Northwest Association of Networked Ocean Observing Systems

18 July 2016

Ms. Jenifer Rhoades
U.S. Integrated Ocean Observing System
1315 East West Highway
Room 2621
Silver Spring, MD 20910

REF: NA16NOS0120019: "Sustaining NANOOS, the Pacific Northwest component of the US IOOS"

Dear Ms. Rhoades,

This Cover Letter accompanies NANOOS' response to your email dated 24 February 2016 stating that NOAA IOOS recommended funding NANOOS at the level of $2,774,532 for FY16.

NANOOS greatly appreciates this funding for the continuation of our IOOS Regional Association and Coastal Ocean Observing System for the Pacific Northwest. On behalf of NANOOS' Governing Council and principal investigators, I relay our sincere thanks for the continued support as we together execute this national and regional system.

As noted in your email, this funding level is less than the funding amount requested of $4M in our 30 August 2015 proposal to IOOS for FY16. Per your request, we include documents to detail how NANOOS will de-scope to meet the reduced funding level. In the text appended here, we present how our proposed objectives will or will not be met under the de-scoped budget and our revised Work Plan. Also provided are a revised SF424A, detailed statements of work, a summary budget, budget justifications, subcontractor packages, and rate agreements.

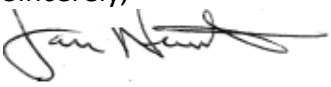
As noted in your email, the FY16 NOAA funding level of $2,774,532 includes five line-item amounts with specific tasks, the latter four of which were not topics presented in our original 2015 proposal request:

1. $405,000 to fund operations and maintenance of High Frequency Radars.
2. $5,000 for System Advisory Committee Meeting travel.
3. $192,543 for NANOOS Ocean Acidification Monitoring and Prediction in Oregon Coastal Waters.
4. $99,437 NANOOS UW OA observatories.
5. $25,000 NANOOS UW OA observatories: Closing the data Gap Enhancing the Cha'ba Mooring Program to Allow Year-Round Deployments.

The FY16 award, less the amounts allocated for the specified tasks above (but including item 1), equals $2,452,552 toward the operation of NANOOS as proposed in 2015 for operation during FY16. Compared to our FY15 RCOOS base award, this is $9,584 less, which was removed for a NOAA Working Capital Tax. NANOOS will absorb this decrease through less travel by NANOOS governance and management staff.

Please let us know if you have any questions.

Sincerely,



Dr. Jan Newton
NANOOS Executive Director

Encl.
NANOOS de scope FY16 (revised objectives and de-scoped work plan)
Revised SF424A
SOWs
Summary budget
Budget justifications
Subcontractor packages
UW Rate Agreements

NANOOS Objectives for FY2016

Our specific objectives for the year (FY 2016 = Y1 of the award = Y10 of NANOOS RCOOS) are listed below as originally proposed, and following directly underneath, as revised per our de-scope funding amount:

We retain our first objective without revision:
1) Maintain NANOOS as the U.S. IOOS PNW Regional Association: Sustain our proven role for regional coordination, administrative infrastructure, and stakeholder engagement, engaging federal and non-federal (tribal, academic, state, local, industry, NGO, etc.) partners.

Our second objective:
Maintain and enhance surface current and wave mapping capability. *Maintain existing HF-radar foundational capability and extend it to un-served areas in Washington, northward to the international border, providing a new portion of critical national capacity; continue investment in wave mapping at critical ports.*
is revised to:
2) Maintain surface current and wave mapping capability. Maintain existing HF-radar foundational capability providing critical national capacity; continue, to the extent possible, existing investment in wave mapping at critical ports.

Our third objective:
Sustain existing buoys and gliders in the PNW coastal ocean, in coordination with national programs. *Maintain and harden these essential assets providing regional observations, with focus on hypoxia, HABs, ocean acidification (OA), climate change detection and invest in biological observations.*
is revised to:
3) Sustain existing buoys and gliders in the PNW coastal ocean, in coordination with national programs. Maintain these essential assets providing regional observations, with focus, to the extent possible, on hypoxia, HABs, ocean acidification (OA), climate change detection.

Our fourth objective:
Maintain and expand observation capabilities in PNW estuaries, in coordination with local and regional programs. Maintain these to aid sustainable resource management, water quality assessment and sub-regional climate change evaluation. Sustain and enhance observing ability including new in-vestments in hypoxia, OA, and biological observations.
i*s revised to:*
4) Maintain observation capabilities in PNW estuaries, in coordination with local and regional programs. Maintain these to aid sustainable resource management, water quality assessment and sub-regional climate change evaluation. Sustain observing ability including to the extent possible, hypoxia and OA.

Our fifth objective:
Maintain and enhance core elements of beach and shoreline observing programs. Contribute to hazard mitigation by providing essential observations and better decision support tools for coastal managers, planners and engineers.
i*s revised to:*

5) Maintain core elements of beach and shoreline observing programs. Contribute to hazard mitigation by providing, to the extent possible, essential observations and better decision support tools for coastal managers, planners and engineers.

Our sixth objective:
Provide sustained support to a community of complementary regional numerical models. Contribute to the operation of regional models, and the tools and products they support, covering the head of tide of estuaries to the outer edges of the EEZ in both OR and WA, with strategic improvements to capabilities and scope, including new forecasts for waves, flood and erosion.
i*s revised to:*
6) Provide sustained support to a community of complementary regional numerical models. Contribute, to the extent possible, to the operation of regional models, and the tools and products they support, covering the head of tide of estuaries to the outer edges of the EEZ in both OR and WA.

Our seventh objective:
Maintain, harden, and enhance NANOOS' Data Management and Communications (DMAC) system for routine operational distribution of data and information. Sustain and enhance the DMAC system NANOOS has built, including the NANOOS Visualization System (NVS), for dynamic and distributed data access and visualization for IOOS.
i*s revised to:*
7) Maintain NANOOS' Data Management and Communications (DMAC) system for routine operational distribution of data and information. Sustain, to the extent possible, the DMAC system NANOOS has built, including the NANOOS Visualization System (NVS), for dynamic and distributed data access and visualization for IOOS.

Our eighth objective:
Continue to deliver existing and create innovative and transformative user-defined products and services for PNW stakeholders. Continue our NVS innovation to succeed in this vital translation: meaningful and informative data products that connect with user applications and serve society.
i*s revised to:*
8) Continue to deliver existing and, to the extent possible, create innovative and transformative user-defined products and services for PNW stakeholders. Continue our NVS innovation to succeed in this vital translation: meaningful and informative data products that connect with user applications and serve society.

Our ninth objective:
Sustain and strengthen NANOOS outreach, engagement and education. Foster ocean literacy and facilitate use of NANOOS products for IOOS objectives, the core task for which NANOOS was constructed, via existing and new approaches for engaging users and increasing ocean awareness.
is revised to:
9) Sustain NANOOS outreach, engagement and education. Foster ocean literacy and facilitate use of NANOOS products for IOOS objectives, the core task for which NANOOS was constructed, via existing approaches for engaging users and increasing ocean awareness.

NANOOS Revised Work Plan for FY2016 de scope

The work plan described in our proposal for the $2.5M level is similar to our award funding amount ($2,457,552 from IOOS, plus $316,980 from NOAA OAP = $2,774,532) and identical to our current level of effort from the previous (FY15) NANOOS award, less $9,584 which was taken out for NOAA's Working Capital Tax. NANOOS thus will maintain all efforts to the current level which matches that of the $2.5M work effort described in our proposal. Any deviations from that level of work effort are described below.

Governance and Management Subsystem

1) **Maintain NANOOS as the U.S. IOOS PNW Regional Association**

Our work plan for this subsystem requires salaries and travel in each year for oversight, coordination, and evaluation. Under this funding level, we will maintain our current effort; however, we will eliminate some travel (1 conference trip for 2 persons) to offset the Working Capital Tax deficit. Lead PI: Newton, UW

Observing Subsystem

2) **Maintain surface current and wave mapping capability.**

PNW Coast HF Surface Current Mapping: Our work plan for this subsystem element is to operate eight existing SeaSonde HF sites designated as Priority 1 sites by the national HF program (six long-range sites and two standard-range sites) and three existing Priority 2 standard-range sites. Effort will be at existing levels, with no new assets or changes in work undertaken. Lead PI: Kosro, OSU

Wave Imaging at Critical PNW Ports: Our work plan for this element is to continue X-band radar monitoring of waves and currents at two important navigational inlets, Yaquina Bay and the Mouth of the Columbia River. Effort will be at existing levels, with no new assets or changes in work undertaken. Lead PI: Haller, OSU

3) **Sustain existing buoys and gliders in the PNW coastal ocean, in coordination with national programs.**

Our work plan for this objective is to sustain the following coastal shelf assets:

WA shelf buoy: Effort will be at existing levels, with no new assets or changes in work undertaken. There is insufficient funding for sustaining the WA glider because the glider was lost and no funds exist to replace the asset. The $50k intended for glider operations will be used for salary for glider data analysis and product development to increase user base and demand for these data. Lead PI: Mickett, UW

OR shelf buoy: Effort will be at existing levels, with no new assets or changes in work undertaken. Lead PI: Kosro, OSU

Columbia River shelf mooring: Effort will be at existing levels, with no new assets or changes in work undertaken. Because of the ramp down of the NSF funding for the 10-year CMOP program, there is insufficient funding to sustain the shelf mooring, estuarine moorings (see

objective 4, below), and the shelf glider, thus the glider operations will not be conducted. Lead PI: Baptista, OHSU

N. CA shelf glider: Effort will be at existing levels, with no new assets or changes in work undertaken. Lead PI: Barth, OSU

4) **Maintain observation capabilities in PNW estuaries, in coordination with local and regional programs.**

Our work plan for this objective is to sustain the following PNW estuarine assets:

Puget Sound, WA, 6 profiling buoys: Effort will be at existing levels, with no new assets or changes in work undertaken. Lead PI: Mickett, UW

Puget Sound, WA, US-Canada ferry-box: Effort will be at existing levels, with no new assets or changes in work undertaken. Lead PI: Maloy, WDOE

Columbia River, OR and WA: Effort will be at existing levels, with no new assets or changes in work undertaken. Because of lack of leverage NSF funds for these assets, these will be maintained but with impact to the Columbia River shelf glider (see Objective 3, above). Lead PI: Baptista, OHSU

South Slough/Coos Bay, OR: Effort will be at existing levels, with no new assets or changes in work undertaken. Lead PI: Helms, ODSL

5) **Maintain core elements of beach and shoreline observing programs.**

Our work plan for this objective is to sustain this bi-state network for WA and OR shorelines:

WA and OR beach, shoreline and bathymetry: Effort will be at existing levels, with no new assets or changes in work undertaken. WA beach monitoring, Lead PI: Kaminsky, WDOE; OR beach monitoring, Lead PI: Allan, DOGAMI; WA and OR nearshore bathymetric observations of beach and shoreline morphodynamics, Lead PI: Ruggerio, OSU

Modeling and Analysis Subsystem:

6) **Provide sustained support to a community of complementary regional numerical models.**

Our work plan for this objective is to support the following existing regional models:

NE Pacific and Salish Sea: The daily forecast model, LiveOcean, simulates ocean circulation and bio-geochemistry in the Salish Sea and in coastal waters of the NE Pacific, including Oregon, Washington, and British Columbia. Effort will be at existing level. Lead PI: MacCready, UW

Columbia River estuary and plume: The OHSU circulation modeling system covers the Columbia River estuary and plume. Effort will be at existing level. Lead PI: Baptista, OHSU

PNW Coastal Waters: The OSU real-time coastal ocean forecast model covers the coastal waters off OR and WA. Effort will be at existing level. Lead PI: Kurapov, OSU

Data Management and Communications (DMAC) Subsystem:

Our strategic DMAC work plan is focused on sustaining the NANOOS DMAC Information System and user-facing Web and Products suite, including the integrated and thematically customized NANOOS Visualization System (NVS) framework.

7) Maintain NANOOS' Data Management and Communications (DMAC) system for routine operational distribution of data and information.

We will sustain our DMAC information system, and the Regional Data Assembly Center (DAC) that supports it. Effort will be at existing level for the following four areas. Lead PI: Mayorga, UW

Mature Regional DAC Operations: NANOOS will continue its regular strategic assessment of current and future needs for DAC operations, to sustain a highly available, robust, distributed hardware and software environment; maintain appropriate staffing and team coordination; and maintain up-to-date operations and system documentation to ensure transparent and clear descriptions of DAC architecture.

IOOS/DMAC Functional Roles: NANOOS will continue to meet IOOS/DMAC Functional Roles (per IOOS/DMAC Guidance) for at least a subset of assets.

NVS Support and Development: NANOOS will maintain its user-friendly NVS data discovery, access and visualization application framework that has served a critical role in NANOOS' service to its stakeholders. The NANOOS DAC will maintain NVS support as one of its central roles, leveraging regional user needs, feedback and data reviews to assure relevance and quality of metadata for observing and modeling data assets integrated and served by NANOOS.

Engagement in National and Cross-regional DMAC Efforts: NANOOS will continue to actively participate in IOOS DMAC community development activities, to the extent possible.

8) Continue to deliver existing and, to the extent possible, create innovative and transformative user-defined products and services for PNW stakeholders.

Our work plan for this objective will be evaluated and prioritized annually by the Tri-Com (= DMAC, User Products, and OEE committees) based on user feedback, NANOOS Governing Council input, and outreach results for regional priorities. Effort will be at existing level and confined to the following two tasks. Lead PI: Tanner, UW

Web Site: Web content relevant to stakeholder issues, especially those related to Maritime Operations, Ecosystem Assessment, Fisheries & Biodiversity, Coastal Hazards, and Climate, will continue to be evaluated and updated as new information/issues become available.

Tailored Products Development: NANOOS will annually evaluate priorities for products at the Tri-Com meeting, based on outreach feedback, regional issues, and GC input, and will implement new tailored products to the extent possible.

9) Sustain NANOOS outreach, engagement and education.

Our OEE efforts will be at existing levels and will continue to focus on four main areas: *Product Development*; *User Engagement*; *Ocean literacy*; *Communications.* OEE will provide the link between users and DMAC, engaging users in product development through focus groups,

targeted interviews, or surveys to garner feedback and input on products as they are developed. We will utilize our developed partnerships with key education programs of NANOOS members to foster ocean literacy. And we will continue to use existing methods for communication of NANOOS outputs on local, regional, and national levels, in collaboration with the IOOS Program Office and IOOS Association. Lead PI: Newton, UW

NANOOS assures the stipulations outlined in our award letter, below, are being funded at the amounts indicated for the tasks indicated. Pursuant to the President's Budget and congressional appropriations to build a national operational High Frequency Radar network and pursuant to ICOOS Act direction to the U.S. IOOS Program Office to develop national system capacity, we have made the following allotments with our FY16 funding:

- $405,000 is allocated to fund operations and maintenance of High Frequency Radars. The specific, priority HF Radars that will be supported with these funds, including locations and approximate operating frequencies are as follows: eight (8) SeaSonde HF sites which have been designated as Priority 1 sites. These are six long-range sites: LOO1 (46° 26'N, 124° 04'W), MAN1 (45° 38'N, 123° 57'W), YHL1 (44° 41'N, 124° 05'W), WIN1 (43° 40'N, 124° 12'W), CBL1 (42° 50'N, 124° 34'W), and PSG1 (41° 47'N, 124° 15'W), and two standard-range sites: STV2 (46° 11'N, 123° 59'W), and SEA1 (45° 59'N, 123° 57'W). We anticipate operating all of the long-range systems at 4.785 MHz. The two standard range systems, SEA and STV, we anticipate to operate at 12.247 MHz and 12.157 MHz respectively.
- $5,000 is allocated for System Advisory Committee Meeting travel.
- $192,543 is allocated for NANOOS Ocean Acidification Monitoring and Prediction in Oregon Coastal Waters.
- $99,437 is allocated NANOOS UW OA observatories.
- $25,000 is allocated NANOOS UW OA observatories: Closing the data Gap Enhancing the Cha'ba Mooring Program to Allow Year-Round Deployments.

Additionally, we have separately submitted to IOOS a package for a partial funding award in the amount of $74,368 for three tasks requested of NANOOS by NOAA's OAP regarding OA (a new OA observing technology, a new synthesis product, and a new OA data portal).

This completes our NANOOS Work Plan for FY2016.

BUDGET INFORMATION - Non-Construction Programs

OMB Approval No. 0348-0044

SECTION A - BUDGET SUMMARY

Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1.		$ 2,774,532.00	$	$	$	$ 2,774,532.00
2.						0.00
3.						0.00
4.						0.00
5. Totals		$ 2,774,532.00	$ 0.00	$ 0.00	$ 0.00	$ 2,774,532.00

SECTION B - BUDGET CATEGORIES

6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY				Total
	(1)	(2)	(3)		(5)
a. Personnel	$ 428,970.00	$	$	$	$ 428,970.00
b. Fringe Benefits	231,787.00				231,787.00
c. Travel	43,310.00				43,310.00
d. Equipment	32,262.00				32,262.00
e. Supplies	31,228.00				31,228.00
f. Contractual	1,457,543.00				1,457,543.00
g. Construction	0.00				0.00
h. Other	323,201.00				323,201.00
i. Total Direct Charges *(sum of 6a-6h)*	2,548,301.00	0.00	0.00	0.00	2,548,301.00
j. Indirect Charges	226,231.00				226,231.00
k. TOTALS *(sum of 6i and 6j)*	$ 2,774,532.00	$ 0.00	$ 0.00	$ 0.00	$ 2,774,532.00
7. Program Income	$ 0.00	$	$	$	$ 0.00

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SECTION C - NON-FEDERAL RESOURCES				
(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e) TOTALS
8.	$	$	$	$ 0.00
9.				0.00
10.				0.00
11.				0.00
12. TOTAL *(sum of lines 8-11)*	$ 0.00	$ 0.00	$ 0.00	$ 0.00

SECTION D - FORECASTED CASH NEEDS					
	Total for 1st Year	**1st Quarter**	**2nd Quarter**	**3rd Quarter**	**4th Quarter**
13. Federal	$ 2,774,532.00	$ 2,774,532.00	$	$	$
14. Non-Federal	0.00				
15. TOTAL *(sum of lines 13 and 14)*	$ 2,774,532.00	$ 2,774,532.00	$ 0.00	$ 0.00	$ 0.00

SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT				
(a) Grant Program	FUTURE FUNDING PERIODS (Years)			
	(b) First	(c) Second	(d) Third	(e) Fourth
16.	$	$	$	$
17.				
18.				
19.				
20. TOTAL *(sum of lines 16-19)*	$ 0.00	$ 0.00	$ 0.00	$ 0.00

SECTION F - OTHER BUDGET INFORMATION	
21. Direct Charges: Other: APL prorated direct costs-$256,385 + Services: $66,816	22. Indirect Charges:
23. Remarks:	

Statements of Work for UW-led activities for NANOOS in FY16

The award is for the continued operation of the Northwest Association of Networked Ocean Observing Systems, NANOOS, for FY 16. NANOOS is a complete observing system, composed of observing assets, data management, web display and visualization of data products, and education and outreach. NANOOS is implemented by UW-APL with several regional subcontractors that allow our system to address the diverse needs for coastal information in the Pacific Northwest. As a Regional Association of IOOS, NANOOS delivers data and information that allows the public and a variety of user groups to make decisions that involve the health, economy, and sustenance of uses of the marine coastal environment.

Statement of work for Newton and Martin for NANOOS Management

Newton will oversee and direct all elements of NANOOS RA and RCOOS. Martin, NANOOS Board Chair and IOOS Association Board member, will assist with oversight of NANOOS. This includes travel to national and regional meetings, holding NANOOS meetings, assuring NANOOS governance is executed and involving NANOOS membership in the products and decisions of NANOOS. Newton will oversee all US IOOS-NOAA OAP efforts.

Statements of work for Mickett for UW contribution to NANOOS WA coastal buoy Observations

1. Cha'ba base operations: Funds to NANOOS PI Mickett are for maintenance of the Cha'ba surface and NEMO subsurface buoys, and ensuring online availability of the data. Available funds will allow the operation and once-annual servicing of the Cha-Ba coastal buoy and the nearby subsurface profiling mooring, with moorings deployed in spring and recovered in the fall. This funding, combined with NOAA OAP funding to build and sustain a winter mooring, will allow for a year-round deployment of a surface mooring. Salary is included for the buoy field engineers, as well as for the project PI. Funds will cover annual calibration of instrumentation, travel expenses, Iridium/cell telemetry, and consumable items such as mooring hardware and batteries. We have included 22K for the purchase of two SBE 37 Inductive MicroCAT CTDs with optical dissolved oxygen to allow for year-round deployments. The budget does not include ship time (R/V Robertson or other more suitable platform) with the hope that UW Marine Operations/School of Oceanography will continue to support our operations through student cruises and other cruises of opportunity.

We will work with DMAC to ensure that real-time and archived data from both the moorings will be accessible online. Additionally, we will continue work on developing a set of standard analyses using these data to enhance the usefulness of the data streams to various users. Mickett will also analyze mooring data and publish and present scientific findings as funds allow.

2. NOAA OAP work to maintain a real-time coastal pCO2/ocean acidification mooring: We will continue to provide platform, technical and field support for the pCO_2 sensors that are operational Cha'ba in collaboration with NOAA-PMEL. NOAA-PMEL is responsible for calibration and maintenance of the OA sensors, which include pCO_2, pH and temperature/salinity. APL will obtain calibration samples and coordinate with PMEL.

3. NOAA OAP Winter Chaba; fabrication and deployment of a winter pCO_2/ocean acidification mooring: With additional funding this year, we will complete fabrication of a wintertime version of the Cha'ba buoy, allowing for year-round data for ocean acidification assessment. This funding will be used for deployment (October/November 2016) of a winter surface mooring that will allow year-round deployment of the PMEL pCO_2 system. Newton will be responsible for the overall coordination and direction of the work and leading PI-level collaboration with the PMEL Carbon Group. Mickett will supervise the design, fabrication and deployment of the proposed mooring and will coordinate mooring servicing cruises, instrument calibrations and maintenance, and data handling. Mickett will also directly supervise the supported APL field engineers, who will carry out much of the work, including mooring fabrication/assembly, instrument integration, all mooring maintenance, instrument care, mooring deployment and recovery operations, and the collection of validation samples.

Statement of work for Lee for UW contribution to NANOOS WA coastal glider Observations
Because of the loss of Seaglider 187 and no means to replace it, the proposed budget provides funds to support APL Research Associate Curry to utilize existing data to develop user products that will promote its desirability and need in the PNW. NANOOS PI Lee and Director Newton will advise this operation.

Statement of work for Mickett and Devol for NANOOS Puget Sound Observations
This effort will focus on status quo maintenance of 6 profiling buoys in Puget Sound that make atmospheric and oceanographic measurements in Puget Sound. APL-UW in collaboration with the UW School of Oceanography via NANOOS co-PIs Mickett and Devol and their teams will continue to operate these profiling buoys in Puget Sound, maintaining and servicing the buoys, sensors, and assuring high quality data streams to the web in near-real time.

Available funds will be used for partial salary for the PIs and technicians, travel for meetings and fieldwork, as well as supplies, instrument calibration, repairs and miscellaneous fieldwork expenses including vessel fees. Fieldwork involves roughly monthly to bi-monthly visits to each mooring to service the winch system, power system and swap out instrument packages as needed. Funds will allow for one 1-day mooring recovery/deployment cruise aboard the R/V JACK ROBERTSON.

This work will include deployment and recovery of mooring systems, maintenance of mooring system and components, maintenance, calibration, and deployment of oceanographic instruments, and collection and laboratory analysis of various water samples for calibration. These duties will involve field work from small boats for trouble-shooting problems and sample collection for sensor calibration, laboratory analyses of calibration samples. We will also continue to provide platform, technical and field support for the pCO_2 sensors that are operational on two of the buoys in collaboration with NOAA-PMEL. The team will continue processing and distributing the ORCA data stream, including data analysis, database management, and streaming of data to web portals, as well as submitting data for publication, writing reports, and producing other data products to stake holders and collaborators.

Statement of work for MacCready for UW contribution to NANOOS Modeling tasks: LiveOcean

We will continue development of our daily forecast model, LiveOcean. The model simulates ocean circulation and biogeochemistry in the Salish Sea and in coastal waters of the NE Pacific, including Oregon, Washington, and British Columbia. The model has been used for research on river plumes, phytoplankton growth, Harmful Algal Blooms (HABs), hypoxia, and Ocean Acidification (OA), and has been extensively validated against a wide variety of observational data. More information is available at http://faculty.washington.edu/pmacc/LO/LiveOcean.html.

Previous NANOOS support has allowed rapid development of the forecast system, and daily forecasts of physical properties have been available online for the past year, through the NANOOS NVS portal. The model focus is on OA in coastal waters, an issue of great concern to shellfish growers. Over the coming year we will focus on three extensions/improvements to the modeling system that will greatly enhance its utility to stakeholders:

1. High resolution nested sub-model of the Salish Sea, with addition of smaller rivers
2. Testing of the carbon chemistry simulations against observations
3. Improvement of web access to the model output and data comparisons, developed in collaboration with stakeholders

The Washington shellfish industry lobbied for state funding of OA research. Our forecast model, funded in part by WA State, is designed to deliver information needed by the shellfish growers, specifically giving several days advanced warning of corrosive (low Aragonite saturation state) waters flowing over shellfish beds. The model is already showing good skill in predicting hypoxia, and testing of the carbon chemistry is proceeding with data from many different sources. The daily forecast system is ideally suited to this work because it can make use of new OA observations as soon as they are available.

The modeling system is also directly useful for HAB prediction on the coast. NOAA has recently continued funding of the model system through the MERHAB program to help predict *Pseudo-nitzschia* blooms on the WA coast. These bring domoic acid (which leads to Amnesic Shellfish Poisoning) to the razor clams harvested there.

Extension of the model with higher spatial resolution into Puget Sound and the coastal estuaries will allow it to be used to understand and potentially respond to HAB, OA, and hypoxia events in these heavily utilized regions. A well-validated forecast model would also be useful for oil spill response. In the longer term the model system can be transitioned over to NOAA for operational ecological forecasting, allowing the knowledge gained by over a decade of federal science funding to be most effectively applied to real problems.

Statement of work for Mass for UW contribution to NANOOS Modeling tasks: Pacific Northwest weather

UW-Atmospheric Science's Pacific Northwest Modeling group (Mass, PI) will give APL-UW access to high resolution numerical weather forecast data. These data are produced by the UW's Weather Research Forecast (WRF) model. The PNW WRF is run in a 24/7, semi-operational mode, and is available at a variety of resolutions. The WRF data will be used in the NANOOS modeling effort and support several sub-tasks. These include the NANOOS Boaters App showing forecasted wind vector at grid points and the NANOOS Visualization System (NVS) showing specific forecast parameters where there are observing assets in the water and to provide meteorological boundary conditions to support MacCready's model.

The UW Pacific Northwest Modeling group will allow access to the WRF data at least once every twelve hours. The resolution and data parameters are to be determined by mutual agreement. Access to the data will be for a period of twelve months, upon receipt of funds, and available for yearly renewal.

Statement of work for Tanner for UW NANOOS Website and Products

PI Troy Tanner will lead the implementation of the APL-UW portion of the web portal and products tasks.

The web portal will be continuously updated with new content relevant to stakeholder issues, especially Maritime Operations, Ecosystem Assessment, Fisheries & Biodiversity, Coastal Hazards, and Climate. Content will consist of NANOOS generated educational pages, learning tools, lesson plans, and links to appropriate external materials. Prominent and crucial events will be displayed in the slide show on the home page. As information consumption by users continues to change, specifically towards a more mobile world, the portal framework will evolve to support new standards. The portal will also host content and products from related external partners, such as J-SCOPE and the 2014-2015 Pacific Anomalies Workshop. It is impossible to know in advance what external products will request a presence within the NANOOS portal, but our flexible framework has proven to be and effective and cost-efficient way to make information available that would otherwise be unavailable to out stakeholders and the general public. To better understand the needs of our users, the content they use the most, and content and products they would like us to provide, we will expand our user tracking to include in-page events. To support a growing user base, we will periodically upgrade hardware.

NVS (NANOOS Visualization System) will continue to evolve, based on the needs of our users. We intend to add real-time and situational overlays to the map, allowing users to compare measurements from various platforms at the same time. We intend to develop a unified depth tool to make it easier for users to evaluate and interact with depth related information, similar to how the timeline provides a consistent manner for viewing and interacting with time. Once the new depth control is functional, we intend to add new depth layers to appropriate overlays. We will start the development of a new notification capability. Users have consistently asked for the ability to be automatically notified when measured values fall outside of a certain range, and the first step if for us to develop an engine that can process real-time data streams as they are pulled into NVS and compare the data against specified ranges. We will investigate different approaches, and then start work on the notification engine. We

will also start the development of a new framework for mobile apps, starting with a Data Explorer that mimics the web-based NVS Data Explorer.

Statement of work for Mayorga for UW contribution to NANOOS DMAC

Mayorga will continue to serve as the primary point of contact between the NANOOS DMAC team and the IOOS Program Office DMAC efforts, and will coordinate DMAC activities among core NANOOS DMAC partners. More broadly, APL-UW DMAC efforts will focus on sustaining and enhancing the NANOOS DMAC information system and the Regional Data Assembly Center (DAC) that supports it, in these areas:

1. Mature Regional DAC Operations: We will continue our regular strategic assessment of current and future needs for DAC operations, to sustain, refresh and enhance a highly available, robust, distributed hardware and software environment; maintain appropriate staffing and team communication; and maintain up-to-date operations and system documentation to ensure transparent and clear descriptions of DAC architecture. We will expand our growing suite of tools and procedures to monitor system servers, web services, data flows and processing, and user application status. The DAC will continue to ingest and process all NANOOS supported observing and modeling assets, increasing it IOOS/DMAC Guidance compliance; and will expand the engagement of local providers (not NANOOS funded), integrating their data into NVS and DMAC services, and assisting with their data management & workflows when possible. DAC capabilities and efficiencies will be additionally strengthened through the regional and thematic partnerships with state agencies, municipalities, tribes and industry NANOOS has successfully engaged in.

2. IOOS/DMAC Functional Roles: We will continue to pursue and expand pilots to meet IOOS/DMAC Functional Roles, in some cases starting with a subset of assets while progressively extending compliance to all NANOOS-funded assets and as many non-NANOOS-funded assets as resources and partnerships allow. NANOOS already provides open data sharing, with only limited exceptions; it contributes some of its data to the WMO GTS; employs a Service-Oriented Architecture; has registered many of its standards-based data services which offer data in approved common formats and using IOOS semantics and identifiers, and are described using standard-compliant metadata. These capabilities will be incrementally expanded. Current pilots implementing Glider DAC submission and NCEI data archiving will be finalized, then extended to other assets once matured. A QARTOD pilot will be initiated soon, leading to at least partial operational implementation this year. Service implementation using 52North IOOS SOS, THREDDS, GeoServer WMS, and Web-Accessible Folder metadata will be enhanced and complemented with an operational ERDDAP server on top of some of these services.

3. NVS Support and Development: The user-friendly NVS data discovery, access and visualization application framework has served a central role in NANOOS' service to its stakeholders. The NANOOS DAC will maintain NVS support as one of its central roles, leveraging regional user needs, feedback and data reviews to continually improve the relevance and quality of metadata for observing and modeling data assets integrated and served by NANOOS. DMAC support will include more complex data types,

including multi-deployment long time series, depth profilers, drifters and gliders; as well geospatial ("GIS") datasets.

4. Engagement in National and Cross-regional DMAC Efforts: We will continue to actively participate in IOOS DMAC community development activities, particularly QARTOD; vocabulary management and semantic mapping (to which Mayorga has contributed); OGC WMS/WFS support for geospatial data; and collaborative code development and testing via github and other channels, including the Python common environment for IOOS. NANOOS DMAC will sustain its collaborations with West Coast RA DMAC teams, particularly via the West Coast Ocean Data Network and IOOS Pacific region Ocean Acidification (IPACOA) activities. Moreover, we will proactively leverage and interact with marine-DMAC relevant efforts, particularly NSF OOI (an engagement that has already been initiated), the NSF EarthCube cyberinfrastructure initiative (Mayorga is a funded participant in EarthCube), watershed monitoring initiatives, international GOA-ON ocean acidification activities and Canadian collaborations.

Statement of work for Newton for NANOOS Education and Outreach

Salaries are for E&O staff, Sprenger and Wold, for NANOOS Education and Outreach activities as well as a new part-time junior staff to be hired as Wold takes maternity leave and returns part time. E&O staff will conduct networking, outreach, and user engagement to facilitate the use of NANOOS data and products. Their focus will be on keeping the NANOOS portal current and fresh, updating content to reflect NANOOS new products, and using NANOOS home page, Facebook, and NANOOS blog to bring traffic to NANOOS portal.

Sprenger, Wold/new hire will provide outreach events for targeted groups including recreational boating and maritime operations communities. They will support the web development team's efforts in refining the NANOOS web portal to meet the needs of data users via such activities as gathering feedback from targeted users, coordinating focus groups with targeted user groups, creating training resources within the NVS Help App, such as FAQs and tutorial videos.

Sprenger will have a specific focus on working with the K-12 education community to use information and data from regional ocean observing systems to support ocean literacy and science, technology, engineering and mathematics (STEM) education in the Pacific Northwest.

Both Sprenger and Wold/new hire will work with IOOS Association and NOAA IOOS office to support IOOS education efforts on a national scale.

Statements of Work for subcontractor-led activities for NANOOS in FY16

OSU will be responsible for observing, DMAC, and modeling: Specific tasks include nearshore bathymetric surveying (Ruggerio); harbor wave observations for maritime ops (Haller); HF surface current mapping (Kosro); Oregon shelf mooring (Kosro); N California glider (Barth, Shearman); PNW coastal shelf modeling (Kurapov); Oregon DMAC support (Kosro); OA observations off Oregon (Hales).

OHSU will be responsible for Columbia River shelf and estuary observations, regional DMAC support, and modeling around the Columbia River estuary and plume (Baptista).

DOGAMI will be responsible for Oregon shoreline observing (Allan) and for Allan to participate as User Products Committee Chair.

OR Dept. State Lands will be responsible for estuarine observations in South Slough/Coos Bay (Helms).

WA Dept Ecology will be responsible for Salish Sea ferry-box observing (Maloy) and for Washington shoreline observing (Kaminsky).

For each subcontract, the detailed SOWs are provided within the subcontractor package, including their detailed budgets, budget justifications, and other supporting documents.

RCOOS YR 10-14 REDUCED EFFORT DISTRIBUTION BREAKDOWN SUMMARY

YEAR 10 **$2,774,532**

UNIVERSITY OF WASHINGTON:

Area / Lead	Mngmt Newton	DMAC Mayorga	Product & Web Dev Tanner	Outreach & Education Newton	WA Shelf Buoys Mickett	Puget Snd Buoys Mickett	WA Shelf Gliders Lee	SACM Newton	OA WA SHELF Mickett	OA DATA Fabrication Mickett	**APL TOTAL**	Other UW: ATMOS Atm Model Mass	Other UW: OCN PS Model MacCready	Other UW: OCN PS Buoys Devol	**Combined Yr 10 Grand TOTAL**
Salaries	100,585	38,536	68,973	52,706	20,450	17,134	21,498	0	29,503	16,178	**365,563**	4,888	20,405	38,114	**428,970**
Benefits	61,659	23,623	42,281	32,309	9,721	10,144	9,911	0	15,129	8,584	**213,361**	1,584	5,478	11,364	**231,787**
Equipment	0	0	10,000	0	22,262	0	0	0	0	0	**32,262**	0	0	0	**32,262**
Travel	21,448	4,548	3,337	1,854	2,580	2,580	0	3,183	2,580	0	**42,110**	0	0	1,200	**43,310**
Sub Awards	1,457,543	0	0	0	0	0	0	0	0	0	**1,457,543**	0	0	0	**1,457,543**
Services	16,140	0	0	468	12,688	23,648	0	0	13,872	0	**66,816**	0	0	0	**66,816**
Supplies	672	138	0	1,790	10,416	10,857	422	0	5,582	238	**30,115**	0	11	1,102	**31,228**
Grad Op Fees	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	**0**
Prorated Direct Costs	104,161	21,390	36,669	28,521	17,874	19,671	10,186	1,019	16,894	0	**256,385**	0	0	0	**256,385**
Total Direct	1,762,208	88,235	161,260	117,648	95,991	84,034	42,017	4,202	83,560	25,000	**2,464,155**	**6,472**	**25,894**	**51,780**	**2,548,301**
Indirect Coss	57,887	16,765	28,740	22,352	14,009	15,966	7,983	798	15,877	0	**180,377**	3,528	14,106	28,220	**226,231**
TOTAL	**1,820,095**	**105,000**	**190,000**	**140,000**	**110,000**	**100,000**	**50,000**	**5,000**	**99,437**	**25,000**	**2,644,532**	**10,000**	**40,000**	**80,000**	**2,774,532**
Target:	1,820,095	105,000	190,000	140,000	110,000	100,000	50,000	5,000	99,437	25,000	2,644,532	10,000	40,000	80,000	2,774,532

SUBAWARDS Breakdown Summary:

OREGON STATE UNIVESITY:

Area / Lead	CA Shelf Glider Barth	OR Shelf Buoy Kosro	Nearshore Bathymetry Ruggerio	HF Radar Kosro	Port Radar Haller	OR-WA Coast Model Kurapov	OSU DMAC Kosro	Hales	**OSU Total**	**OHSU** Col shf Obs Model, DMAC Baptista	**DOGAMI** OR Shore Observ Allan	**OR DOSL** S. Slough Moorings Helms	**WA Ecolgy** Estuarine & Shoreline Kaminsky	**Sub Award Total**
Salaries	23,447	30,228	16,266	148,810	21,305	26,070	19,299	50,900	**336,325**	141,166	27,183	0	40,257	544,931
Benefits	11,173	15,425	6,059	78,114	12,357	11,767	10,228	25,146	**170,269**	46,876	13,864	0	15,106	246,115
Equipment	0	10,000	0	0	0	0	0	14,000	**24,000**	0	0	17,095	0	41,095
Travel	1,300	2,500	3,500	6,000	600	2,000	4,000	3,000	**22,900**	4,762	5,170	0	5,800	38,632
Sub Awards	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0
Services	1,500	0	0	36,526	0	2,000	3,400	28,000	**71,426**	0	816	0	9,150	81,392
Supplies	13,774	13,281	3,526	7,000	550	2,735	4,028	14,827	**59,721**	30,212	63	12,905	3,853	106,754
Other	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0
Grad Op Fees	0	0	0	0	0	4,702	0	0	**4,702**	0	0	0	0	4,702
Total Direct	51,194	71,434	29,351	276,450	34,812	49,274	40,955	135,873	**689,343** **0**	223,016	47,096	30,000	74,166	1,063,621 0
Indirect Cost	23,806	28,566	13,649	128,550	16,188	20,726	19,045	56,670	**307,200**	57,984	12,904	0	15,834	393,922
TOTAL	**75,000**	**100,000**	**43,000**	**405,000**	**51,000**	**70,000**	**60,000**	**192,543**	**996,543**	281,000	60,000	30,000	90,000	1,457,543
Target:	75,000	100,000	43,000	405,000	51,000	70,000	60,000	192,543	996,543	281,000	60,000	30,000	90,000	1,457,543

Budget Justification

Budget will be used to support the NANOOS RA for regional coordination and for NANOOS' essential RCOOS subsystems. Detailed budgets for UW, the fiscal agent of NANOOS, are provided, along with subcontractor sub-budgets. We describe here budget justification and detailed narrative according to budget category.

a. Personnel:

Personnel salaries are for sustaining the following sectors of the NANOOS enterprise:

- Management, for PI Newton and co-PI Martin to oversee and direct all elements of the NANOOS RA and RCOOS; Newton will oversee the US IOOS-NOAA OAP efforts.
- Observing Subsystem, for lead PIs and technicians (for UW, this includes salaries for PI Mickett and field engineers to service La Push, WA, buoy, for PIs Mickett/Devol and field engineers to provide periodic servicing of 6 buoys throughout the Puget Sound region), see subcontracts for additional Observing Subsystem PIs. The glider budget (PI Lee) is being directed to salary for product development.
- NOAA OAP addendum to our Observing Subsystem, to support sampling for IOOS-OAP ocean acidification (OA) observations from the La Push, WA buoy and Newport, OR buoy (for UW, salaries for PI Mickett and field engineers; see OSU subcontract for Oregon OA (PI Burke). In addition, completion and deployment of an OA buoy will be done to supplement the current La Push WA buoy so year-round coverage is attained.
- Modeling and Analysis Subsystem, for lead modelers and technicians needed to maintain numerical models (for UW, this includes salary to PI MacCready for his ocean modeling group and to PI Mass for his atmospheric modeling group), see subcontracts for additional Modeling Subsystem PIs.
- DMAC Subsystem, for lead PIs and technicians needed to maintain DMAC capabilities (for UW, this includes salaries for PI Mayorga and data engineers), see subcontracts for additional DMAC Subsystem PIs.
- Web Development, to maintain the NANOOS website (for UW, this includes salaries for PI Tanner and technicians) and see DOGAMI subcontract for salary for the User Products Committee Chair Allan to coordinate user product prioritization and execution.
- Education and Outreach Subsystem, for E&O staff Sprenger and Wold/new hire to execute education and outreach activities.

b. Fringe Benefits:

The benefit and leave rates included in the budget were in accordance with UW's proposed rates submitted to the Department of Health and Human Services (DHHS) for approval. The University has proposed these fringe benefit rates in its F&A rate negotiations with DHHS and expects them to be approved as reasonable and allowable. Per UW policy on proposal budgets, these are the rates the University began using for proposals effective 7/1/16. The benefit rates differ between APL-UW and other departments at UW. APL's proposed benefit rates used in this proposal budget are 31.3% for Professional Staff and 17.9% for Hourly employees. Other UW department's proposed benefit rates of 32.4% for Professional Staff. In addition to the UW

benefit rates, APL charges leave rates of 30.0% for Professional Staff. [NOTE: These are the rates that were authorized at the time this funding was received and the funds placed in the budget. Rates have been updated since that time]. The latest approved rate agreement is dated 26 May 2016 and a copy is attached to this proposal.

c. Travel:
Regional and national travel is requested for coordination, meetings, and workshops associated with NANOOS (including NANOOS Governing Council meeting; Tri-Committee meeting, All-PI meeting, and regional Observing, DMAC, Modeling, and Education and Outreach meetings), IOOS Association (including bi-annual Board meetings), and IOOS (including bi-annual IOOS meetings and IOOS DMAC meetings). Web development travel is for regional coordination. Education and Outreach travel is for focused user group and education meetings. Local travel and ferry costs are associated with buoy support and maintenance of the observing subsystem.

Funds for domestic and international travel are included in this proposal. Permission for international travel is requested. While not budgeted at this time, it is possible Newton, in her work representing IOOS with the Global Ocean Acidification Observing Network (GOA-ON) will require international travel. Should additional international travel be required, funds from domestic travel may be used after consultation with the NOAA IOOS program manager.

d. Equipment:
Equipment for purchase by UW and its subcontractors is listed in the accompanying table showing task, number, amount, and justification. Equipment purchased will be owned by UW or its subcontractors, but will be used for NANOOS as long as funding is provided. The cost of the equipment listed in the budget is based on quotes from the manufacturer or distributor. Quotes are available upon request.

EQUIPMENT TO BE PURCHASED BY UNIVERSITY OF WASHINGTON:

Task	No	Equipment	Amt per	Justification
WA coast buoy (Mickett)	2	SBE 37 MicroCAT IMP	$11,131	Replace damaged instrument; need one spare
Web development (Tanner)	2	Server	$5,000	To replace aging servers and to acquire development and test platforms

EQUIPMENT TO BE PURCHASED BY SUBCONTRACTORS:

Task	No	Equipment	Amt per	Justification
OSU: NH-10 buoy (Kosro)	1	Buoy	$10,000	Replace buoy lost in storm
OSU: OA buoy (Hales)	2	Mooring release	$7,000	Facilitates faster turn-around of moorings

ODSL: (Helms)	1	Coastal mooring	$17,095	Upgrade system

Lease-versus-buy analysis: Lease of the equipment listed above is either not available or not cost-effective for sustained operations. Analysis of lease vs. purchase options for common oceanographic equipment such as current point-measurers or current-profilers, CTDs, wave-tide gauges, sonars, and water quality sensors (temperature, salinity, oxygen, chlorophyll, turbidity, optics) shows leasing rates are generally set to repay instrument purchase costs in 250 to 500 days. Because instruments purchased here will be used in a sustained observing program, beginning with the five-year program funded under this grant, and with the anticipation of future participation, the purchase option is the more cost effective for all of these applications.

e. Supplies:
Supplies costs are required to maintain existing observing subsystem assets for coastal, estuarine and shoreline observations. Supplies are for buoy repair /replacement parts (e.g., shackles, cables) and consumables (e.g. batteries, chemicals). Additional supplies for NANOOS outreach include folders, postcards, decals, pens, etc.

f. Contractual:
The strong academic-industry-government-NGO partnership of NANOOS' RCOOS requires that subcontracts be established for certain sub-element tasks, to:

- OSU for observations, DMAC, and modeling in OR waters: nearshore bathymetric surveying (Ruggerio); harbor wave observations for maritime ops (Haller); HF surface current mapping (Kosro); Oregon shelf mooring (Kosro); N California glider (Barth, Shearman); PNW coastal shelf modeling (Kurapov); Oregon DMAC support (Kosro); OA observations off Oregon (Hales);
- OHSU for Columbia River shelf and estuary observations, regional DMAC support, and modeling around the Columbia River estuary and plume (Baptista);
- DOGAMI for Oregon shoreline observing (Allan) and for Allan to participate as User Products Committee Chair;
- OR Dept. State Lands for estuarine observations in South Slough/Coos Bay (Helms); and
- WA Dept Ecology for Salish Sea ferry-box estuarine observing (Maloy) and for Washington shoreline observing (Kaminsky).

For each subcontract budget justifications are provided in the subcontractor package, including their detailed budgets, SOWs, and other supporting documents.

g. Construction:
None

h. Other:
Included in this section are services and APL-UW Prorated Direct Costs. The University Indirect Cost rate applied to APL-UW is lower than the rate elsewhere on campus (19% vs. 54.5%) and

does not recover the Laboratory's central costs. These are recovered by applying a Prorated Direct Cost of 32.0% on modified total direct costs. Prorated Direct Costs include such expenses as salaries and employee benefits for central service employees, administrative data processing, communications, and some facilities costs. APL-UW's Prorated Direct Costs have been reviewed and accepted by the Navy's resident Administrative Contracting Officer, Evan Wood, Administrative Contracting Officer, Office of Naval Research, Seattle Regional Office, per letter dated 3 May 2016 (copy attached).

The services included in this section include the costs for planned workshops (including meals); conference registration fees; printing brochures/posters/informational material; chemical analysis charges (e.g., nutrients, chlorophyll, oxygen); instrument calibration and satellite tracking and iridium telemetry services and cellular internet services to allow communication with and data transmission from moorings. Another service cost for NANOOS management/outreach is data plan coverage for an iPad tablet used in field or remote settings to connect users with NANOOS data streams. Vessel rental/service charges are also included (e.g., R/V Mackinaw and R/V Robertson).

Funds are requested for annual IOOS Association dues.

j. Indirect charges:
APL-UW's negotiated indirect rate is 19% of Modified Total Direct Costs (MTDC). Other departments at UW have an indirect rate of 54.5% MTDC. MTDC includes all direct costs less equipment, graduate operating fees, and the amount of sub awards above the initial $25,000. The current Facilities and Administrative rate agreement with DHHS is dated 26 May 2016 (copy attached).

As per current, approve practice, the APL-UW may re-budget within the total estimated costs.

Office for Sponsored Research and Award Administration
Oregon State University, A312 Kerr Administration Building, Corvallis, Oregon 97331-2140
Tel 541-737-4933 | Fax 541-737-3093 | sponsored.programs@oregonstate.edu

July 7, 2016

To Whom It May Concern:

Oregon State University is pleased to submit the subaward proposal to the University of Washington for NOAA's program FY 2016 Implementation of the U.S. Integrated Ocean Observing System, and OSU's contribution to NANOOS 2016-2021.

The appropriate programmatic and administrative officials have reviewed and approved this proposal in the amount of $996,543. The period of performance for this project will be June 1, 2016 through May 31, 2021. My signature below, as the authorized institutional official, indicates institutional approval for the proposed project.

OSU has a conflict of interest policy that is compliant with the PHS Financial Conflict of Interest Regulations (42 CFR Part 50 Subpart F).

Oregon State University is prepared to perform the work as outlined in the proposal, subject to the State of Oregon – Oregon State University regulations. Dr. P. Michael Kosro will serve as Oregon State University's principal investigator on this project.

Approved:

Acting for: Patricia A. Hawk
Institutional Authorizing Official

DUNS: 053599908
EIN: 61-1730890

OSU NANOOS, 2016-2017, Modified statements of work and budget justifications

This document updates year-1 of the statement of work to include budget guidance from NOAA and UW. Years 2 thru 5 are not affected by these changes.
Appended below is a Statement of Work, Budget, and Budget Justification for the Oregon State University subcontract contribution to work to be undertaken in pursuit of the goals of year 1 of the 5-year NANOOS (Northwest Association of Networked Ocean Observing Systems) proposal for June 1, 2016 through May 31, 2017, to the University of Washington. Based on year-1 guidance, the budgets shown for year 1 are reduced to a total of $996,543 for the period June 1, 2016 through May 31, 2017. The modified statements of work contained here are reduced during year 1 from those proposed originally.

We present eight projects, each with its own statement of work and budget justification. Budgets for each project, along with a combined budget, are also included.

Contents:

Statements of work

I. Continuing Projects 1-7. Original statement of work had statements of work for funding at $4M annual level, with notations for anticipated cutbacks if NANOOS is funded at $2.5M annually or $1.5M annually. Our funding for year 1 is near the $2.5M annual budget for year 1, and the text below has been modified to reflect that.

Project 1: OR/WA Nearshore Bathymetry. Peter Ruggiero, Oregon State University

Statement of Work: The objective of this component of the RCOOS will be focused on maintaining the nearshore bathymetric component of both the Washington and Oregon beach and shoreline monitoring efforts in cooperation with Jonathan Allan of DOGAMI and George Kaminsky of WA DOE. The purpose of our efforts is to document the seasonal-interannual-decadal changes in beach and shoreline morphodynamics and for identifying coastal hazards, information that is critical to state and federal coastal resource managers, geotechnical consultants, and the public-at-large.

Since sandbars dissipate wave energy and provide a buffering capacity that protects the shoreline, both the temporal and alongshore variability of nearshore bathymetry create varying regions of exposure to coastal hazards along the coast (Cohn et al. 2014). Quantitative knowledge of nearshore bathymetry is also necessary as the bottom boundary condition for the modeling of nearshore flows, sediment transport, and subsequent morphology change (Di Leonardo and Ruggiero, 2015). Therefore these nearshore bathymetric data provide a critical source of information for improving coastal hazard mitigation along the coastlines of the Pacific Northwest.

In recent years, NANOOS funded nearshore bathymetric data has supported the US Army Corps' Regional Sediment Management at the Mouth of the Columbia River; Oregon Wave Energy Trust's ocean wave energy conversion projects; FEMA flood mapping activities in all Oregon Counties; OSU's PISCO group's habitat characterization work; Washington Department of Ecology's coastal hazards assessments along the southwest Washington coast, and basic research on coastal hazards, morphodynamics, and climate change (resulting in multiple publications and student theses). NANOOS funded nearshore bathymetric data is being explicitly incorporated in a coastal hazards decision support tool (Baron et al., 2015, Mull and Ruggiero, 2014) supported by NOAA's Climate Program Office Coastal and Ocean Climate Applications (COCA) program. Through deep engagement with a Tillamook County (OR) Knowledge-to-Action Network (KTAN), we are co-developing a scenario analysis and modeling tool (*Envision*) to explore strategies for reducing vulnerability to coastal hazards based on a variety of drivers of change - population growth, sea level rise, and possible changes in storminess patterns.

Observations: This task consists of annual nearshore bathymetric surveys, measured using a PWC-based Coastal Profiling System at selected sites in Oregon and Washington. During each summer, Peter Ruggiero's group at Oregon State University proposes to collect nearshore bathymetry data along the four sub-cells of the Columbia River littoral cell (CRLC). Over 220 individual cross-shore profiles will be collected, continuing a

nested sampling scheme that has been ongoing since 1999, in which each profile is approximately 2 km long extending from the lower inter-tidal to ~12 m of water depth. Approximately 400 kilometers of nearshore mapping will take place with approximately 10-12 days of field data collection. In all cases these nearshore bathymetry measurements will be combined with topographic measurement collected by PI Kaminsky's group at Ecology developing complete maps of the nearshore planform. These nearshore bathymetric data will continue to provide a critical source of information for improving coastal hazard mitigation along the coastlines of the CRLC.

During each summer, Ruggiero's group will also collect nearshore bathymetric data along much of the Rockaway littoral cell along the north-central Oregon coast, one of the most rapidly eroding stretches of coast in the state. Approximately 75 individual cross-shore beach profiles will be collected from the lower intertidal to ~25 m of water depth (~1500 m from the shoreline). These data will be combined with topographic data collected synoptically by PI Allan's group at DOGAMI developing complete maps of the nearshore planform.

Deliverables: The data will be processed from their raw format into deliverable text files after having passed a rigorous quality assurance process. Specific deliverables include digital data, first in simple ascii tables associated with each nearshore bathymetric map, and ultimately in a gridded form representing the full nearshore planform.

Budget justification: This work, the collection of nearshore bathymetry data along 3 (sub) littoral cells in Washington (North Beach, Grayland Plains, and Long Beach Peninsula) and 1 littoral cells in Oregon (Clatsop Plains), requires part time support of a researcher (Ruggiero), a technical person (TBD), two hourly graduate student workers, and an undergraduate student to perform the majority of the field work. The proposed budget provides for survey preparation and data collection (domestic travel), processing, archiving, and initial change analyses. Domestic travel of $3,500 in year 1 is requested based on 13 days along the Oregon and Washington coast for the team of 5. Minor support $3526) is also requested for minor equipment and supplies (batteries, cables, pelican cases, etc.) required to maintain and operate a 4th generation PWC-based Coastal Profiling System (designed and built by OSU). The PWC based nearshore surveying system used by Ruggiero's group is now over 7 years old and the equipment is showing wear and tear. In particular, the PWCs themselves have been driven for several hundreds of hours in very demanding conditions and need to be carefully maintained to be able to safely collect this data.

References:

Baron, H.M., Ruggiero, P., Wood, N.J., Harris, E.L., Allan, J., Komar, P.D., and Corcoran, P., 2015. Incorporating climate change and morphological uncertainty into coastal change hazard assessments, Natural Hazards, 75:2081-2102, DOI: 10.1007/s11069-014-1417-8.

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Project 2: X-band radar monitoring at navigational inlets, Merrick Haller (OSU)

Background

Our marine radar wave observing station began regular observations at the mouth of Yaquina Bay (Newport, OR) on May 1st 2009 and data is available in real-time through the NANOOS Visualization System. The system collects regular image sequences each hour and uploads all data and products to our database server on the OSU campus.

In April of 2013 we installed an additional station on Cape Disappointment to monitor the Mouth of the Columbia River. This effort was originally supported by the Office of Naval Research (Coastal Geosciences) for the DARLA series of field experiments. The MCR radar installation has proven to be extremely valuable. Data quality at the site is exceptional, primarily due to the substantial increase in elevation of the radar station on Cape Disappointment (CapeD Coast Guard Station). We remain excited about the new radar installation at the Mouth of the Columbia River. We would like to add this station as a real-time station under the NANOOS observational system, as there is significant stakeholder interest in the Columbia River site. We have also been working with the Columbia River Bar Pilots (Captain Dan Jordan) to develop a better understanding of frontal dynamics at the MCR and their impact on navigation. This includes development of a new "front-imaging" data product. These fronts indicate where there are sharp surface current gradients that can affect navigation.

On the science front, the recent PhD Thesis (David Honegger, OSU; "Depth Estimation and Frontal Imaging via X-band Marine Radar") identified two previously unobserved phenomena at the MCR. The first being the presence of oblique internal hydraulic jumps on ebbing tides. The second being a negative backscatter anomaly indicating the leading edge of salt water intrusion as the tide switches from ebb to flood. Both of these phenomena are presently the subject of further study and upcoming paper submissions.

Proposed Effort

Our proposed effort is to continue X-band radar monitoring of waves and currents at two important navigational inlets, Yaquina Bay and the Mouth of the Columbia River. In addition to data collection, this effort will continue software and product development. Real-time data products include wave directional spectra, both the latest observations and one-week historical records, as well as a wave-averaged product for viewing current fronts from the most recent tidal cycle.

Another data product we have been working on extensively is radar-derived bathymetry. Bathymetry is of leading order importance in determining the dynamics of the coastal zone, yet it often remains unknown or poorly constrained. Wave-imaging remote sensors can be exploited for estimating nearshore hydrography. Observational time series of wave speeds and directions can be utilized to estimate hydrography using the linear wave dispersion relation. Reliable around the clock detection of the wave field makes X-band marine radar an attractive sensor choice. In addition, the large wave resolving footprint allows full coverage of important coastal regions such as the ebb shoals of tidal and engineered inlets.

We have already demonstrated success at bathymetric retrievals at the MCR (Benson Beach and the navigational channel area between the jetties. Tests of the algorithm at Newport are still ongoing. These bathymetric retrievals are complementary to the traditional jet ski surveys at these sites, as the radar estimates provide bathymetry information in the seasons between any summer in-situ collections, albeit less accurately than traditional acoustic surveying. Our radar-derived bathymetry effort has also caught the attention of the Office of the Coast Survey (NOAA, Silver Spring, MD). At their request we delivered a Technical Training Course entitled "Wave-Imaging Remote Sensing for Hydrographic Applications" (May 27-28, 2015) and we hope to continue to develop this relationship.

Budget Justification

Support for this effort is primarily for technician time (Faculty Research Assistant, Randy Pittman), with minor amounts of materials and supplies (hard drives, radar parts, routine radar servicing) and travel costs to field sites for service and maintenance. This effort is heavily leveraged with other funds (Office of Naval Research, Coastal Geosciences), which we have secured through 2019. The interest of ONR is primarily with the MCR site, which is what has allowed us to expand our radar monitoring efforts to this as a second site.

Fringe and indirect costs are calculated according to OSU guidance. Travel costs are for both in-state (Newport) and out-of-state (Ilwaco, Washington) field work.

Project 3: HF Surface Current Mapping. P. Michael Kosro, Oregon State University

We propose to continue to operate a suite of current measurement sites using HF radar in a continuous mapping array from southern Washington to northern California. One-dimensional currents ("radials") are collected from each site and, where radials overlap, full 2D "total" currents are measured by combining radials. Each year this system produces approximately 50 million individual hourly-averaged radial current measurements. The vector currents are made available to, and used by, a wide array of stakeholders, including the US Coast Guard for search-and-rescue, NOAA's Office of Response and Restoration for oil spill and pollution response, ecosystem analysts for tracing transport of HABS, fishermen and other ocean users for route planning, the US Weather Service through AWIPS, field scientists for operational planning, and ocean modelers for data assimilation to improve their model fidelity, and for assessment of

ocean interannual variability thanks to their long history.

We will continue to operate eight (8) existing SeaSonde HF sites which have been designated as Priority 1 sites by the national HF program. These are six (6) long-range sites: : LOO1 (46° 26'N, 124° 04'W), MAN1 (45° 38'N, 123° 57'W), YHL1 (44° 41'N, 124° 05'W), WIN1 (43° 40'N, 124° 12'W), CBL1 (42° 50'N, 124° 34'W), and PSG1 (41° 47'N, 124° 15'W), and two standard-range sites: STV2 (46° 11'N, 123° 59'W), and SEA1 (45° 59'N, 123° 57'W). As these resources allow, we hope to also continue operations at our three Priority 2 standard-range sites, YHS2, WLD2 and WSH1.

We will continue to provide data and products. We will continue our collaboration with the modeling community to assist in facilitating the assimilation of HF data into regional circulation models. These measurements will contribute to the improvement of maritime operations (search and rescue, vessel routing), to ecosystem assessment, including analysis and modeling of HAB transport. They also contribute to the assessment of interannual variability, based on histories extending back to 1997 in the longest occupied locations.
These data are part of the national HF surface-current mapping system, which is a coordinated program to provide surface current information in near real-time to the public. In addition to local data collection, processing, and product generation, the radial data are reported in near realtime to the national system, which uses duplicate centers to provide emergency operational backup. The data are combined nationally into eastward and northward currents ("totals") and the results provided via ftp, via a THREDDS server which can provide subsetted data, and via graphical output.

These results are also provided in GNOME format for oil spill/pollution work by NOAA, in netcdf, in AWIPS for the national weather service forecasting offices, and to the US Coast Guard for use in search and rescue.

These data provide high-resolution maps of surface currents on an hourly basis. They have been used in a wide variety of scientific analyses, including examination of topographic effects on coastal flows (Kosro, 2005; Kim et al., 2011), development of interannual variability such as El Nino (Kosro, 2002; Durski et al., 2015), recognition of and mapping alongshore propagating signals in the currents (Kim et al., 2013), unexpected flows such as the subarctic invasion of 2002 (Kosro, 2003) or the delayed spring transition of 2005 (Kosro et al., 2006), the tracking of Harmful Algal Blooms (Hickey et al., 2013), the variability of coastal tidal systems (Erofeeva et al., 2003; Kurapov et al., 2003; Osborne et al., 2011; Osborne et al., 2014). Their combined fine spatial and temporal resolution have allowed the mapping of spatial scales of the fast inertial currents in the Pacific Northwest, an important contributor to mixing (Kim and Kosro, 2013; Kim et al., 2014). They have proven especially valuable in combination with ocean circulation models – by providing ground truth for model comparison (e.g. Liu et al, 2009; Yu et al., 2012; Durski et al., 2015) and (separately!) through assimilation of the HF data, the models are able to do a considerably better job in estimating the ocean flows not only near to, but also distant from the data, both horizontally and vertically (Oke et al., 2002a, 2002b; Kurapov et al., 2003; Paduan et al., 2004; Yu et al., 2012).

They provide long time-series of coastal flows which often vary strongly in space, complementing the time series data available from fixed moorings (e.g. Kim et al., 2011). Near the coast, they delineate the flows associated with rotationally trapped buoyancy currents from river outflow (Mazzini et al., 2015).

The data are also used by the glider community, to improve steering of their gliders. In the same way, fishermen use the data to avoid stemming large currents (on introduction to the measurements at a meeting of "Scientists and Fishermen Exchange" in Newport, one said "this will save me a lot of money").

If funded at the $2.5M/yr. level, we anticipate an allocation for HF of $405,000/yr. This effort will sustain existing Priority 1 radars, but will be unable to add the new radar systems along the Washington coast.

Budget Justification
Salary is proposed for scientific and management participation (Kosro), field repairs and calibration (Arnesen) and data processing, networking, archiving, and quality control (Dorkins).
Travel is budgeted for visits to experimental sites for data archiving (6/yr./site), equipment repairs, and instrument calibration; funds to attend two program or scientific meetings per year are requested. Costs for connection of required computers to the CEOAS network (Research Computing System) have been budgeted). Funds to defray the costs of publication (journal articles, meeting abstracts, etc.) have been budgeted in each year. Funds for on-site (far from OSU campus) electricity, internet connectivity (e.g. cell phone/modem/ISP service) are requested under Other Direct Costs/Other, as are costs to construct, secure, and electrify equipment shelters at each of the proposed new sites, and funds for repair or replacement of on-site electronics. Materials for antenna cables, computer data storage, project-related data acquisition and processing computers, and expendables are also included in Materials & Supplies.

Project 4: Oregon Shelf Mooring System, P. Michael Kosro, Oregon State Univ.

The goal of this project is to maintain a mooring system on the Oregon shelf. The intent is to sustain a mooring similar to the one that is currently transferring real-time data to the NANOOS and NDBC websites.

Moored observations are an important component of an ocean observing system, providing continuous time series information. Time series data observed at a fixed point compliment spatial data, such as observations from gliders and satellites.
The mooring observations can be useful for:
* providing weather information—wind, temperature of air and water, barometric pressure, etc.
* looking at the currents, from near surface to deep,
* obtaining real-time data that will help improve model predictions, and
* continuing time series at NH-10 to help resolve interannual variability.

A shelf mooring will be maintained during the five-year program to collect time-series of ocean parameters at subsurface depths, and to obtain meteorological measurements. This program will operate in cooperation with Burke Hales' biogeochemistry measurement program, which focuses on CO2 and ocean pH.
Since the start of NANOOS, a physical-meteorological mooring has been maintained on the Oregon shelf, measuring water temperature at about 10 depths, water salinity at 3-4 depths, dissolved oxygen in the lower water column, and vertical profiles of horizontal currents using an Acoustic Doppler Current Profiler. On the surface float, meteorological data are collected. There is cell-phone communication between the buoy and shore, with real-time reporting of ocean data (T, S, currents) and meteorological data (wind speed and direction, insolation, air temperature, etc) and buoy diagnostics (GPS location, battery voltage, etc). An Argos satellite-based monitoring system provides alerts should the buoy's location (determined independently of the GPS) depart from its expected location by more than a fixed amount. In addition, the mooring serves as a potential platform of opportunity for other investigators who wish to collect timeseries data from their own sensors.

As it has been historically, the preferred plan will be to recover the mooring and re-deploy it twice per year, to balance costs vs. risk of data loss.

OOI has begun operation at NH10, but its data are not yet released, and cross-validation against NANOOS measurements has not yet been done; NANOOS continues to collect data at NH10 which can be used for this purpose. After the end of year 1, and once these have been satisfactorily completed, we expect to relocate the buoy south to a midshelf location, most likely near Coos Bay, Oregon. This will extend the geographic coverage of NANOOS, putting more sensors closer to its southern boundary. This site has a very rich history of moored time-series measurements to provide climatological perspective on changes to the various cycles and responses to forcing, having been occupied for 33 months during the SuperCODE experiment during 1981-1984 (Allen & Smith), for 59 months during 1986-1991 for ENSO monitoring (Smith), and for 53 months during 2000-2004 for the GLOBEC experiment (Hickey), providing more than 12 years of background data. This location is also near the southern-most glider transect planned for operation by the OOI, providing opportunities for synergy yielding high-temporal resolution data from the mooring at the mid-shelf location, and high spatial resolution but weekly or lower time resolution from the glider. In addition, the mooring will be offshore from the South Slough National Estuarine Research Reserve, a NANOOS member, and near the home waters of the Oregon Institute of Marine Biology (OIMB) in Charleston, Oregon, providing support from offshore measurements for both institutions. The mooring measurements will be downloaded and post-processed at the completion of each 6-month deployment. In addition, a subset of these data will be reported by cell-phone and provided in near-realtime via NVS.

Budget Justification
Funding is requested for support as follows:

PI for management and NANOOS participation; Mooring Technician for engineering, preparation, deployment, recovery of mooring twice/year.
Travel for mooring cruises and regional meetings are included for each year, and funds for attending a national meeting are requested in year 1.
Materials and Supplies: Funds are requested for instrument calibrations, mooring rigging, cell phone charges, ARGOS satellite beacon charges, batteries, replacing worn and damaged sensors, anchors, etc.
Permanent Equipment: In year 1, funds are requested to construct a 2nd surface buoy, telemetry and associated electronics, allowing gapless recovery/redeployments. Most of the equipment currently in use has been purchased by other projects, and is aging. Equipment will be retained by Oregon State University after the project ends for use on other research initiatives.
Ship time for this work has been budgeted under the Hales project for Ocean Acidification.

Project 5: Underwater Glider Observations off Trinidad Head, CA
John (Jack) Barth and R. Kipp Shearman, Oregon State University

We will continue year-round sampling along the Trinidad Head (TH), CA, line (41 3.5'N) using an autonomous underwater glider. Beginning in November 2014, we started glider sampling along the TH line, with financial assistance from NANOOS, CeNCOOS and the NOAA SWFSC. In consultation with NANOOS leadership, we moved our IOOS-supported glider sampling to the TH line after the NSF-supported Ocean Observatories Initiative began glider sampling along the Newport Hydrographic Line where we have been conducting glider sampling since the inception of NANOOS.

The TH line fills an important gap in continuous subsurface oceanographic observations between Newport, OR, and Monterey Bay, CA, and has been identified in many California Current plans as a key sampling location (e.g., the PaCOOS Science Plan). Running a glider on the TH line with support from both NANOOS and CeNCOOS is a perfect opportunity for collaboration between these two northern California Current IOOS regional associations. For the surface-intensified, equatorward-flowing California Current, the TH line forms an important "upstream" boundary condition for central and southern California. For the subsurface, poleward-flowing California Undercurrent, the TH line forms an important "upstream" boundary condition for the Pacific Northwest, with water properties brought north by the California Undercurrent (salinity, temperature, dissolved oxygen, nutrients) setting the source water values for upwelled waters off the Pacific Northwest. Thus, the TH line subsurface observations are critical to keeping ocean models on track.

We are using a 1000-m capable Seaglider equipped with the following sensors: CTD, dissolved oxygen (Aanderaa 4831 optode), light backscatter (700 nm), chlorophyll fluorescence and Colored Dissolved Organic Matter (CDOM) fluorescence (WET

Labs Ecopuck). The gliders also measure depth-averaged velocity which can be combined with geostrophic estimates of relative velocity to get absolute velocity and hence transport. We presently own 3 of these Seagliders, valued at approximately $133K each, so that we can "hot swap" them to maintain continuous coverage along the TH line. The glider will fly from approximately the 100-m isobath (~10km offshore) to at least 130W (~400 km offshore), repeating the line every ~30 days. Data are returned to shore after every dive and submitted in real-time to the IOOS glider data center and to NOAA's NODC. The data are also automatically sent to both NANOOS and CeNCOOS for use by other PIs, for plotting and for creation of value-added products.

In addition to the OSU glider group members, Jack Barth (PI), Kipp Shearman (co-PI), Anatoli Erofeev (lead glider technician) and Steve Pierce (glider technician), we work with CeNCOOS's Dr. Eric Bjorkstedt (NOAA SWFSC, Humboldt State University) and his colleagues who are presently making CTD and zooplankton measurements along the TH line. We work with Eric to make use of the R/V Coral Sea to conduct glider fieldwork. We will also collaborate with NANOOS and CeNCOOS modelers to make sure our glider data is readily available for their data-assimilating circulation models of the California Current.
To utilize the glider data to create products to inform policy and decision-making, we intend to supply not only value-added plots of subsurface data, but a derived, simple "El Niño Index" comparable to that being computed by Dan Rudnick (Scripps, SCCOOS, http://www.sccoos.org/data/elnino/). This index can be displayed on both the NANOOS and CeNCOOS web pages, and we'll collaborate with other west-coast glider operators to track changing ocean conditions. We expect the data, plots and index to be useful to fellow researchers, ocean modelers, ocean users (fishers) and policy makers.

Budget
With $100K/year, and a contribution from CeNCOOS, we will continue year-round sampling on the TH line from June 2017 through May 2021. The costs cover glider batteries, satellite cell phone charges, deployment and recovery costs (to be leveraged with CeNCOOS colleagues as much as possible), glider refurbishment (sensor calibration, compass calibration), and, most importantly and the largest expense, salary and benefits for experienced glider technicians. The $100K/year budget will also allow us to do some minor repair of our aging gliders and the sensors they carry.
Reduced Budgets: With this activity funded at $75K budget in year 1, we propose to forgo any glider refurbishment and do the best we can to continue year-round operations. Should we need to pay for any major repairs, this will result in less than year-round coverage.

Budget justification: Salary is to support a research technician (3.0 months per year) to perform the glider work. The co-PIs Barth and Shearman (0.25 months per year each) will participate in and supervise the operations. Both the co-PIs and the research technician are responsible for data quality and delivery. The OSU gliders

(valued at $133K each, so for two, total of $266K) will be made available for this project at no purchase cost. We request modest funds to maintain the gliders in good working order. Travel funds support OSU personnel costs for traveling to Trinidad Head, CA, to join research cruises and for the NANOOS annual PI meeting. Materials and supplies include computer supplies and batteries for the gliders. The "Other" category includes shipping the glider to the manufacturer in Seattle for servicing, sensor calibration, glider repair, and Iridium cell phone charges for glider operations and data return to shore. Computing services are for partial support of the PI's connection of their computers to the CEOAS network.

Project 6: OSU Coastal Circulation Modeling. Alexander Kurapov, OSU

As part of the NANOOS effort, a real-time coastal ocean forecast model has been developed and run routinely by the OSU modeling group. The model assimilates satellite and land-based observations (altimetry, SST, HF radar surface currents) and provides everyday updates of oceanic forecasts (including surface currents, SST, and other variables) along the Oregon coast (the model domain extent is 41-47N). A new model has been developed, and is currently at the testing stage. Compared to the present, "official" real-time OR model, the new system features the extended domain (41-50N, including the entire OR and WA coasts), improved model resolution (2 km in horizontal), and the Columbia River discharge. This new OR-WA predictor for ocean circulation has been run in near-real time, with data assimilation. In 2016, we will plan to make it the main ocean data assimilation system, providing outputs to NANOOS NVS and the old model will be phased out.

In 2016, we propose to continue supporting and advancing the OR-WA data assimilation system. Improvements over five years will include:

A. Adding temperature and salinity vertical sections from gliders (NANOOS, OOI) to the set of routinely assimilated data
B. Adding fresh water inputs in British Columbia (Fraser River) and Puget Sound (although the 2-km resolution of this model does not make it a competitor in Puget Sound, we need to model the salinity balance in JdF Strait correctly).
C. Develop tools for crab industry (such as conditions for recovering crab pots, depending on three-dimensional velocity information).
D. In collaboration with U. Washington (Dr. Parker MacCready), make steps toward coupled physical/biochemical forecasts constrained by assimilation of physical variables. Research in this direction will be supported by the NOAA MERHAB project and NANOOS will provide support for sustainable 24/7 operational implementation.
E. In collaboration with the OSU Marine Management Program, reach out to local fishermen to obtain feedback about accuracy and usefulness of our products, and to gauge interest in new products.

The above assumes a funded level of $70,000 for year 1.

Budget justification
Salary support is requested at the rate of + 0.5 month/year in year 1 (PI Kurapov) and 3 mo/year in year 1-for the research associate Dr. S. Erofeeva, who has been in charge of everyday model forecast operation and updates. One month in year 1 is requested for the PhD student (Ivo Pasmans) to enable transfer of new data assimilation modules, developed as part of his thesis research, into NANOOS operations. (Note: College of Earth, Oceanic, and Atmospheric Sciences faculty of Associate Professor ranks hold 12-month academic appointment and receive only 4.2 months salary from the College budget. Faculty are expected to raise from research grants the balance of their annual, 12-month salary. Research associate ranks obtain 100% of their salary from research grants.)

Fringe Benefits are calculated based on the estimated future Oregon State University rates.
In year 1, funds are requested to support 1 national, to attend regular coastal ocean research meetings (such as the annual NANOOS PI meeting. The estimated rate is $2,000 (per trip within the US).

Materials and Supplies include funds for expendable project supplies, including data storage media and computer software required for the project.
Computer services costs are estimated based on the rate of $2000/PI accepted at CEAOS.
Tuition is included for 1 term in year 1. The amount is based on the OSU guidelines.
Indirect cost base is equal to the total direct minus equipment expenses and tuition. The OSU facilities and Administrative fee is 46.5% of the direct costs in year 1.

Project 7: OSU DMAC (Data Management and Communication)

PI: P. Michael Kosro, OSU

This project will provide OSU expertise to the NANOOS team on data management and communication, and contribute to the transformation of NANOOS, and especially OSU, data into user products. OSU has a strong concentration of ocean observing and modeling activities for NANOOS. To facilitate the transition of those observations and model outputs into data products conforming to national standards in an efficient and responsive way, NANOOS invests in DMAC expertise local to OSU.

The OSU DMAC specialist will continue to serve as the interface between information generators, product developers, and data standards requirements. He will be a member of the distributed DMAC team (with members from University of Washington and OHSU) to provide local expertise which assists scientists in making their data ready for the NANOOS Visualization System, and other outlets. He will continue to participate in the

weekly phone conferences to share progress and plan development of NVS. He will advise on presentation and delivery of model-based results. He will continue to be a member of the NANOOS User Products committee, helping to define and implement products for NVS, including for measurements such as the surface current maps, NANOOS gliders, the OSU shelf mooring, X-band wave radar, satellite remote sensing fields, coastal sea level, and for model results, including the OSU circulation model, "tuna plots". As funded with a year-1 allocation of $60,000/yr., this effort will result in reduced attention available from the DMAC specialist to OSU data needs.

Budget Justification:
Salary is requested to support a research assistant part-time for participation in the DMAC activities for OSU. Travel funds are budgeted to allow attendance at meetings of NANOOS, of user groups and professional meetings. Funds are budgeted for project-related data acquisition, storage, analysis and presentation. Costs for connection of required computers to the CEOAS network (Research Computing System) have been budgeted. Communications charges (long distance, ISP costs for data transmission from remote sites to OSU, etc.) are also requested.

Project 8: Ocean Acidification Monitoring in US Pacific Coastal Waters. Burke Hales, Oregon State University

Objective
The goal of this component of the project is to continue the mooring and ship-based monitoring of the Ocean Acidification-impacted carbonate chemistry of US Pacific coastal waters. This objective will be accomplished by: 1) continued operation of the Oregon Ocean Acidification Mooring Program, including deployment and maintenance of the surface moorings at the established Ocean Acidification (OA) node at NH10 with surface MAPCO2 systems, near- bottom moorings with SAMI-CO2 and SAMI-pH systems at the NH10 site and the shelfbreak in the early stages of the project, followed by a relocation (following validation exercises, see #3) of these assets to a more biologically productive site to the south; 2) measurement support of the West Coast Ocean Acidification Cruise in 2016; and 3) a validation program for moored measurements off the Oregon Coast. The final component will include a parallel deployment of the NOAA-OAP moored assets at NH-10 for 6-12 months following establishment of the OOI node there to ensure consistency between the OAP and OOI platforms, as well as continued opportunistic sample collection for archiving and analyses in Hales; lab at OSU.

Rationale
Ocean acidification (OA) is an undeniably increasing effect in the global ocean, but it has only recently been recognized that the natural processes of upwelling and de-oxygenation (Feely et al., 2008) are contributing to accelerate the effects of OA in coastal waters of the Pacific Northwest. These natural processes can expose the coastal ocean to waters nearly corrosive to $CaCO_3$ minerals; anthropogenic effects have contributed to intensify these natural effects to drive instances of undersaturation in nearshore surface waters (Feely et al., 2008; Harris et al. 2013).

Recent hatchery failures beginning in 2006 were originally attributed to hypoxia or biological pathogens (Elston et al., 2011), but were ultimately linked to the CO_2 chemistry of hatchery waters in which larvae were spawned (Barton et al. 2012). Recent work at OSU (Waldbusser et al., 2014) has clearly demonstrated the exclusive sensitivity of larval calcifiers to reductions in aragonite mineral saturation state (Ω_a; $\Omega_a = [Ca^{2+}][CO_3^{2-}]/K_{sp,a}$, where $K_{sp,a}$ is the seawater solubility product of aragonite), and provided a linkage to bio-energetic requirements to accelerate precipitation rates over those driven purely by physical chemistry (Waldbusser et al., 2013). The Ω_a effect is already being felt during the variable conditions of the upwelling environment of the US Pacific coast (Barton et al., 2012; Harris et al., 2013) and will define the average condition of these waters within a decade or so (Hauri et al., 2012), far before any likely effects related to pH (Waldbusser et al., 2014). The immediacy of the looming effects demands that the observational network previously supported OAP efforts continue. Further, the fact that Ω_a, which cannot be directly measured, has been definitively determined to be the most impactive component of the effects of OA requires that the carbonate system be observed comprehensively and with abundant validation efforts such that this critically important parameter can be sufficiently constrained.

Proposed Project

This effort consists of the three components outlined above: Continuation of the Oregon OA monitoring program; support of the US West Coast Ocean Acidification (WCOA) cruise; and validation of the in-water moored measurements

Component 1—Operation of the Oregon OA mooring program ~70% of total effort.

This component consists of the continued operation and maintenance of the OA-relevant moorings that have been deployed off the Oregon coast in various capacity since 2008, leading to Hales' advisee-authored publications (Evans et al., 2011; Harris et al., 2013; Evans et al., 2014). This effort has until recently centered around the deployment of SAMI-CO2 and SAMI-pH instruments, augmented with CTD sensors, at the NH10 hydrographic station at a mid-shelf depth on the Newport Hydrographic (NH) line, with surface and near-bottom instrument packages, and a near-bottom instrument package at the shelf break on the NH10 line. This deployment pattern allowed constraint of the seasonal evolution of the carbonate chemistry in surface waters at NH10. The deep moorings allowed quantification of the development of carbonate chemistry in the upwelled source waters at the shelf break, and their modification after transiting the shelf to NH10, both of which determine the signature of and productivity response to upwelling in surface waters at NH10. In early 2014, we incorporated a MAPCO2 system into the NH10 surface expression, and subsequently developed and deployed a winter-worthy MAPCO2-capable mooring deployed in October 2014, with which we merged the classical capabilities of the traditional NH10 hydrographic mooring.

Continued occupation of the NH10 site will be dependent on the arrival and deployment of the OOI node at that location. OOI has asserted pre-eminence on that part of the ocean, and continued observations at that location cannot be based on a pair of moorings, given the goodwill we have established with the local fishing and shipping

communities by minimizing our disruptive footprint. OOI did choose to include OA-relevant sensors in their mooring design; however opted to deploy a relatively new CO_2 sensing technology in their surface expressions (ProOceanus) rather than the 'gold-standard' MAPCO2 systems. In consultation with local OOI managers, we have agreed to keep the MAPCO2-based OAP-supported mooring at NH10 for at least one 6-month field deployment until sufficient cross validation verifies that the OOI-based CO_2 measurements are accurate.

Following that cross-validation exercise, we plan to move the OAP-supported assets to the south, at the 'downstream' end of Heceta Bank, a broad geomorphological feature that always shows a stronger expression of productivity response to upwelling than is seen at NH10, including the elevated CO_2 low-Ω_a response to respiration in near-bottom waters. This location is logistically justified by the proximity to the deep-water port of Coos Bay, where a fleet of charterable vessels exists, including some that have been used by OSU researchers in the past. We will move not only the surface expression of the NH10 MAP system, but also the independent near- bottom package, to the southern site. The shelfbreak mooring may continue to be deployed on the NH line, as that cross-shelf flow pattern at the southern site is not as well understood.

Part of the OAP-supported mooring work has been to merge the OA moored capabilities with the historical NH10 hydrographic measurement program (meteorology, ADCP, water-column thermistor arrays; work by OSU PI Mike Kosro, supported through NANOOS). This was accomplished with the construction of the new MAP-capable mooring currently at NH10 site.
We plan to continue that integration throughout this project.

Component 2—measurement support of the West Coast Ocean Acidification cruise (20% of total effort). This component centers on providing support for the nutrient and O_2-measurement

requirement of the WCOA cruises. Hales oversees the OSU Marine Chemistry Laboratory, along with long-time lab manager Joe Jennings. This facility performs WOCE-quality colorimetric analyses of nitrate, nitrite, ammonium, silicate and phosphate, and Winkler titrations of dissolved O_2, and has performed these analyses for the last WCOA cruises. We will continue this support for the 2016 WCOA cruise, via direct participation in the cruise and shipboard analyses, and post-cruise analysis of archived samples.

Component 3—validation of mooring-based measurements (10% of total effort). The first element of this validation will be via the parallel deployment of the OAP mooring with the OOI NH10 node. The OOI node's actual deployment is expected to be in Spring of 2015; however, it has already missed several deployment targets and the OOI management is uncertain. We will maintain the OAP-supported OA observations at NH10 until a complete field season (~6 months) of intercomparison is made. In addition, we have established a methodology for collection and analysis of discrete samples based on opportunistic sampling by colleagues and local fishermen that are routinely in the vicinity of the mooring sites. These samples are analyzed in Hales' lab

for total CO_2 (T_{CO2}) and CO_2 partial pressure (pCO_2). Hales' lab has participated in several laboratory intercomparisons, and can produce state-of-the art measurement accuracy and precision for these quantities, which can then be used to calculate pH and Ω.

Budget Justification:
Salary is proposed for Hales (2 month/yr. 1) to oversee the project. He will participate in the mooring turnaround efforts, and guide the sampling programs. Salary is requested for Hubbard for 3 months/year. Hubbard is the lead field engineer in Hales' group, and has directed the field mooring work for the last few years. Hubbard will also assist in the opportunistic sample collection and analyses. Jennings is supported for 2 months for his role in maintaining the Marine Chemistry Lab, analyzing the nutrient samples collected on the WCOA cruise, and for analyzing the opportunistic samples for pCO_2/T_{CO2}.

Fringe benefits are included at University-specified rates.

Travel is requested at $3000/Yr. In Yr. 1, $3000 is expected for domestic travel for project meetings, and travel of CEOAS personnel to and from port calls in support of mooring deployment and servicing, and cruise participation.

Equipment is requested at $14000. This covers the cost of two new acoustic releases for our near-bottom moorings at NH10 and the shelfbreak, facilitating faster turnaround.

Miscellaneous supplies are budgeted at $15844 associated with mooring operations and potential relocation, and the WCOA cruise. These might include electronic testing and fabrication tools (volt meters, power supplies, soldering stations), mechanical fabrication supplies (welding supplies, stainless materials and hardware, machine shop charges) that frequently crop up in
projects like this; standard gases and solutions for testing and validation discrete sample analyses; hand and power tools; drill bits, taps, adhesives, cleaning and labeling supplies, and instrument interface and personal computers and associated software. Computer and software resources above and beyond the zero support provided by the college and university for these items are likely to be required to support this work. If a computer must be purchased with these funds, it will be used only in support of this work for the duration of this project. These estimates are approximate, but our previous experience suggests this estimate to be appropriate.

$3000 is budgeted in each year to support shipping and mail costs, and to support the PIs' contribution to the college computer network. The college and university do not provide computer network support, and subscription to the network and IT support is billed on a per-PI basis. This estimate is appropriate for the amount of PI and Tech time allotted for this project.

Funds for small-boat chartering are requested at $25000 in year 1. OSU's small-vessel

Elakha has a charge-out rate of ~$2500/day, but it is not appropriate for deployment of the larger MAPCO2 mooring or for work out of Coos Bay. Other vessels that have been chartered in the past (the *Pacific Storm* in Newport and the *Miss Linda* in Coos Bay) have day rates closer to $5000. The estimated costs are for two two-day cruises per year on the larger vessels for mooring turn- arounds, and two one-day cruises per year for benthic-mooring operations on the smaller vessel.

Overhead is included at the University-specified on-campus rate of 46.5% of direct costs in Yr. 1, less equipment.

Budget Justification Notes, subcontract wide:

Permanent Equipment/Leveraging, Lease-Purchase and Ownership, Salaries: In many of these projects, existing equipment purchased, but no longer being used under, non-IOOS grants are being used for NANOOS, at no cost to NOAA/IOOS. This represents a large leveraging element. As an example, the existing HF array consists of 11 SeaSondes, purchased at a cost of over $1M, using no IOOS funds. However, some new equipment is needed expressly for these projects, and these instruments are described under the individual budget justifications.

An analysis of lease vs. purchase options is possible for common oceanographic equipment such as current point-measurers or current-profilers, CTDs, wave-tide gauges, sonars, and water quality sensors (temperature, salinity, oxygen, chlorophyll, turbidity, optics) and shows leasing rates are generally set to repay instrument purchase costs in 250 to 500 days. Because instruments purchased here will be used in a sustained observing program, beginning with the five year program funded under this grant, and with the anticipation of future participation, the purchase option is the more cost effective for all of these applications. (e.g. http://www.aslenv.com/Doc/Equipment%20Leasing%20Rates%20March%202010.pdf). If lease options were available for the less common, more expensive instruments (e.g. HF and X-band radars) the economic factors are expected to be the same. Equipment purchased under this subcontract will be owned by Oregon State University, and highest priority for its use will be given to NANOOS investigators to perform their funded NANOOS work.

For all projects, OSU Facilities & Administration fees (Indirect Costs) are 46.5% of modified total direct costs in year 1, and 47.0% for years 2 through 5, by federal agreement dated October 3, 2014. Benefits (OPE) are based on Oregon State University guidelines.

Salaries: Assistant, Associate, and Full Professors in CEOAS receive 30%, 35%, and 40% salary directly from the University. Thus, full Professors must raise 60%, or 7.2 months/year, of their salary from external funding. Faculty in the Senior Research category must earn an even larger percent of their salary through external funding.

College of Earth, Ocean, and Atmospheric Sciences, Oregon State University

ESTIMATED BUDGET FOR DURATION OF RESEARCH PROJECT

Start Date: 6/1/2016
End Date: 5/31//17

		YEAR 1		
BUDGET CATEGORIES				
Senior Personnel	**Base Salary (monthly)**	FTE	Months	Cost
Peter Ruggiero	9,412	0.01	0.10	941
	-	-	-	-
Kosro	10,799	0.50	6.00	64,794
Kosro	10,799	0.10	1.20	12,959
John (Jack) A. Barth	11,673	0.02	0.25	2,918
R. Kipp Shearman	8,834	0.02	0.25	2,209
Kurapov	9,564	0.04	0.50	4,782
	-	-	-	-
Burke Hales	11,700	0.17	2.00	23,400
Shearman	8,834	-	-	-
Juranek	6,404	-	-	-
Peter Ruggiero	9,412	-	-	-
	-	-	-	-
	-	-	-	-
	-	-	-	-
	-	-	-	-
	-	-	-	-
Total Senior Personnel				**112,003**
Other Personnel				
Research Associates (Post Doc)			8.00	47,777
Faculty Res Assistants			35.67	165,862
Grad Research Assistants			1.00	2,511
Summer GRAs (no tuition)			2.00	5,200
Undergrads (hourly rate)			1.00	2,013
Sea Pay (daily rate)			12.00	960
TOTAL SAL & WAGES				**336,326**
OTHER PAYROLL EXPENSES		Rate		
Peter Ruggiero		45.00%		424
		0.00%		-
Kosro		43.00%		27,861
Kosro		43.00%		5,572
		43.00%		1,255
R. Kipp Shearman		45.00%		994
Kurapov		45.00%		2,152
		0.00%		-
Burke Hales		42.00%		9,828
Shearman		45.00%		-
Juranek		49.00%		-
Peter Ruggiero		45.00%		-
		0.00%		-
		0.00%		-
		0.00%		-
		0.00%		-
		0.00%		-

Research Associates (Post Doc)				23,741
Faculty Res Assistant				96,011
Grad Research Assistants				414
Summer GRAs (no tuition)				520
Undergrads (hourly rate)				167
Sea Pay (daily rate)				312
TOTAL OPE				**169,251**
TOTAL SALARIES, WAGES AND OPE COSTS				**505,577**
TOTAL EQUIPMENT				**24,000**
TRAVEL				
Domestic				22,900
Foreign				-
TOTAL TRAVEL				**22,900**
PARTICIPANT SUPPORT				
Stipends				-
Travel				-
Subsistence				-
Other				-
TOTAL PARTICIPANT SUPPORT				**-**
OTHER DIRECT COSTS				
Materials & Supplies				59,688
Publication Costs				1,000
Consultant Services				3,000
Computer Services (RCS)				13,550
Communications (Telecom, Network Charges)				5,926
Utilities				2,500
Other				46,500
TOTAL OTHER DIRECT COSTS				**132,164**
TOTAL TUITION				**4,702**
SUBCONTRACTS	included	excluded		
TOTAL SUBCONTRACTS	-	-		**-**
TOTAL DIRECT COSTS				**689,343**
MTDC Method				
MTDC BASE	660,641			
Total Exemptions	28,702			
INDIRECT COSTS	**46.5%**			**307,200**
TOTAL COSTS TO SPONSOR				**996,543**

Research
Development &
Administration

Office of Proposal & Award Management

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July 7, 2016

Jan A. Newton, Ph.D.
NANOOS Executive Director
Principle Oceanographer
Applied Physics Laboratory
University of Washington
1013 NE 40th St.
Seattle WA 98105-6698

Re: Letter of Intent to Collaborate

Dear Dr. Newton:

Oregon Health & Science University (OHSU) submits this letter of intent to collaborate for the following sponsored project.

Title:	Sustaining NANOOS, the Pacific Northwest component of the US IOOS
Principal Investigator:	Dr. Jan A. Newton, Applied Physics Laboratory
Subaward P.I.	Dr. Antonio Baptista, OHSU
Sponsor:	NOAA/NOS Coastal Services Center
Period of Performance:	6/1/2016 – 5/31/2017

OHSU is willing to establish a Subaward for this project. OHSU is aware of the Sponsor's grant and contract policies and agrees to administer the subaward in accordance with them.

OHSU's proposed Statement of Work is attached. OHSU's requested funding is $281,000; a detailed budget is also attached.

Please contact the following individuals for additional information regarding this proposal.

Technical Contact:
António M. Baptista, Ph.D.
Phone: 503-346-3418
Fax: 503-346-3427
Email: baptista@ohsu.edu

Administrative Contact:
Valerie Mansur
Grants/Contracts Admin, OPAM
Phone: 503-494-4854
Fax: 503-494-7787
Email: orserv@ohsu.edu
mansurv@ohsu.edu

Sincerely,

Kellie Guentert
Director, Office of Proposal & Award Management

STATEMENT OF WORK

PI: António M. Baptista, Oregon Health & Science University
June 1, 2016-May 31, 2017

Proposed effort: We propose to maintain an established observation and prediction infrastructure for science and societal applications in the Columbia River estuary (SATURN [*Baptista et al.*, 2015]). Support is requested for observations, modeling, data management, and product maintenance, as follows:

Rationale and Justification for continuation of effort

SATURN (including predecessor CORIE) is among the earliest and most comprehensive estuarine observation and prediction systems in the world, and one of the pioneer subsystems of NANOOS and IOOS. Focused on the Columbia River estuary (broadly defined to include riverine and ocean interactions), SATURN has been developed as a "collaboratory" to support both science and science translation to society. Sample accomplishments:

- Physical observations extend back to 1996 and biogeochemical observations to 2008. These long-term time series are powerful and distinctive witnesses to PNW processes and their variability and change.
- SATURN observations, simulations and products have directly supported multiple multi-institutional science projects, including but not limited to NSF-LMER, NSF-RISE, NSF-CMOP, NOAA-Plume and NOAA-Estuary. NSF-CMOP alone produced over 150 peer-reviewed publications and theses.
- SATURN has helped bridge across stakeholder communities (federal and state agencies, tribes, others) and has provided direct support to major regional decisions, including the Columbia River Channel Improvement Project (CRCIP), the Columbia River Treaty Review, and the Bradwood Landing LNG terminal application. CRCIP exemplifies the multiple ways SATURN serves the region: simulations were used to generate topic-specific consensus among stakeholders during the Re-consultation phase of CRCIP (2001); observations were use to monitor post-construction impacts for almost a decade; and a new generation of simulations were eventually used to generate post-construction consensus about the extent of the impact.
- Recognized as a leading-edge example of modern approaches to estuarine science and science translation, the SATURN collaboratory has helped inspire an initiative promoting the understanding and management of the collective of estuaries as a global ecosystem (Our Global Estuary, ourglobalestuary.org), and its first international workshop (Chennai, India, March 2016).

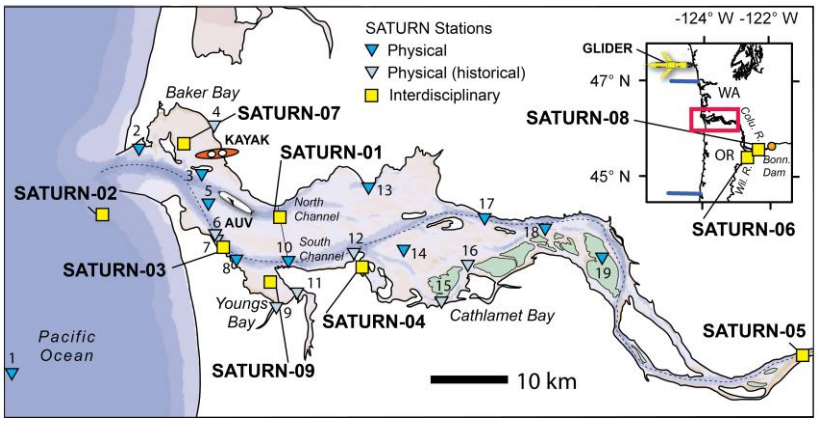
Scope

Task 1a: Observations in the lower estuary and shelf source waters (PI: A.M. Baptista)

- Maintain the network of interdisciplinary endurance stations in the lower estuary and near-plume (SATURN-01, 02, 03, 04, 07 and 09). A new seasonal station (SATURN-10) will be deployed with the support of USACE.

Task 1c: Modeling (PI: A.M. Baptista)

- Maintain the daily forecasts of river-to-shelf circulation in the Columbia River
- Maintain the multi-year climatology of river-to-shelf circulation in the Columbia River (aka Climatological Atlas)



Task 1d: Data management and products (PI: A.M. Baptista)

- Maintain the SATURN observational database
- Maintain existing web products for Columbia River stakeholders
- Export sensor and model data to NANOOS
- Contribute to the central NANOOS DMAC cyber-team

De-scoping note

Since 2006, SATURN has been partially funded by NSF through a Science and Technology Center cooperative agreement, which by the nature of STCs is non-renewable beyond June 2017, and began tapering down in July 2014. CMOP, the center created through this agreement, will remain active and multi-institutional (OHSU, OSU, UW and PSU, plus non-academic partners) beyond July 2017, and will continue to manage SATURN. However, without the core NSF support, SATURN efforts will be de-scoped to remain consistent with available NANOOS and other regional funding. In particular, de-scoping will apply to parts of the proposed Task 1a:

- A network of historical physical endurance stations in the lower estuary will be maintained only on a "as time permits" basis. Interruptions will break a set of long time series approaching climate scale, that offer distinctive insights into the variability and change in the Columbia River estuary and its source waters, and that support model skill assessment for anchoring operational products (e.g., daily forecasts and climatology of circulation).
- No glider deployments will be conducted. This will limit the ability to characterize the sources of shelf water (with implications for modeling and data interpretation), and will eliminate the collaboration with the Quinault Indian Nation for characterization of shelf hypoxia.

In addition, the efforts proposed by OHSU investigators Joseph Needoba [Task 1b: Observations in the river source waters), Tawnya Peterson [Task 2: Monitoring phytoplankton assemblages in Oregon estuaries to assess trends in coastal productivity] and Jon Waterhouse [Task 3: Tribal Outreach] will not be funded—as they all required an increase in the budget assigned to OHSU.

Reference

Baptista, A. M., C. Seaton, M. Wilkin, S. Riseman, J. A. Needoba, D. Maier, P. J. Turner, T. Kärnä, J. E. Lopez, L. Herfort, V. M. Megler, C. McNeil, B. C. Crump, T. D. Peterson, Y. Spitz & H. M. Simon (2015). Infrastructure for collaborative science and societal applications in the Columbia River estuary. *Frontiers of Earth Science*, 9(4), 659-682.

Oregon Health & Science University
Congressional district OR-001

Antonio Baptista: "Sustaining NANOOS, the Pacific Northwest component of the US IOOS"

Budget Justification

A. PERSONNEL. Salary support is requested for PI Antonio Baptista (0.97 calendar months). Salary support is also requested for two field team specialists (total 17.1 calendar months), one modeling team specialist (1.8 calendar months) and one cyber team specialist (2.4 calendar months).

Salary projections reflect actual, 12-month salary for the year ending June 30, 2016. All other salary projections (including Graduate Research Assistants) are based on recent experience for comparable positions in the Center for Coastal Margin Observation and Prediction. All salaries are adjusted to reflect expected salary increases of 3% per year, taking effect July 1 of 2016.

B. BENEFITS. Benefit rate for Antonio Baptista, 28.71%; Michael Wilkin, 31%; Jo Goodman, 36%; Paul Turner, 37% and Charles Seaton, 38%.
OHSU's benefits rates for faculty, staff and students are shown below. Benefits for named personnel are budgeted based upon actual rates for the prior period. Benefits for to be named personnel are budget using the university approved rate chart. Benefit rates include FICA, workers compensation, retirement, unemployment insurance and the UniversityFlex insurance program.

Rep Group	Average Rate	Rate (Jul-Dec)	Rate (Jan-Jun)
AFSCME	36.50%	36.00%	37.00%
Faculty	22.00%	20.00%	24.00%
Faculty – Basic Sciences	26.50%	26.00%	27.00%
Research	36.50%	36.00%	37.00%
Unclassified	30.00%	29.50%	30.50%
ONA	29.00%	28.50%	29.50%
Fellow	32.50%	32.00%	33.00%
Student	9.50%	9.50%	9.50%

C. CAPITAL EQUIPMENT. No funds are requested.

D. OTHER DIRECT COSTS.

1. *Materials and supplies:* The budget includes a total of $30,211 for materials and supplies. These Materials and Supplies are primarily for operating and maintaining the Center's observation network on the Oregon coast, including fabrication, instrument calibration and vessel operation, and secondarily for operating and maintaining computer resources, including maintenance services for hardware and software. We have estimated these expenses based on recent experience in the Center for Coastal Margin Observation & Prediction.

2. *Contracted Services:* No funds are requested.

3. *Domestic Travel:* The budget includes a total of $4,762 for domestic travel. These funds will allow OHSU staff, based in Astoria, OR and in Portland, OR, to attend NANOOS and IOOS meetings in the Pacific Northwest, as well as other regional meetings.

4. *Foreign Travel:* No funds are requested.

5. *Publications:* No funds are requested.

6. *Tuition:* No funds are requested.

7. *Other:* No funds are requested.

8. *Participant Support:* No funds are requested.

9. *Subcontracts:* No funds are requested.

E. INDIRECT COSTS. The Department of Health and Human Services, acting as the cognizant agency of the federal government, approved a facilities and administration (F&A) cost rate agreement for Oregon Health & Science University (OHSU) on March 19, 2015. The Department of Health and Human Services Representative to this agreement is Arif M. Karim, phone 415-437-7820. The Modified Total Direct Costs (MTDC) used for calculating F&A recovery include all project expenditures except capital equipment (>$3,000), subcontract amounts after the first $25,000 and tuition. The F&A rate approved for off-campus research is 26%.

Oregon Health & Science University (OHSU) is a public corporation chartered by the State of Oregon pursuant to Section 353.020 of the Oregon Revised Statutes. OHSU operates under the OMB's Uniform Guidance.

Baptista NANOOS
7/1/2016 to 5/31/2017

PERSONNEL	
Antonio Baptista	20,145
Michael Wilkin	57,498
Jo Goodman	37,850
Charles Seaton	14,347
Paul Turner	11,326
Total Salaries	141,166
OPE	46,876
TOTAL PERSONNEL	188,043
Unburdened Costs	
CAPITAL EQUIPMENT (> $3000)	
Field equipment	-
Computing Infrastructure	-
Lab Infrastructure	-
Other	-
TOTAL CAPITAL EQUIPMENT (> $3000)	-
TUITION	
Tuition (Ph.D.)	-
Tuition (M.S.)	-
TOTAL TUITION	-
PARTICIPANT SUPPORT COSTS (NSF proposals)	
1. Stipend	-
2. Travel	-
3. Subsistence	-
4. Other	-
TOTAL PARTICIPANT SUPPORT	-
SUBCONTRACTS (from worksheet)	-
Subcontracts amount in MTDC (worksheet)	-
Total Unburdened Costs	-
OTHER BURDENED DIRECT COSTS	
Materials and supplies (incl software)	30,211
Contracted services	-
Domestic travel	4,762
Foreign travel	-
Publications	-
Student Fees (Ph.D.)	-
Student Fees (M.S.)	-
Other	-
TOTAL OTHER BURDENED DIRECT COSTS	34,973
TOTAL DIRECT COSTS	223,016
FACILITIES AND ADMINISTRATION (F&A) COSTS	
Modified total direct costs (MTDC)	223,016
F&A rate	26.00%
F&A COSTS	57,984
TOTAL COSTS	**281,000**

Oregon Beach Shoreline Mapping and Analysis Program: Quantifying the short and long-term response of Oregon beaches for Coastal Managers

PI: J.C. Allan

The Oregon Department of Geology and Mineral Industries (DOGAMI), remains a committed partner in the ongoing development of the regional NANOOS RCOOS. The primary objective of our component of the RCOOS will remain focused on maintaining an Oregon beach and shoreline monitoring program (Allan and Hart, 2007a, 2008, Allan and Stimely, 2013), the purpose of which is to document variability in beach and shoreline morphodynamics, information that is important to coastal resource managers. The specific objectives of our study include:

- To provide quantitative information on the morphological response of Oregon beaches and shorelines at various temporal resolutions, including seasonal (due to changes in waves and tides), interannual (e.g. storm-induced, El Niños), and long-term changes (e.g. sea level rise, changes in storm frequency/magnitude, and interdecadal climate shifts such as the Pacific Decadal Oscillation);
- To provide improved knowledge of coastal hazards, particularly the effects of such processes on the patterns and trends of coastal erosion, as wells as flooding and inundation effects to properties and infrastructure located adjacent to the coast.
- To contribute to an overall improved understanding of the role of climate variability in controlling the morphodynamics response of beaches and shorelines along the Oregon coast in order to assist coastal resource managers with important decisions related to management of the coast.

The permitting of new ocean shore development by state and local jurisdictions is based on the best available knowledge and, in some cases, site investigations of specific locations. Though the information collected through these efforts meets the standards required by agencies, at times the information is piecemeal and does not always reflect an adequate understanding of the processes affecting the property for making sound decisions (i.e. site-specific studies on dune-backed beaches tend to be too narrowly focused thereby ignoring the larger picture). Specifically, the information presented often does not fully take into account the high magnitude, episodic nature of North Pacific extratropical storms, the long-term processes that may impact the property, the manner in which the proposed alterations may affect the system, or the affect those alterations may have on adjacent properties. State and local agencies are therefore relegated to making decisions about ocean shore development, with only a partial understanding of their impacts. Those decisions will affect, not only the relative level of risk posed to that development, but also the long-term integrity of ocean shore resources and a variety of public recreational assets. Improved understanding and baseline data on beach morphodynamics and bluff erosion will therefore enable agencies and local Government to begin to predict future rates of coastal change as well as providing the quantitative basis for establishing scientifically defensible coastal hazard setback lines.

Established in 2004, the Oregon Beach Shoreline Mapping and Analysis Program (OBSMAP) presently consists of 674 beach and shoreline monitoring sites established along the length of the Oregon coast. Of these, 178 sites are supported through NANOOS, while the remaining sites were established for the purposes of FEMA coastal flood hazard inundation mapping, Snowy Plover dune restoration (USFWS), landslide changes (ODOT/FHWA), erosion control and engineering design at the mouth of the Columbia River (USACE) and at the Hatfield Marine Science Center in Newport (OSU). None of these monitoring sites would have been made possible without the initial implementation of an RCOOS in the NANOOS region. Monitoring of the beach sites is accomplished using Real-Time Kinematic Differential Global Positioning System (RTK-DGPS), with a precision of ~±2 cm and survey mapping accuracies of ~±4-6 cm (Allan and Stimely, 2013). RTK-DGPS allows DOGAMI scientists to mount the GPS on a backpack worn by a mapper, locate it atop of an ATV vehicle in order to undertake detailed topographic measurements, or on a personal watercraft to collect bathymetric data offshore the coast. These data, served through the NANOOS Visualization System beach mapping portal (http://nvs.nanoos.org/BeachMapping), are of considerable interest and are used in some capacity by state and federal agencies to assist with coastal resource management (e.g. the Oregon Department of Land Conservation and Development (planning) and the Oregon Parks and Recreation Department (permitting

of coastal engineering structures)), coastal geotechnical consultants (e.g. Ashcreek & Associates, HG Schlicker for site-specific geologic investigations), federal agencies such as the Federal Emergency Management Association (FEMA) for coastal flood inundation and erosion mapping, and the public at large (e.g. erosion responses in the communities of Neskowin and Rockaway have led to a greater demand for information about what is happening).

With support from NANOOS, DOGAMI has been tasked with two roles:

1. DOGAMI will continue to maintain the OBSMAP program. Our overall approach will remain unchanged and will reflect the following:
   a. Undertake ***seasonal*** surveys (fall (~Aug/Sep), winter (~Dec/Jan), and summer (~Aug/Sep)) surveys of the Neskowin (15 sites), Netarts (24 sites), Rockaway (25 sites), and Clatsop (6 sites) littoral cells. ***Annual*** surveys (summer only) will be undertaken along the Beverly Beach (15 sites) and Newport (58 sites) beach monitoring network sites. Undertake Mean Higher High Water (MHHW) tidal based shoreline surveys on the same days as the beach profile measurements are carried out.
   b. Assist OSU with the collection of bathymetry data on an annual basis in the Rockaway cell; and,
2. As chair of NANOOS User Products, PI Allan will coordinate, organize and chair meetings of the NANOOS User Products committee. Work with core DMAC committee members to facilitate the development and implementation of products identified by coastal and ocean stakeholders (e.g. continued development of PNW climatology products, enhancements to the maritime operations and boater web applications etc.). Participate in NANOOS Governing Council, PI and Stakeholder meetings.

Budget:

Core Budget	**Amount**
Includes all core activities required to maintain the OBSMAP program.	
PERSONNEL	
J. Allan – Coordinate & undertake field surveys, data reduction & analysis, and reporting (9 weeks).	$ 15,393
L. Stimely - Field assistant (4 weeks)	$ 4,948
J. Allan – NANOOS UPC Chair. (4 weeks)	$ 6,842
Personnel sub-total	**$ 27,183**
Other Payroll Expenses (51% of salary)	**$13,864**
Total Personnel	**$41,047**
TRAVEL	
- Per diem, fieldwork (2 people, $89/night lodging & $51 M&IE, 12 days)	$ 3,360
- Per diem, PI meeting ($151/night lodging & $64 M&IE, 2 days)	$ 430
- Per diem, UPC & GC meetings ($202/night lodging & $74 M&IE, 5 days)	$ 1,380
Total Travel	**$ 5,170**
MISCELLANEOUS COSTS	
- GPS equipment/ ATV maintenance.	$ 816
- NANOOS UPC supplies	$ 63
Total Miscellaneous	**$ 879**
TOTAL DIRECT COSTS	**$ 47,096**
INDIRECT COSTS (27.4%)	**$ 12,904**
TOTAL	**$ 60,000**

Budget Justification:

Personnel / Salaries: For Task 1, PI Allan requests 9 weeks/yr salary to undertake project management, GPS surveys of the beach monitoring sites, data reduction and analyses, and reporting. PI Allan also requests 4 weeks/yr salary support for a Geol-2 DOGAMI staff member to assist with field surveys. For Task 2, PI Allan requests 4 weeks/yr salary support as NANOOS User Products chair in order to facilitate UPC/DMAC/E&O meetings, data analyses (e.g. climatology products) and product development and testing. Salary rates are calculated for project time only. Fringe benefits are calculated at 51% of the base salary. The rate includes components for employee benefits, provisions for applicable cost of living increases and range adjustments in accordance with Oregon Department of Geology policy.

Travel: Considerable time will be spent in the field travelling to coastal field sites. For Task 1, we are requesting in-state travel support for 2 people for a total of 12 days each. Travel costs are based on the following costs: $89/night lodging, $51/day food. Additional travel support is requested for PI Allan to attend NANOOS meetings, which is calculated at $151/night lodging, $64/day food for two days. The total travel budget request for Task 1 is $3,790. For Task 2, we are requesting travel support to enable PI Allan to participate in NANOOS DMAC/UPC/E&O, Governing Council and PI meetings. The travel budget request for Task 2 is $1,380, with a combined total for travel of $5,170.

Equipment and Supplies: DOGAMI is requesting funding to support field operations. This includes general field supplies, Matlab software maintenance and ATV maintenance ($879). The total funding requested to support field operations is $879.

Indirect Costs: A fixed carry forward rate is negotiated with the United States Department of the Interior annually. The current rate is 27.4% and is applied to all direct costs. Indirect charges requested for this project amount to $12,904.

DOGAMI is requesting $60,000 in funding support for Tasks 1 and 2.

References

Allan, J.C. and Hart, R., 2007. Assessing the temporal and spatial variability of coastal change in the Neskowin littoral cell: Developing a comprehensive monitoring program for Oregon beaches Portland, Oregon: Oregon Department of Geology and Mineral Industries Open-file-report O-07-01, 27p.

Allan, J.C. and Hart, R., 2008. Oregon beach and shoreline mapping and analysis program: 2007-2008 beach monitoring report. Portland: Oregon Department of Geology and Mineral Industries Open file report O-08-15, 60p.

Allan, J.C. and Stimely, L., 2013. Oregon Beach Shoreline Mapping and Analysis Program: Quantifying Short to Long-term Beach and Shoreline Changes in the Gold Beach, Nesika, and Netarts Littoral Cells. Portland, Oregon: Oregon Department of Geology and Mineral Industries O-13-07, 46p.

Oregon
John A. Kitzhaber, MD, Governor

Department of State Lands
South Slough National Estuarine
Research Reserve
P.O. Box 5417
61907 Seven Devils Road
Charleston, Oregon 97420
(541) 888-5558
FAX (541) 888-5559
www.southsloughestuary.org

July 07, 2016

Dr. Jan Newton, NANOOS Executive Director
Applied Physics Laboratory
University of Washington
1013 NE 40th St
Seattle, WA 98105-6698

Dear Jan:

The South Slough National Estuarine Research Reserve (SSNERR) is pleased to participate in the collaborative work generated by the Northwest Association of Networked Ocean Observing Systems (NANOOS) to implement regional coastal ocean and estuarine observing activities.

The Oregon Department of State Lands (ODSL)/SSNERR propose to continue to maintain and operate a network of four water quality monitoring stations along with one meteorological station located within the South Slough estuary, install a fifth water quality monitoring station located near the mouth of the Coos estuary, add telemetry equipment to a sixth water quality monitoring station in the Coos estuary, and collaborate with the Confederated Tribes of Coos, Lower Umpqua and Siuslaw Indians (CTCLUSI) to co-manage a water quality station in the lower Coos estuary.

Four of the water quality stations (Charleston Bridge, Valino Island, Winchester Creek, Elliot Creek) and the meteorological station (Tom's Creek Marsh) are operated in cooperation between NANOOS and the NERR System-Wide Monitoring Program (NERR SWMP), two stations (Boathouse, North Point) will be installed and operated by SSNERR/NANOOS, and an additional station will be collaboratively managed by SSNERR/CTCLUSI/NANOOS. These partner stations will be equipped with YSI multi-parameter data loggers that record measurements every 15 minutes of water temperature, conductivity/salinity, dissolved oxygen, pH, turbidity, and water depth. Currently, five stations are equipped with telemetry systems, data are routed through the Geostationary Observational Environmental Satellite System (GOES), and data streams are available through the NANOOS Visualization System and the NERRS Centralized Data Management Office. The data telemetry capabilities of GOES are available to the SSNERR as part of their partnership with NOAA.

New funds provided by NANOOS ($30,000/year) will enable the Reserve to repair, maintain, install, and operate the network of estuarine monitoring stations over 2016-2020.

We look forward to the opportunity to continue to participate as a member of the NANOOS team and to develop the capacity to provide improved service and more relevant information to our coastal stakeholders.

With best regards,

Gary D. Cooper

Gary Cooper, Manager South Slough NERR

NANOOS FY2016-2020 Subcontract ODSL/SSNERR
Oregon Department of State Lands/ South Slough National Estuarine Research Reserve
07/08/2016

Statement of Work**:**

As a participant in the collaborative Northwest Association of Networked Ocean Observing Systems (NANOOS) program, the Oregon Department of State Lands / South Slough National Estuarine Research Reserve (ODSL/SSNERR) shall operate and maintain a network of five water quality monitoring stations and one meteorological station. This network currently includes five South Slough SWMP stations and one Coos estuary water quality station. We are partnering with one of our local tribes to install and maintain telemetry equipment on one of their established water quality stations in the Coos estuary. By 2020, the network will be expanded to include two additional Coos estuary water quality stations. The second Coos estuary station, North Point, is located under the McCullough Bridge in the mid bay and was installed as part of the Partnership for Coastal Watersheds project. The third Coos estuary station, Boathouse, will be located near the mouth of Coos Bay and the site location is a U.S. Coos Guard Aids to Navigation System range marker. The logistics for the North Point and Boathouse stations are more challenging and both will require diving. The Boathouse station will require deployment and retrieval access granted from the USCG along with seasonal obstacles including weather and cormorant nesting as this station is deeper and located close to the mouth of the Coos estuary.

Four water quality stations and one meteorological station are located within the South Slough estuary (Charleston Bridge, soschwq; Valino Island, sosvawq; Winchester Creek, soswiwq, Elliot Creek, sosecwq, Tom's Creek marsh, sostcmet), the fifth water quality station (North Spit sosnswq) is located in the lower Coos estuary, the sixth water quality station will be located in the mid Coos estuary near the McCullough Bridge (North Point, sosnpwq), and the seventh is sited near the mouth of the Coos estuary (Boathouse, sosbhwq). Each moored station is equipped with aYSI multi parameter EXO data logger, and there are telemetry systems at six of the stations. The North Point and Boathouse stations will be equipped with telemetry by 2020. Measurements are recorded every 15 minutes for the following parameters: water temperature, conductivity, salinity, dissolved oxygen, pH, turbidity, and water depth; three stations will also collect chlorophyll by the end of the five year award. The three stations are prioritized by location near oyster growing areas in both the South Slough estuary (Charleston Bridge, Valino) and Coos estuary (North Point).

New funds provided by NANOOS ($30,000) will enable the South Slough NERR to 1) maintain operation of the existing four estuarine water quality monitoring stations and one meteorological station over the period of the project, 2) partner with the Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw Indians (CTCLUSI) to maintain telemetry equipment on their existing North Spit BLM water quality station, 3) install the North Point and Boathouse stations in the Coos estuary, 4) add chlorophyll measurements to the Charleston Bridge, Valino Island, and North Point water quality stations, and 5) purchase an EXO 1 sonde for improved field quality assurance/quality control verification procedures when retrieving and deploying the water quality sondes. The current procedures for field calibration checks use a YSI Professional Plus instrument and the sensors on this instrument are different type than the sonde stations (i.e. polarographic Dissolved Oxygen rather than optical, different style pH sensor, no Turbidity).

Specific expenses associated with operation of the monitoring stations include purchase of replacement and new water quality sondes and sensors, telemetry system components, and calibration solutions for the sensors. Funding provided by NANOOS will enable the South Slough NERR to continue to provide near real-time measurements of the ambient estuarine water parameters to several web-based data access portals including the NANOOS Visualization System (NVS), the NERRS Centralized Data Management Office (CDMO), and the NOAA Hydrometeorological Automated Data System (HADS).

Subcontract Budget:

Estuary Observations	Maintain South Slough moorings; Install North Point and Boathouse Coos estuary telemetry stations; Collaborate with tribes to maintain lower Coos estuary station					
Equipment	**Item Description**	**2016**	**2017**	**2018**	**2019**	**2020**
Sondes/ Sensors	EXO 1 sonde	$5,335.00				
	EXO 2 sonde				$6,450.00	$6450.00
	Conductivity/Temp sensor	$1,650.00			$1,650.00	$1650.00
	pH sensor	$560.00			$560.00	$560.00
	Replacement pH module	(12) $2,040.00	(13)$2,210.00	(15) $2,550.00	(15) $2,550.00	(15) $2550.00
	Dissolved Oxygen sensor	$1,960.00			$1,960.00	$1960.00
	Replacement DO cap	(12) $1,860.00	(13)$2,015.00	(15) $2,325.00	(15) $2,325.00	(15) $2325.00
	Turbidity Sensor	$1,800.00	$1,800.00		$1,800.00	$1800.00
	Chlorophyll Sensor		(2) $6,760.00	(2) $6,760.00		
	Wiper with AF brush	$1,110.00			$1110.00	$1110.00
	Replacement wiper brush	(12) $660.00	(13) $715.00	(15) $1,100.00	(15) $1100.00	(15) $1100.00
	Sonde guard		$880.00	$880.00	$880.00	$880.00
	Copper Tape		(4) $280.00	(4) $280.00	(4) $280.00	(4) $280.00
	Batteries, D cell	(3) $120.00	(3) $120.00	(12) $480.00	(12) $480.00	(12) $480.00
Subtotal		$17,095.00	$15,140.00	$14,375.00	$21,145.00	$21,145.00
Telemetry	Satlink Transmitter	$2,800.00	$2,800.00	$2,800.00		
	SDI12 Signal Adapter	$295.00	$295.00	$295.00		
	Sonde to DCP Cable	$470.00	$470.00	$470.00		
	V2th Satellite Antenna	$325.00	$325.00	$325.00		
	V2th Antenna Mount	$135.00	$135.00	$135.00		
	Fiberglass Enclosure	$205.50	$205.50	$205.50		
	Aluminum backpanel	$33.15	$33.15	$33.15		
	Lightning Protection Kit	$399.00	$399.00	$399.00		
	Solar panel	$100.00	$100.00	$100.00		
	Charge Controller	$50.00	$50.00	$50.00		
	12 V battery	$100.00	$100.00	$100.00		
	Platform hardware/supplies	$504.35	$2,459.35	$3,224.35	$1,367.00	$1,367.00
Subtotal		$5,417.00	$7,372.00	$8,137.00	$1,367.00	$1,367.00
Calibration Solutions	Conductivity standard	(12) $1,488.00	(12) $1,488.00	(12)$1,488.00	(12) $1,488.00	(12) $1,488.00
	pH 7 standard	(12) $960.00	(12) $960.00	(12) $960.00	(12) $960.00	(12) $960.00
	pH 10 standard	(12) $960.00	(12) $960.00	(12) $960.00	(12) $960.00	(12) $960.00
	Turbidity standard	(12) $4,080.00	(12) $4,080.00	(12)$4,080.00	(12) $4,080.00	(12) $4,080.00
Subtotal		$7,488.00	$7,488.00	$7,488.00	$7,488.00	$7,488.00
Totals		**$30,000.00**	**$30,000.00**	**$30,000.00**	**$30,000.00**	**$30,000.00**

Budget Justification:

The Yellow Springs Instruments, Inc. (YSI) EXO2 data logger is the new version of the water quality sonde instrument that is approved for the National Estuarine Research Reserve System as a component of their participation in the System-Wide Monitoring Program (SWMP). YSI supplies the existing water quality instruments used by SWMP to ensure program-wide uniformity in equipment, data parameter specifications, and data file format. YSI, and thus the NERRS, are phasing out the V2/EDS data logger model and transitioning to the EXO series instruments.

The YSI EXO series data loggers will be equipped with an array of water quality sensors to measure water temperature, specific conductivity/salinity, dissolved oxygen, pH, turbidity, water depth, and chlorophyll at a subset of stations. Each instrument also has a centrally located anti-fouling wiper/brush sensor. Funds requested here will allow the Reserve to use equipment that accommodates optical sensor arrays (dissolved oxygen, turbidity, chlorophyll), purchase calibration standard solutions for each of the sensors for monthly calibrations, directly interchange equipment during monthly deployment and retrievals, complete field verification quality assurance/quality control protocols with an EXO1 sonde instrument, and replace malfunctioning equipment. The dissolved oxygen, pH, and wiper sensors have replaceable modules, caps, or brushes that are exchanged approximately annually or during malfunction of the sensor, instead of replacing the entire sensor body itself. Additional items include sonde guards that protect the sensors during field deployment, copper tape for anti-fouling protection of the sensors, and internal D-cell batteries that power the sonde instruments.

The telemetry system components allow seamless and cost-free data stream telemetry via the GOES satellite system. Telemetry system components specifically requested here are for replacing aging equipment at one station (Elliot Creek, 2016), and purchasing telemetry system equipment for two water quality stations (North Point, 2017; Boathouse, 2018); both of these stations will be completed by 2020. Communication components that will be installed include the Satlink Transmitter and antenna/mount for data transmission, SDI-12 Signal Output Adapter (SOA) to convert the EXO RS-485 to SDI-12, and the sonde to Data Collection Platform (DCP) cable to connect the instrument to the transmitter. The remaining equipment are associated with powering and protecting the real-time mooring platforms, including solar panels, charge regulator, batteries, lightning protection system, waterproof enclosures/panel, and mooring hardware and supplies for securing the equipment and platform for long-term data collection. The platform hardware and supplies include Acrylonitrile Butadiene Styrene (ABS) pipe, stainless steel fittings, locks, mounts, nylon straps, and strapping related tools.

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
PO Box 47600 • Olympia, WA 98504-7600 • 360-407-6000
711 for Washington Relay Service • Persons with a speech disability can call 877-833-6341

July 20, 2016

David Martin, Ph.D., NANOOS President
Jan Newton, Ph.D., Executive Director
University of Washington
Applied Physics Laboratory
1013 NE 40th Street
Seattle, WA 98105-6698

Dear Dr. Martin and Dr. Newton,

This Letter of Commitment and relevant attachments outline the Washington State Department of Ecology's (Ecology) statement of work, budget request, and budget justification for its ongoing partnership with Northwest Association of Networked Ocean Observing Systems (NANOOS) Regional Coastal Ocean Observing Systems (RCOOS) from June 1, 2016 through May 31, 2017.

Under the NANOOS Pilot and with the last seven years of grants, Ecology has made estuarine observations through its Environmental Assessment Program (EAP) and conducted shoreline and beach monitoring through its Shorelands and Environmental Assistance (SEA) Program. Although the work under this grant will be conducted separately by each program, they are combined here for the purpose of Fiscal Year 2016 NANOOS funding.

We look forward to another year of successful collaboration with the entire NANOOS team.

Thank you,

Carol Smith, Ph.D.
Environmental Assessment Program Manager

cc: Gary Koshi, EAP Budget Planner, Ecology
Dale Norton, Western Operations Section Manager, Ecology
Carol Maloy, EAP Marine Monitoring Unit Supervisor, Ecology
George M. Kaminsky, SEA Senior Coastal Engineer, Ecology

Washington State Department of Ecology

Scope of Work

Estuarine Observations (Environmental Assessment Program)

EAP will focus our NANOOS support on helping to maintain our collaborative ferry monitoring project with Clipper Navigations, Inc.

Ecology currently has several sensors and a data logging system installed on the Victoria Clipper IV ferry. Funding for the upcoming period ($30,000) will support approximately 35% of one technician, critically important for servicing the water quality sensors on the ferry.

This public-private partnership has been very successful and is extremely cost-effective, saving the cost of expensive ship time. We collect continuous surface data as the ferry makes its twice daily runs between Seattle, WA and Victoria, BC, Canada. This data has been valuable in looking at the timing and spatial extent of blooms in Puget Sound, and the movement of water masses and river plumes, which we report on in our monthly surface condition report, Eyes Over Puget Sound. Recently, the Victoria Clipper ferry data has been useful for tracking the unusually warm water in Puget Sound.

By leveraging some one-time support from EPA's National Estuary Program (NEP) grant program, we improved data flow and telemetry and defined a data calibration/quality assurance strategy. EAP is currently providing funds for monthly data flow and trouble-shooting. Additional funding would allow us to create daily products to report near real-time surface features in Puget Sound as well as use the data to calibrate satellite images. However, current funding does not allow us to develop these products, nor can we respond promptly to technical problems with data acquisition or telemetry. Our ferry monitoring program is at risk, however, due to the fact that the agency currently does not have plans to support the monitoring technician position after October 2016.

Shoreline and Beach Monitoring (Shorelands and Environmental Assistance Program)

With funding of $60,000, Ecology will maintain a reduced-level beach and shoreline monitoring effort in the Columbia River littoral cell. The beach monitoring program requires the support of a two field project scientists/technicians. In the current period, NANOOS funding provides support to fund only approximately 25% of 1 technician, 15% of a project scientist and one project intern plus a portion of operations and expenses. Thus, other project grants are required to fund the remainder of the salaries and indirect costs plus additional operating expenses in order to implement the monitoring program. With leveraging of additional funds, the NANOOS budget enables implementation of data collection, processing, and archiving.

With base-level NANOOS funding, we have reduced our beach surface mapping from 16 sites during both summer and winter and 3 sites during fall and spring, to only 15 sites during summer and 5 sites during winter. This allows us to maintain an annual time series, but does not provide the previous capability to assess regional gradients in beach response to winter conditions,

particularly El Niño signatures that have accentuated asymmetric seasonal forcing. We will sustain this reduced scale monitoring in the current period, though augmented beach monitoring in Grays Harbor County will be made possible with additional funds provided by the state legislature at the request of local governments in Grays Harbor County. Products to be developed and delivered include: digital data, time-series of cross-shore beach profiles, beach surface and contour change, and operational support of the Coastal Profiling System (CPS) through collaboration with Oregon State University.

Although NANOOS funding has remained essentially flat over the past eight years while operating costs have increased, we have been fortunate to leverage support from other organizations that benefit from our beach monitoring program. We have been able to monitor in Puget Sound (e.g., Elwha River mouth), and have been able to increase our surveying capabilities using our 28' twin-hull vessel (beach-landing craft) designed for hydrographic and topographic surveying. We previously collaborated with Washington Sea Grant, National Park Service, Quinault Indian Nation, and the Quileute Tribe on establishing monuments and collecting initial beach profiles along the Olympic Peninsula. These efforts demonstrate the potential to expand the beach monitoring program beyond the southwest Washington coast to serve the needs of more communities throughout the state. Unfortunately, opportunities to acquire funds for sustained monitoring from other sources are extremely limited.

Washington State Department of Ecology

Fiscal Year 16 Budget Request

	WA Beach Monitoring	WA Estuarine Observations
Staff		
FTE Staff	5.5 months	4.2 months
Salaries and Wages	$23,978	$16,279
Employee Benefits	$8,057	$7,049
Indirect (28.6%)	$9,162	$6,672
Staff Sub-Total	*$41,197*	*$30,000*
Operating Expenses		
WCC Contract	$9,150	$0
Travel	$5,800	$0
Supplies	$3,853	$0
Equipment	$0	$0
O&M Sub-Total	*$18,803*	*$0*
Total Annual Cost:	**$60,000**	**$30,000**

Total Combined Cost: $90,000

Washington State Department of Ecology

Fiscal Year 16 Budget Justification

A total of $90,000 is requested for the Washington State Department of Ecology for the period June 1, 2016 to May 31, 2017. This includes $60,000 for WA Beach Monitoring [Shorelands and Environmental Assistance (SEA) Program] and the Coastal Monitoring & Analysis Program (CMAP) for Shoreline and Beach Monitoring, as well as $30,000 for WA Estuarine Observations [Environmental Assessment Program (EAP)].

Costs include:

Section A: Salaries

Senior Personnel

George Kaminsky (Coastal Engineer, SEA), Principal Investigator (PI), will provide overall leadership Shoreline and Beach Monitoring components of this project. Dr. Kaminsky will contribute approximately five months to this project as in-kind service, overseeing all phases of the project and assisting with field-data collection, analysis, data assimilation, product generation, incorporation into local decision-making. Dr. Kaminsky will also coordinate and collaborate with other NANOOS partners and beneficiaries.

Carol Maloy (Marine Monitoring Unit Supervisor, EAP), PI, will provide overall leadership on the Estuarine Observation components of this project as in-kind service, overseeing all phases of the project. Carol Maloy will also lead coordination and collaboration with other NANOOS partners and beneficiaries.

Other Personnel

Other SEA Program staff will provide field data collection, processing, analysis, and product generation support. Diana McCandless (Environmental Specialist 3) and Heather Baron (Environmental Specialist 4) will charge a combination of five months to the project associated with collecting and processing topographic and bathymetric data. In addition, an intern technician will also provide six months of support for field-data collection, vehicle and equipment maintenance as needed.

Other EAP staff will provide field-data collection, processing, analysis, and product generation support. Suzan Pool (Natural Resource Scientist 1) will charge approximately 4.2 months to the project.

Salaries are paid in accordance with Washington State Employee Salary Schedule (McCandless- $4,322/month, Baron- $4,653/month, intern-$9.32/hour, Pool- $3,907/month), plus 2% anticipated increases each year.

Section B: Employee Benefits

The Washington State Department of Ecology benefit rate is dependent on salary level and is approximately 33-45% for the above positions.

Section C: Equipment

None.

Section D: Travel

Travel Requested includes approximately 25 days for two staff at an average per diem rate of approximately $116.00 per day.

Sections E: Other Direct Costs

Services:

Costs include a fixed rate portion for an Individual Placement intern through the Washington Conservation Corps (WCC) estimated to be $9,150.

Materials and Supplies:

Costs for consumables and replacement field surveying supplies are estimated at $3,853 based on prior experience.

Section F: Indirect costs

Washington Department of Ecology negotiated indirect rate is set for each fiscal year. The rate for Fiscal Year 16 is 28.6% of Salaries and Benefits (26.1% for June 2016 only, 28.6% starting July 1, 2016).

COLLEGES AND UNIVERSITIES RATE AGREEMENT

EIN: 916001537

ORGANIZATION:
University of Washington
Management Accounting and Analysis
4300 Roosevelt Way NE, Suite 300
Box 354966
Seattle, WA 98195-4966

DATE:05/26/2016

FILING REF.: The preceding agreement was dated 03/02/2016

The rates approved in this agreement are for use on grants, contracts and other agreements with the Federal Government, subject to the conditions in Section III.

SECTION I: INDIRECT COST RATES

RATE TYPES: FIXED FINAL PROV. (PROVISIONAL) PRED. (PREDETERMINED)

	EFFECTIVE PERIOD				
TYPE	FROM	TO	RATE(%)	LOCATION	APPLICABLE TO
FINAL	07/01/2014	06/30/2015	54.50	(1) & (A)	Organized Research
PRED.	07/01/2015	06/30/2017	54.50	(1) & (A)	Organized Research
PRED.	07/01/2017	06/30/2018	55.00	(1) & (A)	Organized Research
PRED.	07/01/2018	06/30/2020	55.50	(1) & (A)	Organized Research
FINAL	07/01/2014	06/30/2015	26.00	(1) & (B)	Organized Research
PRED.	07/01/2015	06/30/2020	26.00	(1) & (B)	Organized Research
FINAL	07/01/2014	06/30/2015	53.00	(1) & (A)	Instruction
PRED.	07/01/2015	06/30/2020	53.00	(1) & (A)	Instruction
FINAL	07/01/2014	06/30/2015	26.00	(1) & (B)	Instruction
PRED.	07/01/2015	06/30/2020	26.00	(1) & (B)	Instruction
FINAL	07/01/2014	06/30/2015	33.80	(1) & (A)	Other Sponsored Activities
PRED.	07/01/2015	06/30/2016	33.80	(1) & (A)	Other Spon Act

ORGANIZATION: University of Washington Management Accounting and Analysis

AGREEMENT DATE: 5/26/2016

TYPE	FROM	TO	RATE(%)	LOCATION	APPLICABLE TO
PRED.	07/01/2016	06/30/2020	37.00	(1) & (A)	Other Sponsored Activities
FINAL	07/01/2014	06/30/2015	26.00	(1) & (B)	Other Spon Act
PRED.	07/01/2015	06/30/2016	26.00	(1) & (B)	Other Sponsored Activities
PRED.	07/01/2016	06/30/2020	25.00	(1) & (B)	Other Spon Act
FINAL	07/01/2014	06/30/2015	42.00	(1) & (C)	Core Grant
PRED.	07/01/2015	06/30/2016	42.00	(1) & (C)	Core Grant
PRED.	07/01/2016	06/30/2020	38.10	(1) & (C)	Core Grant
FINAL	07/01/2014	06/30/2015	78.00	(1) & (C)	Non-Core Fed
PRED.	07/01/2015	06/30/2016	78.00	(1) & (C)	Non-Core Fed
PRED.	07/01/2016	06/30/2020	83.10	(1) & (C)	Non-Core Fed
FINAL	07/01/2014	06/30/2015	17.00	(1) & (D)	
PRED.	07/01/2015	06/30/2016	17.00	(1) & (D)	
PRED.	07/01/2016	06/30/2020	19.00	(1) & (D)	
FINAL	07/01/2014	06/30/2015	25.00	(2) & (E)	
PRED.	07/01/2015	06/30/2020	25.00	(2) & (E)	
FINAL	07/01/2014	06/30/2015	74.00	(1) & (F)	Organized Research
PRED.	07/01/2015	06/30/2016	74.00	(1) & (F)	Organized Research
PRED.	07/01/2016	06/30/2017	75.00	(1) & (F)	Organized Research
PRED.	07/01/2017	06/30/2019	76.00	(1) & (F)	Organized Research
PRED.	07/01/2019	06/30/2020	76.50	(1) & (F)	Organized Research
PROV.	07/01/2020	Until Amended		(G)	

*BASE

(1) Modified total direct costs, consisting of all direct salaries and wages, applicable fringe benefits, materials and supplies, services, travel and up to the first $25,000 of each subaward (regardless of the period of performance of the subawards under the award). Modified total direct costs shall exclude equipment, capital expenditures, charges for patient care, rental costs, tuition remission, scholarships and fellowships, and the portion of each subaward in excess of $25,000.

(2) Direct salaries and wages including vacation, holiday and sick pay and other paid absences but excluding other fringe benefits.

(A) On-Campus
(B) Off-Campus
(C) Washington National Primate Research Center - see Section II Special Remarks.
(D) Applied Physics Laboratory
(E) Vessel Operations
(F) Lake Union Campus

(G) Use same rates and conditions as those cited for fiscal year ending June 30, 2020.

ORGANIZATION: University of Washington Management Accounting and Analysis

AGREEMENT DATE: 5/26/2016

SECTION I: FRINGE BENEFIT RATES**

TYPE	FROM	TO	RATE(%)	LOCATION	APPLICABLE TO
FIXED	7/1/2015	6/30/2016	24.30	(1) & (B)	Faculty & Res. Assoc.
FIXED	7/1/2015	6/30/2016	30.70	(1) & (A)	Medical Residents & Senior Fellows
FIXED	7/1/2015	6/30/2016	17.70	(1) & (A)	Grad. Students
FIXED	7/1/2015	6/30/2016	22.80	(1) & (A)	Post Doc. Trainees
FIXED	7/1/2015	6/30/2016	39.40	(1) & (B)	Class. Staff
FIXED	7/1/2015	6/30/2016	30.50	(1) & (B)	Prof. Staff
FIXED	7/1/2015	6/30/2016	17.60	(1) & (B)	(D)
FIXED	7/1/2015	6/30/2016	21.20	(1) & (B)	(E)
FIXED	7/1/2015	6/30/2016	8.30	(1) & (B)	(F)
FIXED	7/1/2015	6/30/2016	18.80	(1) & (A)	Hourly
FIXED	7/1/2015	6/30/2016	23.90	(1) & (A)	Pre-Doctoral Trainees & Fellows
FIXED	7/1/2015	6/30/2016	67.50	(2) & (C)	Class. Staff
FIXED	7/1/2015	6/30/2016	53.30	(2) & (C)	Prof. Staff
FIXED	7/1/2015	6/30/2016	51.10	(2) & (C)	Faculty & Research Associates

** DESCRIPTION OF FRINGE BENEFITS RATE BASE:

(1) Direct salaries and wages including vacation, holiday, and sick pay but excluding other fringe benefits.

(2) Direct salaries and wages excluding vacation, sick leave, holidays, other paid absences and all other fringe benefits.

(A) Entire University
(B) All except Applied Physics Laboratory
(C) Applied Physics Laboratory
(D) Professional Staff - Global (No Health)
(E) Professional Staff - Global (No Retirement)
(F) Professional Staff - Global (No Health or Retirement)

SECTION II: SPECIAL REMARKS

TREATMENT OF FRINGE BENEFITS:

The fringe benefits are charged using the rate(s) listed in the Fringe Benefits Section of this Agreement. The following fringe benefits are included in the fringe benefit rate(s):
HEALTH INSURANCE, SOCIAL SECURITY & MEDICARE TAXES, WORKERS COMPENSATION, MEDICAL AID & INDUSTRIAL INSURANCE, UWRP, STATE RETIREMENT, UNEMPLOYMENT COMPENSATION, AND SEPARATION LEAVE PAYMENTS FOR CLASSIFIED & PROFESSIONAL STAFF.

TREATMENT OF PAID ABSENCES

Vacation, holiday, sick leave pay and other paid absences are included in salaries and wages and are claimed on grants, contracts and other agreements as part of the normal cost for salaries and wages. Separate claims are not made for the cost of these paid absences. Beginning July 1, 2011, unused leave payments made upon separation of Classified and Professional Staff are included in the fringe benefit rates.

Beginning October 1, 1996 the Applied Physics Laboratory (APL) has separate fringe benefit rates from the remainder of the University of Washington. These rates include paid absences. Therefore, charges for direct salaries and wages from APL must exclude charges for paid absences, including vacation, sick leave, holidays, and other paid absences.

DEFINITION OF EQUIPMENT
Prior to 07/01/2016, equipment is defined as tangible nonexpendable personal property having a useful life of more than one year, and an acquisition cost of $2,000 or more per unit. Effective 07/01/2016, equipment is defined as tangible nonexpendable personal property having a useful life of more than one year, and an acquisition cost of $5,000 or more per unit.

DEFINITION OF ON-CAMPUS, OFF-CAMPUS AND SPECIAL RATES:
DEFINITION OF OFF-CAMPUS RATE
a. An off-campus program is one that is conducted (1) in leased facilities where space related costs (e.g. rent, utilities and maintenance) are charged directly to the program, or (2) in facilities made available (at no cost) to the program by a non-University organization, or (3) away from the University over an uninterrupted period of time in excess of 30 days for field work. The Off-Campus rate is not to be used as a substitute for the Vessel Operations rate or the Applied Physics Laboratory rate. Even though Pack Forest, Big Beef Creek, and Olympic Natural Resource Center are owned and operated by the University, these facilities are considered to be off campus.

b. Projects conducted at two or more locations:
There are instances where a project supported by a single grant or contract is conducted at two or more locations, thus requiring special consideration

in determining the appropriate indirect cost provision. The following should be observed in such circumstances:

(1) Where the total annual amount of the grant or contract direct costs is less than $250,000, a single indirect cost rate will be applied. This rate will be the one currently applicable to the location where the preponderance of project salaries is located.

(2) Where the total annual amount of the grant or contract direct costs is $250,000 or more, the appropriate rate for each location will be applied to the modified total direct costs specifically assigned to the respective location. In the absence of the institution's ability to specifically identify and assign costs to each location, the appropriate rate for each location will be applied to total project costs in the same ratio as direct salary costs incurred at each location during the period covered by the project billing or accounting.

PRIMATE CENTER RATES:
The Washington National Primate Research Center (WNPRC) has two Federally recognized rates for each time period. The NIH Office of the Director Primate Research Center (P51) Core Grant rate is 42.0% for 07/01/14 - 06/30/16. The NIH Office of the Director Primate Research Center (P51) Core Grant rate is 38.1% for 07/01/16 - 06/30/20. The Non-Core Federal Rate of 78.0% for 07/01/14 - 06/30/16 is the sum of the Core Grant (42.0%) and the WNPRC specific F&A expenditures (36.0%). The Non-Core Federal Rate of 83.1% for 07/01/16 - 06/30/20 is the sum of the Core Grant (38.1%) and the WNPRC specific F&A expenditures (45.0%).

NEXT PROPOSAL DUE DATE
An indirect cost proposal based on actual costs for fiscal year ending June 30, 2019 will be due no later than December 31, 2019.

ORGANIZATION: University of Washington Management Accounting and Analysis

AGREEMENT DATE: 5/26/2016

SECTION III: GENERAL

A. LIMITATIONS:

The rates in this Agreement are subject to any statutory or administrative limitations and apply to a given grant, contract or other agreement only to the extent that funds are available. Acceptance of the rates is subject to the following conditions: (1) Only costs incurred by the organization were included in its facilities and administrative cost pools as finally accepted: such costs are legal obligations of the organization and are allowable under the governing cost principles; (2) The same costs that have been treated as facilities and administrative costs are not claimed as direct costs; (3) Similar types of costs have been accorded consistent accounting treatment; and (4) The information provided by the organization which was used to establish the rates is not later found to be materially incomplete or inaccurate by the Federal Government. In such situations the rate(s) would be subject to renegotiation at the discretion of the Federal Government.

B. ACCOUNTING CHANGES:

This Agreement is based on the accounting system purported by the organization to be in effect during the Agreement period. Changes to the method of accounting for costs which affect the amount of reimbursement resulting from the use of this Agreement require prior approval of the authorized representative of the cognizant agency. Such changes include, but are not limited to, changes in the charging of a particular type of cost from facilities and administrative to direct. Failure to obtain approval may result in cost disallowances.

C. FIXED RATES:

If a fixed rate is in this Agreement, it is based on an estimate of the costs for the period covered by the rate. When the actual costs for this period are determined, an adjustment will be made to a rate of a future year(s) to compensate for the difference between the costs used to establish the fixed rate and actual costs.

D. USE BY OTHER FEDERAL AGENCIES:

The rates in this Agreement were approved in accordance with the authority in Title 2 of the Code of Federal Regulations, Part 200 (2 CFR 200), and should be applied to grants, contracts and other agreements covered by 2 CFR 200, subject to any limitations in A above. The organization may provide copies of the Agreement to other Federal Agencies to give them early notification of the Agreement.

E. OTHER:

If any Federal contract, grant or other agreement is reimbursing facilities and administrative costs by a means other than the approved rate(s) in this Agreement, the organization should (1) credit such costs to the affected programs, and (2) apply the approved rate(s) to the appropriate base to identify the proper amount of facilities and administrative costs allocable to these programs.

BY THE INSTITUTION:

University of Washington Management Accounting and Analysis

(INSTITUTION)

Elizabeth Cherry

(SIGNATURE)

Elizabeth Cherry

(NAME)

Interim Vice President, Finance & Facilities

(TITLE)

June 13, 2016

(DATE)

ON BEHALF OF THE FEDERAL GOVERNMENT:

DEPARTMENT OF HEALTH AND HUMAN SERVICES

(AGENCY)

Arif M. Karim -S Digitally signed by Arif M. Karim -S DN: c=US, o=U.S. Government, ou=HHS, ou=PSC, ou=People, cn=Arif M. Karim -S, 0.9.2342.19200300.100.1.1=2000212895 Date: 2016.05.27 17:07:28 -05'00'

(SIGNATURE)

Arif Karim

(NAME)

Director, Cost Allocation Services

(TITLE)

5/26/2016

(DATE) 2129

HHS REPRESENTATIVE: Janet Turner

Telephone: (415) 437-7820

DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH
SEATTLE REGIONAL OFFICE
300 FIFTH AVENUE, SUITE 710
SEATTLE, WA 98104

IN REPLY REFER TO

ONR 247
May 3, 2016

Dr. Jeffrey A. Simmen
Director, Applied Physics Laboratory
University of Washington
909 NE Boat Street
Seattle, WA 98105

Reference: Applied Physics Laboratory Provisional Prorated Direct Cost Rate submitted March 23, 2016, for the period October 1, 2016 through September 30, 2017.

Dear Dr. Simmen:

Based on my preliminary review, the below Applied Physics Laboratory (APL) provisional Prorated Direct Cost (PDC) rate is approved for pricing and billing purposes, effective October 1, 2016.

Rate Category	Rate	Application Base
Prorated Direct Cost	32%	(a)

(a) APL Modified Total Direct Costs (MTDC) consisting of salaries and wages, applicable fringe benefits, materials and supplies, services, travel, and up to the first $25,000 of each subaward (regardless of the period of performance of the subawards). MTDC excludes equipment, capital expenditures, charges for patient care, rental costs, tuition remission, scholarships and fellowships, participant support costs and the portion of each subaward in excess of $25,000.

This rate, applied to MTDC, shall be used effective immediately on any pricing actions which will include costs after September 30, 2016, and for billing purposes on all awards effective October 1, 2016.

It should be noted that subsequent audits may result in necessary adjustments to the provisional rate. The provisional rate is subject to unilateral amendment by the government or bilateral amendment by the contracting parties at any time.

Please contact me if you have any questions or concerns at (206) 548-7240 or evan.wood@navy.mil.

Sincerely,

Evan M. Wood

Evan M. Wood
Administrative Contracting Officer

E-Copies to:

ONR 242/L. Shipp
ONR 25/E. Simonoff
NAVSEA/J. Piunno
DHHS/T. Lin
UW/D. Martin
UW/M. Kummer
UW/K. Hovick