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.

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 unique 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 each section with a tabular representation of progress to this point:

a) Observing System efforts

- **Shelf**

  - The mooring component, headed by Murray Levine, operated successfully with daily delivery of meteorological data, currents, and water column temperature, salinity, and dissolved oxygen, before the December storm. The mooring also has served as a platform of opportunity, with measurements of bioptical properties and dissolved CO_2 being made under funding from other programs (though not reported in real time). The real-time measurements are being reported both to the web through OSU (http://www.orcoos.org) and to NOAA's NDBC, which also presents the data. The December storm damaged this mooring, tearing it loose from the anchor. The team successfully located and recovered the bulk of the mooring after about a week, saving many of the instruments and mooring gear from being lost; nonetheless, the program suffered about $25K in lost or damaged equipment. The mooring was refitted with a somewhat reduced complement of instruments, redeployed on April 10, 2008, and is again reporting ocean measurements in real time.
  - Addressing this major storm event in more detail (which NANOOS also severely impacted official NOAA buoys):

    - Coastal storm, December 3rd 2007: This severe storm did considerable damage to the observatory at the entrance to the Columbia River as well as to

the NH10 Oregon State University buoy off the Newport line noted above. Both of these buoys broke loose, and were recovered after several days. The Coastal region was without utility power and communications for nearly a week interrupting the collection and transmission of data. Several stations inside the Columbia River where also damaged; unfortunately coming at the start of the winter season repair to the damaged stations proved difficult and time consuming.

- **Estauries**

  - Michael Wilkin, from OHSU attended the MTS/ONR Buoy Technology Workshop, March 3rd-6th 2008, hosted by NDBC Stennis Space Center, MS
  - OHSU hired Katie Rathmell and (through June 30, 2008) Matthew Kalisz as field staff in Astoria, joining the team headed by Michael Wilkin. This team is jointly supported by NANOOS, NSF core funding for CMOP, and regional stakeholders.
  - The team is responsible for the following stations of the CORIE/NANOOS network (see http://www.stccmop.org/corie/observation_network): 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'
  - The team is responsible for the following stations of the new NSF-supported SATURN network, which data is contributed to NANOOS: Pt Adams Packing pier (SATURN-04), Astoria-Meglar Bridge pier 11 (SATURN-01)
  - We endured a fishing vessel strike to Fort Stevens Wharf light 9th September 2007: Fishing vessel Emerald Sea struck and destroyed USCG structure 'red26' along with CORIE instrumentation that was attached. This was a significant loss of instrumentation and loss to a long term data record. However Pt Adams Packing agreed to host our observation station on their pier some 600m upstream of the original site. The loss of a long term data site apart this is a very good site, it is in deeper water than red 26, has direct access from land, a building and utility power.
  - Though NSF core funding to CMOP, the OHSU team added capabilities of direct relevance to NANOOS:
    - SWAP2, developed by OHSU computer staff and OSU marine technical staff, was deployed around the Columbia and Yaquina Estuaries. This vastly improved wireless network has allowed far greater internet availability to UNOLS and other vessels visiting Newport and Astoria, provides telemetry for the new SATURN stations in the Columbia River and telemetry links for CODAR coastal radar in Newport.
    - SATURN01, located at Astoria Meglar Bridge pier 11. This station can actively profile the water column with a suite of instruments. Early testing was with a simple CTD; later instrumentation includes an ISUS and an FLNTU. Profiling provides more meaningful data than a single point at the seabed, and is cheaper than multiple instruments spread through the water column. Station is in a period of experimental operation.

        - SATURN02, located at Pt Adams Packing Pier. This station too has an improved instrumentation package (CTD, ISUS and FLNTU). The covered pier and availability of utility power is allowing us to begin experimenting pumping seawater from the sampling point to an instrument on top of the pier. This along with land access should allow us to keep the conductivity sensor in calibration and free from biofouling without resorting to diving and retrieving the instrument package periodically.
    - During the report period the ORCA (Oceanic Remote Chemical Analyzer) group at the University of Washington (UW) had four buoys in operation in Hood Canal, Puget Sound. 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. Two buoys, the Twanoh and Hoodsport buoys operated continuously throughout the period, while the Duckabush and North Buoys had several down periods (see http;//orca.ocean.washington.edu for buoy locations). Sampling frequencies at all buoys were 12 profiles per day through October, scaled back to 4 (Twanoh and North) or 2 (Hoodsport and Duckabush) in winter due to lack of solar energy for recharge of the power system. All buoys will be back to 12 profiles per day by the end of April. All buoy data is made available in near real time on the NANOOS website.
    - Comparison of the Washington State estuary dissolved oxygen data during the report period (winter) with dissolved oxygen measured in previous year indicates that inflows to the Hood Canal deep water were more oxygenated this year than in previous years. Nevertheless, by the end of March dissolved oxygen in the bottom waters of Lynch cove declined to more or less “normal” for that period.
    - Also during the reporting period, and leveraging NANOOS funding, we analyzed the discrete samples that were taken to calibrate the ISUS nitrate sensors and are currently working on those calibrations. It appears that we can use a linear calibration with concentration coupled to a linear drift for calibration. We anticipate we will be finished with this calibration by the end of April. Also, we have spent significant effort on dissolved oxygen calibration and on software to automatically apply corrections to the dissolved oxygen data. We also anticipate that this task will be finished by the end of April.
    - We have also put considerable effort into producing a wind product for input into model simulations, which we have finished. Wind speed and direction and solar radiation are highly reliable data streams, however, barometric pressure, rain rate, and sometimes air temperature are not. Consequently, we have been investigating other weather station manufacturers, especially those that use sonic measures of the data. Thus one of the future goals is improvement in our meteorological observations for NANOOS.
- We continue to contribute to regional estuarine observations by maintaining moorings on a monthly basis in Willapa Bay and South and Central Puget Sound. These moorings produce valuable data 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 Willapa Bay, four mooring stations have monitored near-surface water temperature, salinity, and chlorophyll fluorescence since 1997 (cut back to 2 stations for 2008, see section 4 below). In Puget Sound, three fixed mooring stations have monitored nearshore, near-bottom water temperature, salinity, and dissolved oxygen since 2006. All three Puget Sound stations are configured for telemetry, and data are available in real-time on the web: http://www.ccalmr.ogi.edu/nanoos/.

- In November 2007, a second fixed sensor package was added to the Manchester pier site in Central Puget Sound to collect near-surface data (water temperature, salinity, chlorophyll fluorescence and turbidity). Paired with the near-bottom sensor, this mooring will provide information on 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.

- *Presentation of results* – Preliminary results for 2007 on near-bottom dissolved oxygen dynamics at 2 stations in South Puget Sound were presented at the Pacific Estuarine Research Society annual conference in Newport, OR in February (Jaeger, S, Z. Holt, and C. Maloy). In summary:
  - On a short-term scale, the Squaxin site tends to show more tidal variability than the Budd site, due to flushing and mixing characteristics of basins.
  - On a seasonal scale, both sites show a similar pattern of daily-averaged temperature, with peaks in late summer/early fall. However, near-bottom dissolved oxygen drops and holds below the criteria limit (5 mg/L) during the late summer at the Budd Inlet site, likely due to stratification and less mixing than the Squaxin Passage site.
  - Longer records of continuous data are needed in determining inter-annual trends, and capturing minimum and maximum values in the systems.
  - Real-time data available on public website is subject to error and users must be made aware of these issues. For example, biological fouling of sensors may result in considerable underestimates of dissolved oxygen levels.
    - These results were also presented informally at the first South Puget Sound Science Symposium in March.

- **Shorelines:**

  - Monitoring of the Oregon Beach and Shoreline Mapping Analysis Program (OBSMAP) was successfully undertaken at 46 sites on several occasions between October 1, 2007 and March 31, 2008. Specifically, beach cross-section surveys were carried out in October 2007 (post-summer survey) and in January 2008 (fall survey) along the Neskowin littoral cell, and in December 2007 (fall survey) in the Rockaway cell and along the Clatsop plains. The beach surveys involved the conventional approach of re-measuring the existing transect sites using RTK-DGPS surveying technology developed for PNW beaches. Furthermore, in

October we initiated a new effort to document shoreline variability by measuring the Mean High Higher Water (MHHW) contour, a tidally-based proxy for the position of the shoreline, along each of the littoral cells currently being studied. Information from this latter effort was used to identify potential "hotspots" for erosion going forward into the 2007/08 winter, with the results being provided to the Oregon Parks and Recreation Department for the Rockaway cell on a trial basis to see if this additional effort would be useful. The outcome was that the identified "hotspot" sites were indeed subjected to localized erosion (above normal erosion) and was used by OPRD staff to assist with their permitting process for deciding whether to allow new emergency engineering to occur.

- Beach measurements by Peter Ruggiero's group at OSU are being planned in collaboration with the state agencies of Oregon and Washington. Field measurements will commence this summer

- With NANOOS funding, Washington State's Department of Ecology's Coastal Monitoring & Analysis Program (CMAP) continued to maintain a beach and shoreline monitoring effort in the Columbia River littoral cell (CRLC) at a reduced scale during year 1, including support for the Coastal Profiling System through collaboration with Oregon State University. The monitoring program performs beach profile surveys on a quarterly basis.

- CMAP collected geospatial data on transects at 46 locations in the CRLC twice during this semiannual period. In addition, a total of eight surface maps were conducted, which contain an average of 10,000 data points over an alongshore distance of three to four kilometers. These quarterly field campaigns serve to continue ongoing monitoring that is now in its 11th year of operation.

    - These data have been processed from their raw format into deliverable text files and have passed a rigorous quality assurance process, which continues to be refined over time. The text files are organized and cataloged into onsite network drives with accompanying FGDC metadata.

- CMAP is undertaking recovery and examination of the geodetic network used to spatially reference our data sets. We visit each monument, complete any required maintenance, photograph the site, and correct and discrepancies with descriptions found in NGS datasheets. Once complete these updates will be submitted to the NGS website as 2008 recovery notes..

- CMAP provided information from our monitoring program to the Seattle Times for a news article on North Cove erosion and the impacts of storm events. We also provided information for an Oregon and Washington public radio feature story on climate change and coastal erosion.

- **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 via the national HFR-net; NOAA is replotting the data at the NDBC web site. In December 2007, an unusually severe, hurricane-strength winter storm battered the Oregon coast, leaving communities without phone or power for up to a week and producing widespread damage to structures. The HF equipment suffered storm damage at several locations, due to erosion and to high-winds on antennas. This damage has now been fully repaired, and the system again is operating at full strength.

Summary: Observing System Milestone Schedule and Evaluation of Progress.

Area	**Sub-element**	**Proposed Effort For Year 1**	**Progress Assessment**
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	-Partially satisfactory – reduction in level of funding has delayed WA buoy component completion. Storm damage to OR buoy has hampered shelf monitoring
	Estuaries	- Maintain Puget Sound, Columbia River, Willapa Bay, Gray's Harbor, and South Slough moorings	- Satisfactory – we have maintained some Puget Sound, Columbia River, Willapa Bay, Gray's Harbor, and South Slough moorings though have been hampered by less than anticipated funding
	Shorelines	- Maintain quarterly profiles at 47 sites - Maintain 3-D mapping at 16 sites - Maintain expanded NANOOS Pilot efforts at 46 sites	Per above text – progress here is satisfactory though restricted funding and winter weather have hampered our efforts.

	Currents	- Maintain OR radar sites and survey/obtain permits for three WA HF sites	- Funding has only allowed repair and minimum maintenance of OR sites. WA State Radar effort abandoned due to insufficient NOAA funds – effort halted for now.

b) Modeling efforts

- APL-UW and the UW School of Oceanography began integrating their respective capabilities toward developing an operational Puget Sound Princeton Ocean Model (PS-POM). Mitsuhiro Kawase at SOO assisted in transitioning his PS-POM code to David Jones and Nicholas Lederer at APL-UW. This code has been implemented on a robust operational computing resource. The model is run daily and the data is currently available via an opendap server http://metoc1.apl.washington.edu/). New data and visualization products will be passed to the NANOOS portal when it becomes operational.
- Routine hindcasts of POM-based Puget Sound model are being performed at UW/APL, UW/Oceanography has focused on implementation of a new numerical model with higher resolution and a more modern algorithm. Stanford University's SUNTANS ocean circulation model has been chosen for this purpose. SUNTANS is a three-dimensional hydrodynamic code utilizing depth coordinate in the vertical and unstructured finite difference grid in the horizontal. The model includes nonhydrostatic dynamics, which is expected to be important in areas of strong bottom relief and fast currents such as Admiralty Inlet. It has provisions for wetting and drying of tidal flats, which should improve simulation of terminal basins in Puget Sound. The model is MPI-parallelized with automatic load balancing. SUNTANS has been implemented over a Puget Sound model grid including San Juan Islands and Bellingham Bay with a nominal resolution of 250m. It has been running on an eight-core desktop workstation (Mac Pro) and is undergoing tidal calibration. Fresh water input from rivers, temperature and salinity boundary conditions along open boundaries, and wind forcing will be implemented during Spring-Summer 2008.
- Antonio Baptista (OHSU) became a member of the NFRA Modeling Committee, and participated in its first organizing meeting (March 19, 2008)
- Though a combination of NANOOS funds, NSF funds, and stakeholder funds, we maintain 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.
- Until very recently, with the exception of the Columbia River (the primary CMOP testbed) and Coos Bay (by virtue of a MS thesis), these forecasts had received only the most basic initial calibration (mostly as a part of a graduate-level class taught at OHSU). Recent increases in computer resources and dedication of a full-

time staff member to PNW model development (Nate Hyde) immediately address two of these shortcomings.

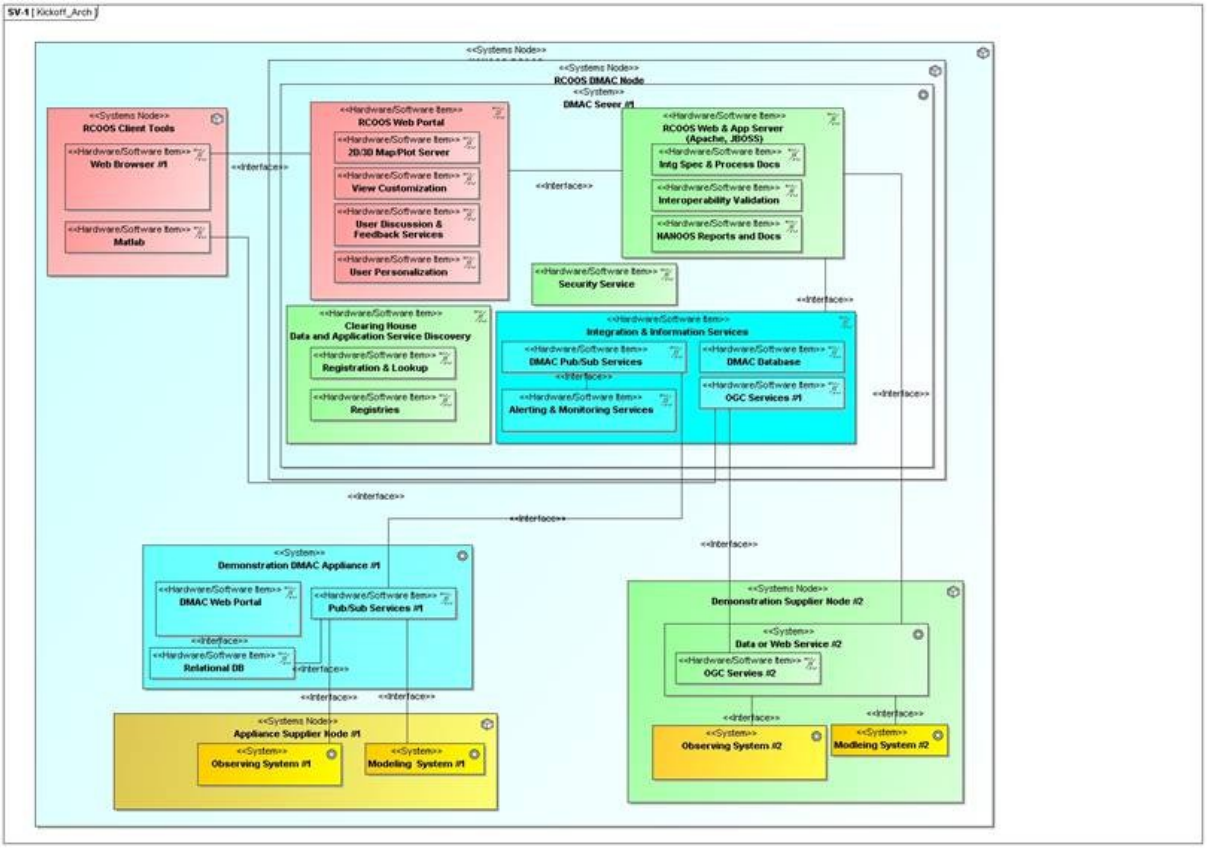
- Calibration methodology and support infrastructure are now being developed alongside calibration of individual estuaries. Also, we are benefiting from the NSF-supported development of numerous classification and characterization numbers, which will allow estuarine inter-comparisons under contemporary conditions and for scenarios of change (e.g., due to climate change or to tectonic activity in the Cascadia Subduction Zone).
- As a testbed for the methodologies and support infrastructure, the calibration emphasis was on Yaquina Bay (see Appendix). The effort benefited from the recent installation by WETLabs of a LOBO station in the estuary, but it is still hampered by the absence of an extended observation network. This problem is common for many of the PNW estuaries: a methodology for cost-effective observation of basic properties in small estuaries is urgently needed, and should be considered by NANOOS as a necessary scope addition in future years, as allowed by budgetary constraints.
- Computer circulation modeling is being conducted by Alexandre Kurapov's group, 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).
    - Two projects under the original proposal package were not scheduled to receive funding during year 1 due to budget reductions. These were the repeat sampling of water column temperature, salinity, currents and dissolved oxygen along the historically well-sampled Newport Hydrographic Line, using autonomous gliders (Kipp Shearman/Jack Barth), and the ports radar system which provides realtime wave information (Mick Haller).

Area	**Sub-element**	**Y1**	**Y2**
Modeling		**Proposed Effort For Year 1**	**Progress Assessment**
	Oregon/Washington Estuaries	- Integrate and enhance existing forecasting capabilities at OSU, OHSU, & UW	- Progress is satisfactory given level of funding. Progress continues to come by leveraging projects funded by agencies other than NOAA.
	Oregon/Washington Coastal Shelves	- Begin to develop state of the art cross-shore profile change models and probabilistic shoreline change models at OSU	- Progress is satisfactory with caveat noted above.
	Integrative Synthesis	*- Liaise with*	- This effort now unfunded due to Y2

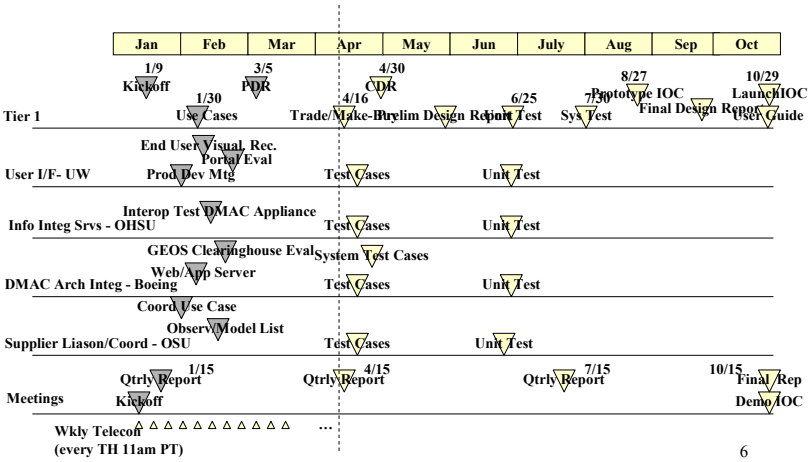
	Operational Modeling	*stakeholders to verify prioritized operational modeling requirements*	NOAA budget shortfalls – project halted and resources (very minor) for Y1 going to other modeling efforts (this was previously reported to NOAA).

c) **Data Management and Communications**:

- Held a NANOOS DMAC Kickoff Meeting at Boeing on Jan 9-11, 2008 with attendees from Boeing, UW, OSU and OHSU. At this meeting we assigned roles and responsibilities to team members, defined a top-level NANOOS DMAC architecture, Figure 1, and created a schedule that would lead to Initial Operating Capability for the NANOOS system in October 2008, Figure 2 – shown below:



NANOOS DMAC Schedule



- Defined a DMAC architecture based on service oriented architecture (SOA) and NOAA data integration framework (DIF). An initial set of service types have been identified for development by team members including:
    - Discovery Service – this provides service registration and lookup
    - Metadata Registry - this is the FGDC metadata service
    - Catalog Service - this is an implementation of a std data catalog service
    - Data Provider Service – provides core observation data
    - Data Aggregator Service – provides integration of multiple data sources
    - GUI Data Provider - portal display, graphing applications that can access Data Providers and Data Aggregators for 2D plots
    - GUI Data Aggregator - portal display user application accessing one or more Data Providers or Aggregators
- Worked with NANOOS Product Group to identify and select relevant use cases around which development tasks will occur
- Established weekly DMAC technical team telecon to discuss tasks and status progress
- Started re-host of NANOOS portal to new server to support DMAC integration
- Created comprehensive list of observation assets in Pacific Northwest Region
- Conducted a Preliminary Design Review (PDR) of the NANOOS DMAC at Boeing on March 5, 2008
- Bill Howe(OHSU) attended the NANOOS DMAC Kickoff Meeting at Boeing on Jan 9-11, 2008 with participants from Boeing, UW, OSU and OHSU. We determined a high level architecture at this meeting (see Boeing's report for figure.) This meeting was crucial for integrating the team's diverse backgrounds: Oceanography, Computer Science, and Software Engineering.
- Bill Howe attended the NANOOS DMAC Preliminary Design Review at Boeing on March 5, 2008.

- PNW representatives participated in weekly DMAC "tag up" teleconferences led by The Boeing Company..
- The NSF-funded Science and Technology Center for Coastal Margin Observation and Prediction (CMOP) hired a developer, Alex Jaramillo to assist with the NOAA-funded NANOOS project. The hiring process was temporarily suspended on the news of reduced NANOOS funding, but we were able to successfully retain Alex by dividing his time between the core NSF CMOP grant and NANOOS. Alex is expected to join the team in late May.
- Conducted an experiment to test the feasibility of providing dynamic visualization services over large netCDF files. The prototype is available at http://amb25.stccmop.org/ws/product/netcdftest.py. This experiment has since been adopted by Craig Risien at OSU to visualize ocean circulation model results on the web.
- Extended PySOS, a python-based implementation of the Open Geospatial Consortium's Sensor Observation Service (SOS) standard, to allow more efficient time and space queries. PySOS was originally authored by Bill Howe in Winter 2007 motivated by a collaboration with the OOS Tethys project (http://www.oostethys.org/). The software has since been installed by two more customers in the ocean observing community for serving their own data. Further, our own PySOS installation is providing data to several external applications, including the Shellfish Water quality application (Jan has url), and the OpenIOOS realtime map (http://www.openioos.org/testbed/sos/gm_sos.html). This service is expected to be a core capability of the NANOOS system.
- Updated the NANOOS Pilot Project to support new requirements and to improve maintainability. All content on the website is now dynamically generated from a relational database, allowing this technology to be redeployed as part of the new NANOOS website.
- Continued development (largely through NSF CMOP funding) of the Product Factory, a library for generating dynamic visualizations of ocean observations in response to web requests. Each "factory product" encodes a family of related visualizations. For example, a single depth-profile product allows visualization of any number of CTD casts from multiple research cruises. Each of these products can be generated on demand and re-used in a variety of contexts with no additional programming. As an example, consider the following product for plotting timeseries data from the CMOP SATURN observation network: http://www.stccmop.org/datamart/station/timeseries
- Led the design and development of the Information Integration Architecture of the NANOOS system, authoring a design document following the DODAF framework, as well as several Sequence Diagrams in the Unified Modeling Language (see example in Appendix B). These diagrams are essential for communicating design details between developers.
- OSU is a partner in the Data Management side of NANOOS, coordinating the scientist/data-management liason. Craig Risien is OSU's DMAC specialist, and has contributed to the NANOOS DMAC kickoff, the Design Review, and to the early User Products definition meeting. He has compiled an extensive list of ocean observing assets in the NANOOS region, which is helping to guide our activities. He

is also providing assistance in the effort to provide data to the management team, including model, mooring and HF data. He is collaborating with the other DMAC specialists at Boeing, Oregon Health and Sciences University, and University of Washington, coordinated through weekly phone meetings.

- For the UW – we focus on specific DMAC task completion:

    - Task 1: Architecture Design: Stuart Maclean and Troy Tanner participated in the DMAC PDR at Boeing in March. Maclean discussed data search requirements and APL-UW's experience with environmental model data used by applications. Tanner provided the portal data requirements that the DMAC team needs to consider.

    - Task 3: NANOOS Portal Development: APL-UW completed the initial NANOOS portal design. The design was presented to the NANOOS President and Executive Director. They approved of the new design. Tanner has since worked on converting the old NANOOS website to the NANOOS Portal, conducting preliminary research into what types of technologies make the most sense.

    - J. Olsonbaker of UW led a review of current products on the NANOOS website and those products envisioned by earlier research of the User Products Committee (UPC). She led a discussion with the UPC during its 23 March 2008 meeting in Portland, OR. Based on input from the UPC, buttons and navigational structure have been revised for a simpler and easier-to-use format. Users will see Data as either derived from observations or models. Visual Products fall under three categories: Forecasts, Tools, and Applications. Olsonbaker is developing the content for all menu items and pages. The NANOOS portal will become available for limited tested by the NANOOS community in May 2008.

- During their March meeting, the User Product Committee (UPC) decided that the NOAA/Washington Sea Grant funded application called the Boater Information System (BIS) should be expanded beyond its Puget Sound boundaries to extend over the entire NANOOS domain. This new application will be called the NANOOS Visualization System (NVS) and will incorporate additional data sources needed for safe marine operations. A NVS prototype is scheduled for demonstration in June 2008.

Area	**Sub-element**	**Y1**	**Y2**
Data Management and Communications		**Proposed Effort For Year 1**	**Progress Assessment**
	Task 1: DMAC Systems Architecture Definition and	- The Boeing Company lead with OHSU co-lead	- Satisfactory - as noted above.

	Development	develop conceptual systems architecture design in compliance with IOOS standards and protocols	
	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	- 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	- Satisfactory - as noted above.

d) Education and Outreach

- In mid October Amy Sprenger (M. Ed.) began working at APL-UW for NANOOS part-time as the NANOOS Education and Outreach Specialist. In its history to date, NANOOS has made more progress on outreach than education, so the NANOOS Executive Director requested Sprenger to emphasize education in her efforts. Her initial focus was on putting together educational content for the new iteration of the NANOOS website. She compiled teaching resources geared towards the grade 6-12 classroom, adapting existing classroom-tested lessons to use NANOOS data. She has linked all of the teaching resources to Oregon and Washington's respective education standards, the ocean literacy essential principles and the national science education standards.
- Sprenger met with Veronique Robigou, Director of COSEE-OLC, and Karen Wegner and Vanessa Green, CMOP Education Directors, on future collaborations in educational efforts. Each of these directors represents a major PNW regional marine effort with significant investment in education. Integration, coordination and leverage with NANOOS were discussed.
- Sprenger completed limited work on producing NANOOS outreach products on the four NANOOS focus areas, primarily because she was on maternity leave for several months of this 6 month period.

- Conducted telephone conference meeting of the NANOOS Education and Outreach (E&O) committee on Jan 17, 2008.
- Established contact with the Oregon COSEE to explore collabortion.
- Represented NANOOS at meeting of the Scientists and Fishermen's Exchange (SAFE) in Feb 2008 on Marine Reserves.
- Reported to the Governing Council meeting in March.

Area	**Sub-element**	**Y1**	**Y2**
Education and Outreach		**Proposed Effort For Year 1**	**Progress Assessment**
	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	Fully Accomplished – but note delayed start caused by reduced level of award has hampered effort
	Ocean Literacy	- Focus on 7 basic principles of ocean literacy - Enhance collaboration with PNW COSEE efforts and NSF-funded CMOP STC ocean education efforts	- Satisfactory though delivery of marine education material via web (Ed-Web) because of a reduced level of effort due to reduction of NOAA funding. We are specifically focusing on enhancing ongoing PNW marine education efforts including OIP, NAME, and WAML efforts
	Focus area products	- Begin development of education materials for 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	- Progress is satisfactory as we are developeing education materials for two NANOOS focus areas according to stakeholder prioritization between: fisheries, maritime operations, coastal hazards, and ecosystem impacts - Continue work with SAFE, BIS, and NERRS on educational products ~~hazards~~

		ecosystem impacts	
	Training	-Establish a training group to meet with one user focus group per quarter	-We have implemented training of prioritized target groups throughout region at a reduced level of effort

4) Issues

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

A. Estuarine observations

Storms and station status – In December 2007, high winds and flooding on the coast of Washington resulted in damage to 2 mooring sites in Willapa Bay. One mooring broke free and was recovered by a beachcomber near Tokeland one week later. The instruments were returned to the manufacturer and diagnosed in good condition, except for a missing fluorometer. An attempt to redeploy a new I-beam structure at the site near the mouth of the bay (Bay Center) was conducted on March 5-6th with the assistance of EPA divers, but efforts were discontinued due to boat engine troubles (1st day) and weather conditions (2nd day). The next I-beam installation is scheduled for May 1st at Bay Center.

In addition, due to physical instability of the USCG navigational marker used for mooring attachment at a 3rd site in Willapa Bay (Oysterville), this station was retired in July 2007. Only the 4th and most protected site (Naselle) is currently in operation in Willapa Bay, but the planned redeployment at the Bay Center site would provide a total of 2 surface moorings for the next cycle. Internal operating budget constraints have resulted in the cut to 2 stations in Willapa Bay for 2008. Reductions in NANOOS budget have hindered efforts for further expansion in monitoring sites (such as Grays Harbor).

The mooring system and design continues to be considered robust for future applications, as moorings have only broken free twice during winter storms (Jan. 1999 and Dec. 2007) over the last decade of deployment.

B. Beach and shoreline observations

The duration of this campaign and the harsh environment that our equipment must operate in is taking a toll on its reliability and functionality. CMAP's primary equipment includes vehicles and GPS surveying equipment. Both of these have suffered causalities recently. The amphibious ATV used to collect surface map data is near the end of its operable life span, however due to our fastidious maintenance schedule is still functioning far beyond its normal life expectancy. The cost of keeping it running is increasing with each use. Some of our GPS gear is over 12 years old and the manufacturer no longer offers parts to service equipment this outdated. In the past we had two GPS receivers used for collecting bathymetry data from two Waverunners operated in tandem. One of these receivers has stopped functioning, so collection of this

data will be severely hampered. The bathymetry data is merged together with our wading surveys and surface maps to cover the beach system from the dune out to the depth of closure. These data are collected during the summer months. Given the limited NANOOS budget for this year and next, we are in a process of seeking additional funds from other agencies so that we can repair or replace equipment so that we are able to perform the summer surveys as we have over the past 10 years.

5) Key Personnel Changes
There are none to note.

6) Budget Analysis
All financial reports are up to date. At the end of March 2008 (50% of the Year 1 time allotted), NANOOS had obligated 40.6% of its award – no difficulties, other than the impacts on various efforts due to reduced funding mentioned above are expected.