clatsop Plains in Oregon to researchers at the O.H. Hinsdale Wave Research Laboratory who used the data to aid in developing physical scale models of Seaside, OR for tsunami inundation research.

- Ruggiero's group, with support from NANOOS, continues to develop a 4th generation Coastal Profiling System (CPS), a platform for a physical/biological sampling system for the nearshore ocean. The platform essentially consists of a pair of personal watercrafts (PWCs) outfitted with fixed sampling equipment for high-resolution surveying of sea bottom topography and for physical and ecological sampling in the previously inaccessible surf zone. The Coastal Profiling System is a unique asset that is supporting emerging research into nearshore ocean processes in the PNW.

- Ruggiero presented results from the CRLC time series of nearshore bathymetry at the 2008 AGU Ocean Sciences Meeting in Orlando, FL and at the 85th Meeting of the Coastal Engineering Research Board held in Portland, Oregon.

- The data and information obtained from this monitoring program continues to be a critical component to ongoing work on regional sediment management at the mouth of the Columbia River. Results of the monitoring program have been presented and discussed at several meetings hosted by the Lower Columbia Solutions Group (LCSG), convened by the Governors of Washington and Oregon, in their ongoing projects, including the Southwest Washington Littoral Drift Restoration (Benson Beach) Project, and the Oregon Nearshore Beneficial Use Project.

- **Currents**

1. Coastal Currents:

The HF surface current mapping program directed by Mike Kosro at Oregon State University (OSU) has been providing near-real-time maps of ocean currents along the Oregon coast to the public via the web (http://bragg.coas.oregonstate.edu, plus links to this page from the NANOOS web site), as well as downloadable text files containing the data values. These data are also being provided to NOAA/NDBC via the national HFR-net. To provide near-continuous operation over the past six months, and to take advantage of updated data acquisition software from CODAR, we have replaced computers at three of our sites. We have upgraded communications to sites at Point St. George CA and Winchester Bay, OR by installing wireless backhaul equipment, allowing high-speed Internet connection. A lightening strike at the Point St. George site on Dec 25, 2008 resulted in significant damage, with repairs required to site electronics, cables and communications equipment, and computer replacements. Replacement electronics have been borrowed from CSU Humboldt, during their operational hiatus. We have also contributed to the IOOS plan for a National HF Radar system through work on the draft plan, and by providing a requested report to IOOS HQ on our experience with staffing needs. We prepared a special data set for J. Moriarity, a U. Chicago student interested in ocean currents and sedimentation from the Umpqua River. On Feb 23, we met with CODAR at their headquarters to review data extraction algorithms and to renew the collaboration on effects of high currents and strong horizontal shear on data resolution. We are working with OSU colleagues and a graduate student to examine model predictions of localized enhanced diurnal tidal energy off Heceta Banks.

2. Port Radar:

Led by Merrick Haller (OSU), a marine radar wave observation system has been newly installed at the entrance to Yaquina Bay (base of the South Jetty) during March 2009. Antenna was mounted on existing tower, which was reinforced with guy wires to reduce vibrations. Custom Pelican case was assembled for weather-proofing the data acquisition system and installed in existing "block house" structure. Initial data collections indicate that antenna site provides good views of waves both around the mouth of Yaquina Bay and along the beaches to the north and south. Working with Toby Martin at ShipOps (Hatfield Marine Science Center) we established data access to the outside world through the existing local radio link with HMSC. However, data is not yet available through NANOOS. Presently we are working on optimizing the data collection scheme and automating the data transfer and quality control

procedures. File sizes of the raw radar imagery are large and stretch the bandwidth capabilities of the radio link. We are working with Toby Martin to potentially increase the radio bandwidth and improve the efficiency of the data transfer.

b) Modeling efforts

- **Shelf**

Computer circulation modeling of PNW coastal ocean shelf conditions is being conducted by Alexandre Kurapov's group at OSU, which produces new forecasts each day of ocean conditions, including currents, temperatures and salinities through the water column. Maps of the nowcasts and forecasts are posted daily to the web (http://agate.coas.oregonstate.edu/forecast_index.html) available through the NANOOS website.

Several model improvements were recently made to improve model prediction accuracy. In April 2008, the climatologic model boundary conditions were replaced by forecasts from the real-time NCOM model of the California Current System (I. Shulman, NRL). To enable forecasts without interruption during days when real-time boundary conditions are not available, in addition to our current first-choice model, we have continued to run the back-up model with the climatologic boundary conditions. We also improved the model bathymetry and vertical resolution. Model-data comparisons using hindcast runs for 2007 and 2008 and HF radar and mooring time-series data, obtained with NANOOS support, have been done to show that the new, improved model predicts variability in currents better than the previously used model with climatologic boundary conditions.

We have continued to work toward inclusion of data assimilation in our forecast model. The PI on this project (Kurapov), using leveraging from the ONR grant, developed tangent linear and adjoint codes suitable for assimilation in the coastal ocean. After initial idealized tests with this model (Kurapov et al., 2009), we have run hindcast tests for 2008 assimilating alongtrack satellite SSH altimetry and HF radar observations in our coastal model. Assimilation performed in a series of 2-6 day time windows shows promising results constraining circulation in the eddy dominated coastal transition zone. Our data assimilation results were presented at the 2009 Assembly of the European Geophysical Union.

Model outputs have been shared with our NANOOS collaborator Craig Risien (OSU) who has worked to improve the interactive content of the presented model information.

- **Estuaries**

1. Puget Sound:

Modeling for Puget Sound is being jointly conducted by Mitsuhiro Kawase (UW Oceanography) and Nicholas Lederer/David Jones (UW, APL).

The UW Washington Inland Waters model is now run for tidal hindcasts. Sea surface heights are sampled at a number of locations throughout Puget Sound, eastern Strait of Juan de Fuca, San Juan Islands and the southern Georgia Basin where historical tidal constants compiled by NOAA are available, and are harmonically analyzed for comparison with historical data. Generally very good tidal hindcasts have been achieved in Puget Sound; tidal response in the Strait of Juan de Fuca and outwards still need improvements due to uncertain boundary conditions and possible bathymetric errors. Tidal prism, transport, and barotropic tidal energy flux are calculated and shown to be in good agreement with previous observational and model estimates. During Year 3, the model will be set up for routine hindcasting to supplement and eventually replace the POM model currently run at APL. Initial modeling results will be reported at several conferences in the fall of 2009. This modeling effort is now supported also by the U.S. Department of Energy, under the Northwest National Marine Renewable Energy Center (NNMREC).

APL-UW is maintaining a semi-operational run of the Puget Sound Princeton Ocean Model (PS-POM) and regularly producing three automated graphics products. Changes to tidal forcing at the boundary have been monitored and continue to provide better performance than when the model was running 12 months ago. Changes were made to the code-base to allow the model to more gracefully accommodate intermittent initialization data provided by outside resources.

APL-UW created a new interface for retrieving graphics products, matching the style of the NANOOS website, and allowing users to search through available dates to select dates of interest. Development on this part of the system is ongoing, and input from modelers and laypeople are being used in the process.

The Puget Sound modeling team began discussions and planning to run operationally a new circulation model developed by M. Kawase based on the SUNTANS model. This would not replace the PS-POM, but become an additional source of model output. Resolution and model dynamics would be superior to the PS-POM model.

With the help of Neil Banas, the software package named *Particulator* was upgraded to accept input from additional circulation models. The software package uses java to calculate particle trajectories from circulation model output and display particle paths graphically. The code now reads in output from the GETM and ROMS models, and plans are being made to add support for POM and SUNTANS output.

APL-UW worked with the DMAC Committee to provide an OPeNDAP service to PS-POM gridded data. This is one of the core NANOOS DMAC services and it follows the DIF standard.

2. Columbia River and other Oregon estuaries:

- Coordination of the OHSU participation in NANOOS has been conducted by Antonio Baptista, who serves in the NANOOS Executive Committee, and provides scientific guidance to the OHSU modeling, field and DMAC teams.
- Baptista represents NANOOS in the NFRA Modeling Committee, which meets monthly. In this role: (a) he coordinated an inventory of NANOOS-region modeling assets, submitted to IOOS during the reporting period; and (b) is participating in the definition of the role of regional associations in a national modeling system.
- Though a combination NSF core funds for CMOP, stakeholder funds, and NANOOS funds, a CMOP team coordinated by Grant Law, continues to maintain:
    1. Daily 3D circulation forecasts for the following “extended PNW” estuaries: Columbia River, Coos Bay; Fraser River; Grays Harbor; Humboldt Bay; Monterey Bay; Siletz and Depoe Bay; Tillamook, Nahalem and Netarts Bays; Willapa Bay; and Yaquina and Alsea Bays.
    2. Multi-year simulation databases for the Columbia River estuary and plume, dating back to January 1, 1999.
- Recent progress includes (same funding sources):
    1. Automated quantitative skill assessment, based on model-data comparison metrics, applies to all Columbia River forecasts and simulation databases
    2. The most recent simulation database (DB21) has substantially improved skill in simulating temperature in the Columbia River estuary, in response to needs of fisheries science requirement to guide management decisions on hydropower and ecosystem restoration.
    3. Climatologies of a set of circulation model-based environmental indicators were developed and are being used for analysis of impacts of climate and human activities in the Columbia River ecosystem.
- Usage: Forecasts and simulation databases are used by a range of regional stakeholders, several of which (e,g., NOAA Fisheries Science Center, Bonneville Power Administration) fund elements of

the modeling system. Models are also used to support scientific research, including near real-time support of scientific cruises (historically: BPA/NOAA, EcoHAB, RISE, CMOP).

c) Data Management and Communications

1. Managerial:

The overall NANOOS DMAC Architecture is shown in Figure 1, Appendix 2. Boeing is taking lead for managerial duties. Steve Uczekaj (Boeing) is the Chair of the NANOOS DMAC Committee and represented NANOOS as such:

- Participated in IOOS Workshop in Baltimore Dec 2-4, 2008.
- Attended a NFRA meeting in D.C. March 4-5, 2009.
- Attended IOOS DIF Implementation workshop in Silver Springs, MD on March 10-12, 2009. Contributed to discussions on DIF standards adoption and volunteered to work on several working groups including KML interfacing for Google display, and data/service meta-data Registration.
- Organized and lead a NANOOS DMAC kickoff meeting on February 20, 2009.
- Participated in OOSTethys open source code development working on advancing tools for SOS integration using a Java Toolkit.

2. Summary of Significant DMAC Technical Accomplishments:

- Launched the NANOOS DMAC Initial Operating Capability on October 29, 2008. The DMAC IOC includes an SOS service at serving up integrated observation data from NANOOS region, a beta Registry service at for looking up data services by core variable type, and two OpenDAP servers for serving up model forcast data.
- Added two new data offerings to the NANOOS SOS service:
  1. Willapa Bay Fixed Station (from Washington Dept of Ecology)
  2. NH10 Buoy (from Oregon Ocean Observing System)
- Migrated contents of the NANOOS pilot project map to 4 separate KML layers that one can overlay on a Google map.
- Worked with other User Product and Education & Outreach committees to identify DMAC needs and approach for upload/download capabilities and a plan to implement during this phase of effort.
- The CMOP contributions to the NANOOS DMAC team include:
  1. Developing graphic clients to distribute data from NANOOS sponsored stations.
     e.g. http://ambwd02.stccmop.org/datamart/inventory
     e.g. http://ambwd02.stccmop.org/datamart/fixed_station/saturn03

  Note: Currently these clients access to CMOP-OHSU server using proprietary protocols. In the next reporting period, the same interface will access data using IOOS DIF standards.
  2. Maintained database at CMOP, primarily focused on Columbia River data from the CORIE/SATURN observation network. Other regional data is also ingested, either to support regional stakeholders or to serve as a basis for skill assessment of CORIE/SATURN simulations.

3. Task 1 Progress: DMAC Systems Architecture Definition and Development:

Refined NANOOS service registry to comply with OGC CSW standards and successfully added new data sources into the NANOOS service registry. Participated in IOOS standardization committees for SOS service implementation, national data provider registry, and standards compliance testing. Provided direction to the IOOS program office on formation of data encoding standards for SOS get Observation service call. Started Design of a federated data discovery architecture based on OGC standards. Lead discussions on distributed scalable approaches to registration and data discovery which is a main topic for DMAC at the IOOS level. Also investigating approaches for standardized service interface for model data access including leveraging THREDDS and ERDDAP server development.

4. Task 2 Progress: DMAC Network Engineering Definition and Development:
Continued work on maturing NANOOS SOS server integration with network of NANOOS observation assets. Decision was made to standup a two NANOOS SOS services (one at OHSU and one at UW) to provide integration of observation database databases in Oregon and Washington. Also, an effort was started to investigate alternate approaches to aggregating observation data and determine impact on performance and scalability.

5. Task 3 Progress: DMAC User Product Development:
Determined User Product needs for downloading aggregated data, and worked with UW on identifying new assets to integrate into a new SOS server. Determined Portal Interface needs for model data aggregation and delivery and started investigation of ERDDAP server. Supported migration of asset visualization from NVS to Google Earth/Maps and will continue work with national IOOS effort on approaches for use of KML standard. Did an inventory of which data sources are served by NANOOS DMAC and identified high priority items to be integrated including the NH10 buoy, OSU glider data, ORCA buoys and data from PRISM Cruises.

d) Education and Outreach

This section details NANOOS Education and Outreach activities. NANOOS has an Education and Outreach Coordinator (Amy Sprenger) and an Education and Outreach Committee (Mike Kosro, Chair). The work of this committee is informed by NANOOS' User Products Committee and is partially executed via the NANOOS web. We thus divide this section into those three inter-related and interacting components.

1. User Products Committee:

- The NANOOS User Products Committee is comprised of fifteen members, including 6 members who are part of the DMAC committee and another 4 who are members of Education and Outreach (E&O).
- The full UPC committee met in November 2008 to discuss ongoing issues as they relate to DMAC, Web development, User Product development and outreach. A smaller sub-group of UPC and DMAC continue to meet weekly in order to monitor DMAC and User Product activities and product development.
- In April 2009, the majority of the UPC members participated in the first NANOOS tri-committee meeting (User Products, DMAC, Education & Outreach). The roles and responsibilities of the different committees were re-examined, agreement was reached on the look and feel of the NANOOS web portal, and goals and timelines were established in our strategic areas.
- As part of UPC outreach efforts, Jon Allan (UPC chair) and Amy Springer (E&O chair) attended the Salty Dog Conference in Newport, OR, which was predominantly attended by recreational fishermen. Craig Risien UPC member attended a Project CROOS (Collaborative Research on Oregon Ocean Salmon) workshop in February 2009 to interact with commercial fishermen. Jon Allan (UPC chair) attended a Project CROOS meeting on April 14 to meet with key members of the CROOS project team.
- UPC has begun to develop several products that integrate a variety of datasets including:
    - Integrating HF currents (nowcast) with different satellite data layers (chlorophyll, SST etc.);
    - Integrating surface currents, T, S, from an operational oceanographic model to provide 24h and 48h forecasts of conditions offshore the OR coast (now used by commercial fishermen);
    - Estuarine circulation modeling – vector plots of T, S;
    - Manipulation of Wavewatch III marine data, so that it is focused only on the NANOOS region (including the development of two virtual stations where forecasts of wave conditions can be easily viewed out to several days);
    - NANOOS web product search engine for locating information and data;

- The core focus of the UPC team over the next several months will be to oversee the development of an interactive GOOGLE-based web portal.

2. Web-related Outreach:

APL-UW, with help and guidance from several NANOOS committees, continues to build-out the NANOOS Portal and focus on outreach with respect to several key issues for the PNW. A targeted approach for the portal is to create theme pages. As part of its DMAC web development, APL-UW (Jones, Olsonbaker, Tanner) worked with Newton and others to develop the first of several NANOOS Web Portal Theme Pages.

The first theme page was put up on the NANOOS Web Portal in March 2009: "**Ocean Acidification is on the Rise**." The public can learn in some detail about ocean acidification or "the ongoing decrease in the pH of the Earth's oceans caused by the uptake of carbon dioxide from the atmosphere."

These pages highlight NOAA's study of the growing problem of increased CO_2 in the ocean through their collection of real-time data. Portal visitors learn about the variety of efforts underway 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.

Users can self-select from a number of tabs:
What is Ocean Acidification? The problem defined and scoped
What Do We Know? State of the science and the effect on species
Who's Doing What? NOAA PMEL and UW scientists working together
Real-time Data Now any scientist has easy access to NOAA's real-time data
Scientists Talk In their own words—audio explanations from PMEL oceanographers Dick Feely and Chris Sabine

Other theme pages under development include such topics as Harmful Algal Blooms and Coastal Hazards.

Additional content includes new Lesson Plans (described in more detail in the E&O section), and descriptions of other noteworthy projects in the NW region. APL-UW also created tools for individuals to add their own content such as links, graphics, and documents. For example, APL-UW created a general-purpose image editor that allows a user to quickly select a graphic, crop it and then load it to the web without the typical requirement of off-line image editor software.

As part of a continuous usability-testing program, APL-UW visited the NOAA Hazardous Materials Response Team at NOAA Sandpoint, WA. They explained how they use environmental data for their responsibilities, and then they received a demonstration of how they could find much of the required data via the NANOOS Portal. After the demonstrations they provided feedback on the usability of the portal, which APL-UW has incorporated into later improvements.

As part of the User Products Committee (UPC) efforts, APL-UW worked with Craig Risien at OSU to migrate his Excel-based NANOOS observational asset list to a web-based database. Based on the recommendation of the UPC, APL-UW migrated products from the OrCOOS site to the NANOOS Portal.

As part of the DMAC Committee efforts, APL-UW developed a visual use interface to the Service Registry. This web interface allows a user to search for observational services through via the use of geographic or text based search criteria.

3. Education & Outreach Committee:

- Under the leadership of Amy Sprenger (NANOOS Education and Outreach Specialist) and Mike Kosro (NANOOS Education and Outreach Committee Chair), the NANOOS Education and Outreach

Committee has held two bi-monthly meetings to discuss NANOOS E&O efforts as well as E&O activities of NANOOS members. Sea Grant, CMOP STC, and COSEE staff are part of this Committee and actively participate.

- Amy Sprenger and Mike Kosro, along with five committee members, participated in the first tri-committee (User Products, DMAC, Education & Outreach) meeting, 15-16 April 2009. The roles and responsibilities of the different committees were discussed, and goals and timelines were established in our strategic areas.
- Amy Sprenger has participated in the monthly conference calls of the NFRA Education subcommittee.
- NANOOS continues to support an OSU graduate student, Sarah Mikulak, in the development of an interactive exhibit at the Newport Marine Science Center. The exhibit is focused on building understanding and appreciation for real-time measurements, using data from the LOBO (Land/Ocean Biological Observatory) mooring in Yaquina Bay (http://yaquina.loboviz.com/), owned and operated by NANOOS member WetLabs of Philomath, Oregon.
- Teacher lesson plans on Ocean Observation and on Satellite Tracking have been adapted by Amy Sprenger, and posted to the Education section of the NANOOS web page. Eight additional lesson plans are in development.
- NANOOS continues to contribute to the Scientist and Fishermen Exchange (SAFE) program. On Feb 20, 2009 Mike Kosro gave a presentation on the physical aspects of the spring transition to upwelling; others addressed the biological aspects. The presentations produced a lively and respectful exchange of information with the fishers.
- Amy Sprenger and Jon Allan attended the Salty Dog Convention in Newport at the end of Feb 2009, where they interacted with about 50 tuna and halibut fishers.
- Amy Sprenger also presented on NANOOS at the COSEE OLC Citizen Science workshop. Citizen Science was also a theme at a meeting of CROOS (Collaborative Research on Oregon Ocean Salmon) attended by Jon Allan and Craig Risien. NANOOS is now investigating how to provide storage and web presence for Citizen Science observations, properly labeled.
- Amy Sprenger attended the Shellfish Growers Meeting (WSG), with about 70 attendees where shre presented poster on the NANOOS/NERRS real time water quality data website for shellfish growers.
- Amy Sprenger set-up a NANOOS exhibit booth at the National Science Teachers Association regional conference in Nov. 08. Outreach with close to 300 teachers on ocean observing, NANOOS and future educational products.
- Amy Sprenger presented on ocean observing, NANOOS and its educational products to approx 40 educators from north and central Puget Sound at 2 Storming the Sound conferences for environmental and sustainability educators.
- A NANOOS display was exhibited at the Puget Sound Georgia Basin Research Conference in Feb 09.
- NANOOS Ed &Outreach committee members Sarah Mikulak and Craig Risien presented at 2 one day workshops at HMSC on using real time data in the classroom. Mikulak presented lesson plans and the interactive exhibit she is building featuring the LOBO data from Yaquina Bay. Risien presented on remote sensing and using Google Earth in the classroom. 40 attendees including local classroom teachers, and volunteer docents from HMSC and Oregon Coast Aquarium. Sprenger also attended these workshops.
- NANOOS continues to support NERRS in maintaining the Real Time Water quality data website for Shellfish Growers.

4) Issues

In addition to the points noted previously, NANOOS notes the following specific issues in relation to available funding:

- Budget restrictions have limited activities across all areas of participation of OHSU, but in particular modeling.

5) Key Personnel Changes

- In January 2009, APL-UW hired Emilio Mayorga to be a member of the NANOOS team. Emilio has both academic and operational experience in chemical oceanography and environmental informatics. He is taking a lead role as a member of the APL-UW DMAC team and is developing a back-end database system that meets DIF standards for data storage and services.

- Replacing Bill Howe, Alex Jaramillo serves as the primary OHSU representative in the NANOOS DMAC team. Alex is jointly supported by NANOOS, regional stakeholders, and the core NSF CMOP grant.

Appendix 1. Milestone Schedule and Project Timeline.

Area	**Sub-element**	**Y1**	**Y2**	
				Progress toward Y2 milestones, as revised to NOAA funding level
Observations				
	Shelf	- ~~Purchase equipment for coastal buoy at Juan de Fuca eddy for HAB warning focus~~ - Maintain OrCOOS (OR) buoy in Newport line for hypoxia/anoxia alerts	-Purchase equipment to refurbish OR buoy - Maintain ~~both WA and~~ OR buoy~~s~~ for HAB & hypoxia alerts - ~~Maintain OrCOOS (OR) glider transects on Newport line for extended range hypoxia assessment~~	*Per above text – progress here is satisfactory.*
	Estuaries	- Maintain Puget Sound, Columbia River, Willapa Bay, Gray's Harbor, and South Slough moorings	- Maintain some ~~and expand~~ Puget Sound, Columbia River, Willapa Bay, Gray's Harbor, and South Slough moorings - ~~Improve estuarine monitoring systems to provide real-time data~~	*Per above text – progress here is satisfactory.*
	Shorelines	- Maintain quarterly profiles at 47 sites - Maintain 3-D mapping at 16 sites - Maintain expanded NANOOS Pilot efforts at 46 sites	Maintain quarterly profiles at ~~47~~ reduced number of sites - Maintain 3-D mapping at reduced number of sites - ~~Maintain expanded NANOOS Pilot efforts at 46 sites~~	*Per above text – progress here is satisfactory.*
	Currents	- Maintain OR radar sites ~~and survey/obtain permits for three WA HF sites~~	- Maintain OR sites, ~~purchase two long range HF systems~~ - Purchase and install one X-Band port radar system at high priority port	*X-band radar observing system has been installed, presently working to improve bandwidth for data throughput as we are butting up against the existing limit.*

Area	**Sub-element**	**Y1**	**Y2**	
				Progress toward Y2 milestones, as revised to NOAA funding level
Modeling				
	Oregon/Washington Estuaries	- Integrate and enhance existing forecasting capabilities at OSU, OHSU, & UW	- Integrate ~~and enhance~~ existing forecasting capabilities at OSU, OHSU, & UW	*Per above text – progress here is satisfactory.*
	Oregon/Washington Coastal Shelves	- Begin to develop state of the art cross-shore profile change models and probabilistic shoreline change models at OSU	- ~~Continue development of cross-shore profile change models and probabilistic shoreline change models at OSU~~ - ~~Work with state agencies to test use~~	*Not funded*
	Integrative Synthesis Operational Modeling	~~- Liaise with stakeholders to verify prioritized operational modeling requirements~~	- ~~Initiate establishment of 24/7 operational modeling center. Investigate federal/state organizations for future transition opportunities. Focus on SAR applications.~~	*Not funded*

Area	**Sub-element**	**Y1**	**Y2**	
				Progress toward Y2 milestones, as revised to NOAA funding level
Data Management and Communications				
	Task 1: DMAC Systems Architecture Definition and Development	- The Boeing Company lead with OHSU co-lead develop conceptual systems architecture design in compliance with IOOS standards and protocols	- Continue to refine and implement NANOOS DMAC systems architecture across NANOOS domain at a reduced level of effort	*Satisfactory- as noted above*
	Task 2: DMAC Network Engineering Definition and Development	- OHSU lead with The Boeing Company co-lead develop NANOOS DMAC network engineering design in compliance with IOOS standards and protocols	- Continue to refine and implement NANOOS DMAC network engineering across NANOOS domain at a reduced level of effort	*Satisfactory- as noted above*
	Task 3: DMAC User-product development	- UW lead with OSU co-lead define NANOOS DMAC/Web interface specifications in compliance with IOOS standards and protocols based on direct liaison with NANOOS stakeholders	- Continue to refine and implement NANOOS DMAC user products web interface design across NANOOS domain with initial nodes at UW, Boeing, OHSU, and OSU at a reduced level of effort	*Satisfactory- as noted above*

Area	**Sub-element**	**Y1**	**Y2**	
				Progress toward Y2 milestones, as revised to NOAA funding level
Education and Outreach				
	E&O infrastructure	- Fund the NANOOS Education and Outreach (E&O) Coordinator to work with the E&O SC Chair, the Executive Director, and the web development team Note: delayed start	- NANOOS E&O Specialist to work with NANOOS Administration, E&O Standing Committee, User Products Standing Committee and other stakeholders at a reduced level of effort	*Per above text – progress here is satisfactory.*
	Ocean Literacy	- Focus on 7 basic principles of ocean literacy - Enhance collaboration with PNW COSEE efforts and NSF-funded CMOP STC ocean education efforts	- Initiate delivery of marine education material via web (Ed-Web) at a reduced level of effort Specifically focus on enhancing ongoing PNW marine education efforts including OIP, NAME, and WAML efforts	*Per above text – progress here is satisfactory.*
	Focus area products	- Begin development of education materials for a ~~four~~ NANOOS focus areas of: fisheries, maritime operations, coastal hazards, and ecosystem impacts - Focus on SAFE for fisheries - Focus on BIS for marine operations - Continue joint pilot with NERRS for ecosystem impacts	- Continue development of education materials for two ~~four~~ NANOOS focus areas ~~of~~ according to stakeholder prioritization between: fisheries, maritime operations, coastal hazards, and ecosystem impacts - Continue work with SAFE, BIS, and NERRS on educational products - ~~Begin work with DOGAMI and WDOE on focus for coastal hazards~~	*Per above text – progress here is satisfactory.*

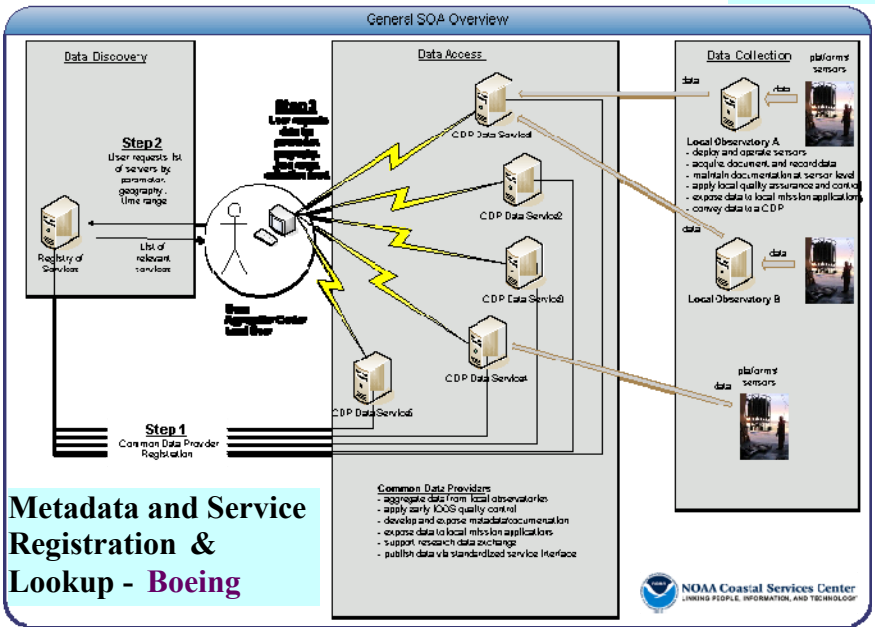
	Training	~~-Establish a training group to meet with one user focus group per quarter~~	-Implement training of prioritized target groups throughout region at a reduced level of effort	*Will commence in second half of Y2*

Appendix 2

Figure 1, NANOOS DMAC Architecture

Asset List & Sensor Formats - OSU

User Interface Portal - UW



Metadata and Service Registration & Lookup - Boeing

Data Integration Framework - DIF

Data Integration Services - OHSU