Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Navy											Date: February 2016	
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602435N *I Ocean Wrfghtg Env Applied Res*							
COST ($ in Millions)	**Prior Years**	**FY 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**	**FY 2018**	**FY 2019**	**FY 2020**	**FY 2021**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	62.643	72.252	42.618	-	42.618	43.368	43.634	43.789	43.941	Continuing	Continuing
0000: *Ocean Wrfghtg Env Applied Res*	0.000	43.303	42.252	42.618	-	42.618	43.368	43.634	43.789	43.941	Continuing	Continuing
9999: *Congressional Adds*	0.000	19.340	30.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	49.340

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (20 Jan 2015). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

This PE provides the unique, fundamental programmatic instrument by which basic research on the natural environment is transformed into technological developments that provide new or enhanced warfare capabilities for the Battlespace Environment (BSE). The objectives of this program are met through measuring, analyzing, modeling and simulating, and applying environmental factors affecting naval material and operations in the BSE. This program provides for BSE technological developments that contribute to meeting top joint warfare capabilities established by the Joint Chiefs of Staff, with primary emphasis on Joint Littoral Warfare and Joint Strike Warfare.

This PE fully supports the Director of Defense Research and Engineering's Science and Technology Strategy and is coordinated with other DoD Components through the Defense Science and Technology Reliance process. Work in this program is related to and fully coordinated with efforts in accordance with the on-going Reliance joint planning process. There is close coordination with the US Air Force and US Army under the Reliance program in the BSE categories of Lower Atmosphere, Ocean Environments, Space & Upper Atmosphere, and Terrestrial Environments. Within the Naval Transformation Roadmap, the investment will contribute toward achieving each of the "key transformational capabilities" required by Sea Strike, Sea Shield, and Sea Basing. Moreover, environmental information, environmental models, and environmental tactical decision aids that emerge from this investment will form one of the essential components of FORCEnet (which is the architecture for a highly adaptive, human-centric, comprehensive maritime system that operates from seabed to space). The Navy program includes efforts that focus on, or have attributes that enhance, the affordability of warfighting systems.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

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B. Program Change Summary ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Previous President's Budget	65.388	42.252	44.210	-	44.210
Current President's Budget	62.643	72.252	42.618	-	42.618
Total Adjustments	-2.745	30.000	-1.592	-	-1.592
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	30.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-1.466	0.000			
• SBIR/STTR Transfer	-1.279	0.000			
• Program Adjustments	0.000	0.000	-0.973	-	-0.973
• Rate/Misc Adjustments	0.000	0.000	-0.619	-	-0.619

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2015	FY 2016
Project: 9999: *Congressional Adds*		
Congressional Add: *AGOR Mid-life Refit*	19.340	30.000
Congressional Add Subtotals for Project: 9999	19.340	30.000
Congressional Add Totals for all Projects	19.340	30.000

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602435N / *Ocean Wrfghtg Env Applied Res*	Project (Number/Name) 0000 / *Ocean Wrfghtg Env Applied Res*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
0000: *Ocean Wrfghtg Env Applied Res*	0.000	43.303	42.252	42.618	-	42.618	43.368	43.634	43.789	43.941	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project provides technologies that form the natural environment technical base on which all systems development and advanced technology depend. Furthermore, this technical base provides developments that may be utilized in the Future Naval Capabilities programs: Organic Mine Countermeasures (MCM) and Autonomous Operations. This project contains the National Oceanographic Partnership Program (NOPP) (Title II, subtitle E, of Public Law 104-201) and efforts aimed at understanding and predicting the impacts of underwater sound on marine mammals.

Major efforts of this project are devoted to: gaining real-time knowledge of the BSE, determining the natural environment needs of regional warfare, providing the on-scene commander with the capability to exploit the environment to tactical advantage and, developing atmospheric research related to detection of sea-skimming missiles and strike warfare. This project provides natural environment applied research for all fleet operations and for current or emerging systems. Major developments are routinely transitioned to the Fleet Numerical Meteorology and Oceanography Center and to the Naval Oceanographic Office where they are used to provide timely information about the natural environment for all fleet operations.

Joint Littoral Warfare efforts address issues in undersea, surface, and air battlespace. Efforts include ocean and atmospheric analysis and prediction for real-time description of the operational environment, shallow water acoustics, multiple-influence sensors for undersea surveillance and weapon systems, and influences of the natural environment on MCM and Anti-Submarine Warfare (ASW) systems. Joint Strike Warfare efforts address issues in air battlespace dominance. Efforts include influences of the natural environment on air operations, electromagnetic (EM)/electro-optic (EO) systems used in intelligence, surveillance, reconnaissance, targeting, bomb damage assessment, and detection of missile weapon systems. They also include improvements in tactical information management about the BSE.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Title: Coastal Geosciences/Optics	6.323	6.297	6.604	0.000	6.604
Description: The goal of this activity is to determine the sources, distribution, and natural variability (concentration and properties) of optically important matters in the coastal ocean in support of Naval Mine, Undersea, and Special Warfare. Research investments in this activity support the development and testing of expendable and autonomous bioluminescence sensors, the continued development of extended range underwater imaging technologies, and algorithm development and testing for application to ocean color remote sensing from aircraft and space in order to characterize key features of the coastal battle space such as bathymetry, shallow-water bottom types, and the distribution of ocean water optical properties.					
FY 2015 Accomplishments:					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiated the effort to develop new methods using sparse representation theory for global inversion of marine gravity to deep-water seafloor topography. - Continued the effort to combine optical (Vis/SWIR/TIR) and passive microwave (PM) data to (1) improve the performance of the existing NRL microwave soil moisture (SM) and vegetation water content (VWC) algorithm near inland waterways and heavily vegetated regions at 40-km resolution; and (2) develop a down-scaling algorithm to generate SM and VWC data globally at 1 km spatial resolution, which is critical but unfilled DoD requirement for determining soil strength at spatial scales required for Marine Crops/Army mobility predictions. - Continued to refine algorithms that fuse sediment information extracted from operational sonar with historical sediment databases. - Continued development of a Benthic Unattended Generator to power an autonomous ocean environmental profiler and provided demonstration. - Continued experiments (and data collection) to test user performance as a function of display clutter. - Continued effort to understand and predict how power harvesting from the seabed is controlled by sediment geochemistry, microbiology,properties, and energetics. - Continued effort to develop and evaluate an integrated multi-sensor suite, including a small microflow cytometer, to characterize optical and biological properties of subsurface particle layers in coastal waters using unmanned underwater glider technology. - Continued effort to develop an intelligent decluttering algorithm (or system of algorithms) that accounts for both global and local clutter metrics in complex, multivariate displays. - Continued development of riverine expert system for environmental characterization. - Continued an effort to create a unified framework for measuring, recording, aggregating and presenting the uncertainty of data, models, and processes to support current and future efforts to add certainty measures to environmental products. - Continued studies for rapidly relocatable prediction models for riverine, estuarine and nearshore environments. - Continued development of the BMFC (Benthic Microbial Fuel Cell) into a functionally capable technology practical for powering Navy devices. - Complete the effort to detect and recognize targets beneath foliage using new polarimetric analysis techniques applied to ultra wideband (UWB) synthetic aperture radar (SAR) imagery. - Complete the development of methods to retrieve water depth, bottom type and water constituents in complex coastal waters, inland waterways, and denied areas using multispectral imagery (MSI) by extending techniques used for coarser resolution hyperspectral imagery to account for larger (MSI) data sets.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Complete the development of a new capability for the Navy to forecast the temporal and spatial evolution of bottom roughness along sandy coasts by developing a seafloor boundary layer model to predict spectral description of seafloor and sediment transport and then two-way coupling it to an ocean wave model. ***FY 2016 Plans:*** - Continue all efforts of FY 2015 less those noted as completed above. - Complete development of the BMFC (Benthic Microbial Fuel Cell) into a functionally capable technology practical for powering Navy devices. - Complete the effort to combine optical (Vis/SWIR/TIR) and passive microwave (PM) data to (1) improve the performance of the existing NRL microwave soil moisture (SM) and vegetation water content (VWC) algorithm near inland waterways and heavily vegetated regions at 40-km resolution; and (2) develop a down-scaling algorithm to generate SM and VWC data globally at 1 km spatial resolution, which is critical but unfilled DoD requirement for determining soil strength at spatial scales required for Marine Crops/Army mobility predictions. - Initiate studies to reduce uncertainties in data-assimilative littoral models in data-sparse environments - Initiate analysis of historic remote sensing modalities to determine whether robust climatologies can be developed which provide utility for initialization of littoral geosciences forecast models in data-poor regions. - Initiate a baseline study of littoral geosciences environmental variables and their value, singly or in combination, to reducing uncertainty of inverse and forward models, in data-poor regions ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016 less those noted as completed above. - Complete the effort to develop new methods using sparse representation theory for global inversion of marine gravity to deep-water seafloor topography. - Initiate development of new technologies and methodologies to delineate suspended sediment orientations in the water column and the turbulent motions which give rise to their spatial distributions, in response to the highly varied forcing of the littoral region. ***FY 2017 OCO Plans:*** N/A					
Title: Marine Mammals and Biology ***Description:*** Research on the sensitivity of Marine Mammals to sound produced by Naval operations and training will continue. The research in this program supports Navy environmental compliance information needs and facilitates acquiring LOAs from NOAA that enable all Navy training and testing operations, and the development of appropriate state-of-the-art mitigation measure. The goal of this activity is to support: (1) marine	3.485	3.576	3.446	0.000	3.446

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
mammal research related to understanding impacts of sound (especially sonar) on marine mammal behavior, hearing, physiology, distributions and ecology; (2) development and testing of new technologies for the detection of marine mammals at sea; The marine mammals research conducted in this PE represents part of a total effort executed in coordination with complementary research performed in PE 0602747N. The emphasis of efforts within PE 0602435N are Marine Mammals and Biology thrusts that include Integrated Ecosystem Research/ Sensor and Tag Development, Controlled Exposure Experiments (captive, free-ranging European waters), part of the Monitoring & Detection thrust (DCL algorithm development), and effects of chronic stress (free-ranging animal studies). ***FY 2015 Accomplishments:*** - Continued at-sea demonstration of radar and acoustics systems to monitor marine mammals in fleet activities. - Continued multi-investigator, coordinated field research to test responses of marine mammals (especially beaked whales) to controlled sound exposures. - Continued development of new technologies for detection and localization of marine mammals, including (but not restricted to) gliders equipped with passive acoustic sensors, radar and thermal imagery. - Continued research examining hearing sensitivity of marine mammals (including temporary and permanent threshold shifts). - Continued research efforts examining distributions and abundances of marine mammals relative to prey fields and basic oceanographic parameters. - Continued development of and evaluated models that predict time- and space-dependent sound fields produced by anthropogenic noise sources and mammal responses to the noise. - Continued development and testing of multi-frequency acoustic technologies for detection, identification and enumeration of fish. - Continued research on the physiology and stress of marine mammals in the wild. ***FY 2016 Plans:*** - Continue all efforts of FY 2015 less those noted as completed above. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016 less those noted as completed above. ***FY 2017 OCO Plans:*** N/A					
Title: Marine Meteorology	11.563	11.078	10.807	0.000	10.807

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
Description: The marine atmosphere affects most aspects of naval operations. This activity develops observing technologies, models, Numerical Weather Prediction (NWP) systems and Tactical Decision Aids (TDA) that describe the atmospheric environment and its impacts on naval sensors and operations. This activity focuses on uniquely marine aspects of atmospheric science such as air-sea interaction, coupled ocean-atmosphere modeling, EM and EO propagation, coastal meteorology, Tropical Cyclone (TC) prediction, and the use of remote sensing to obtain quantitative observations of atmospheric properties. Aspects of the atmospheric environment of particular interest include near-surface phenomena that affect refractivity, marine boundary layer dynamics that affect clouds, rain, visibility and fog, and processes that control TC structure, track, and intensity. Objectives of this activity are improved NWP systems and TDAs that provide NOWCAST and forecast skill at global, regional, and tactical scales for operational support, sensor and system development, and performance prediction. Funding decreases from FY 2015 - FY 2016 due to completion of the development of the ability to accurately detect, monitor and forecast the 3-D areal extent of global airborne dust, volcanic ash, and smoke and improve aerosol optical depth analyses and forecasts through the use of a suite of satellite sensors and the Navy Atmospheric Aerosol Prediction System (NAAPS). ***FY 2015 Accomplishments:*** - Initiated the effort to produce the world's first numerical weather prediction model of operational accuracy covering the entire middle atmosphere. - Continue development of a quantitative prediction capability of EM propagation (EMProp) and sensor performance through improved mesoscale modeling, and characterize the uncertainty in these predictions due to the environment and propagation models. - Continue the effort to develop and evaluate a global coupled atmosphere-ocean system that can accurately simulate and predict the Madden Julian Oscillation (MJO), which is a phenomenon that serves as a bridge between current weekly forecasts and extended-range forecasts. - Complete the design, assembly, testing and delivery of a threat detection technology for Tier 1 environmental analysis of aerosols. - Complete the development of the ability to accurately detect, monitor and forecast the 3-D areal extent of global airborne dust, volcanic ash, and smoke and improve aerosol optical depth analyses and forecasts through the use of a suite of satellite sensors and the Navy Atmospheric Aerosol Prediction System (NAAPS).					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Complete the development of a Hybrid Ensemble 4D-VAR Data Assimilation (DA) scheme for regional models based on the global data assimilation techniques, in order to simultaneously estimate regional and global model initial conditions. ***FY 2016 Plans:*** - Continue all efforts of FY 2015 less those noted as completed above. - Complete development of a quantitative prediction capability of EM propagation (EMProp) and sensor performance through improved mesoscale modeling, and characterize the uncertainty in these predictions due to the environment and propagation models. - Complete the effort to develop and evaluate a global coupled atmosphere-ocean system that can accurately simulate and predict the Madden Julian Oscillation (MJO), which is a phenomenon that serves as a bridge between current weekly forecasts and extended-range forecasts. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016 less those noted as completed above. -Completed the effort to produce the world's first numerical weather prediction model of operational accuracy covering the entire middle atmosphere. - Initiate development of a high-altitude version of the tropical cyclone intensity prediction model (COAMPS-TC) to incorporate new upper-level physics that affect storm dynamics. - Initiate development of a probabilistic tropical cyclone forecasting system, based on the COAMPS-TC ensemble, that generates probabilistic guidance and quantifies the forecast uncertainty. - Initiate development of a high resolution global weather prediction system (based on NAVGEM) with an improved dynamical core, increased resolution (approx. 10km and 100 layers), physics upgrades, new physics-dynamics coupling, and advances in the NAVDAS-AR data assimilation system. ***FY 2017 OCO Plans:*** N/A					
Title: National Oceanographic Partnership Program (NOPP) ***Description:*** This activity focuses on US Navy investments in the NOPP. NOPP, established by the US Congress (Public Law 104-201) in Fiscal Year 1997, is a unique collaboration among 15 federal agencies involved in conducting, funding, or utilizing results of ocean research. NOPP's value to the Navy derives from the capacity of the partnership to enable and ensure multi-agency efforts where such collaboration enhances efficiency or effectiveness, and/or reduces costs. Major areas of investment by NOPP include: development of an integrated coastal ocean observation system and development of sensors, communications and data	8.415	8.260	8.626	0.000	8.626

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
acquisition, storage and processing tools required to affect it, modernization of ocean research and observation infrastructure, and marine mammal-related research. ***FY 2015 Accomplishments:*** - Continue an Arctic remote sensing program. - Continue an Advancing Air/Ocean/Land/Ice Global Coupled Prediction on Emerging Computational Architectures program - Continued development of sensors for sustained, autonomous measurement of chemical or biological parameters in the ocean. - Continued marine mammal program on methods for detection and tracking of marine mammals and mapping their habitat. - Continued real-time forecasting system of winds, waves and surge in Tropical Cyclones (TCs). - Continued effort to develop global ocean models with sufficient resolution to accurately simulate tides and internal waves to improve the fidelity of ocean prediction systems. - Continued development of improving wind-wave predictions: global to regional scales. - Continued study of arctic processes. - Continued development of global and climate prediction studies. - Complete a study on Improving Wind Wave Predictions: global to regional scales. - Complete a project to develop an high resolution version of HYCOM with tides. ***FY 2016 Plans:*** - Continue all efforts of FY 2015 less those noted as completed above. - Initiate marine mammal tagging as a component of the marine arctic ecosystem dynamics study. - Initiate development of coupled Arctic System Models to support improved forecasting and prediction of sea ice and other operational parameters - Initiate efforts to seamlessly nest high-resolution regional ocean models into tide-resolving global HYCOM ocean forecasts - Initiate project to understand the role of the ocean in providing skill in extended-range predictions of the environment through systematic model intercomparisons ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016 less those noted as completed above. ***FY 2017 OCO Plans:***					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
N/A					
Title: Ocean Acoustics	3.347	2.586	2.288	0.000	2.288
Description: This activity is dedicated to the determination of the impact of the natural ocean environment on acoustic wave phenomena in support of naval undersea warfare and underwater force protection operations. This activity studies underwater acoustic propagation, scattering from ocean boundaries, and ambient noise issues that impact the development and employment of acoustic systems. The Littoral Zone (LZ) has been the ocean environment of greatest interest. Aspects of this environment, that greatly impact underwater acoustic systems, are the shallow water included in the Littoral Zone, the consequent closeness and physical significance of the ocean bottom, and the complexities inherent to rapid changes of the ocean structure. The objectives of this program are met through measuring, analyzing, modeling and simulating, and exploiting ocean acoustic factors to gain advantage over potential adversaries using undersea acoustic systems. Results of this activity support acoustic sensor and system development, performance prediction, and tactical decision aids. Funding decrease from FY 2015 to FY 2016 is due to the completion of efforts associated with acoustic performance predictions. ***FY 2015 Accomplishments:*** - Initiate effort to reduce acoustic propagation forecast error through a coupled ocean-acoustic assimilative model. - Continue effort to develop a new through-the-sensor environmental characterization capability for multistatic sonobuoy systems. - Continued development of an integrated hydrodynamic/acoustic propagation modeling capability for littoral regions to predict acoustic ASW system performance in dynamic environments. - Continued development of a Tactical Decision Aid (TDA) that can predict the dynamic oceanographic characteristics of shallow-water internal waves and their effects on underwater acoustic signals. - Continued development of a validated, physics-based processing algorithm that diagnoses acoustic performance directly from oceanographic data. - Continued development of a set of physics-based environmental acoustic metrics to evaluate the predictions of TDAs that are used in planning asset allocation and placement of distributed Autonomous Undersea Vehicles (AUVs) in a time evolving scenario.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued development of improved performance predictions for sonar surveillance systems that utilize horizontal line arrays operating in shelf-break environments and relate horizontal-array signal gain and coherence length to the statistics and scale lengths of transverse environmental inhomogeneities. - Continued development of an ocean magnetic prediction system for magnetic fields generated by high amplitude internal waves, internal bores, and internal solitary waves. - Continued development of a coupled algorithm to assimilate in-situ acoustic data into an acoustic model used for autonomous system decision support. - Complete enhancements to the accuracy of acoustic performance predictions through stochastic algorithms dealing with environmental uncertainty. ***FY 2016 Plans:*** - Continue all efforts of FY 2015 less those noted as completed above. - Complete development of a coupled algorithm to assimilate in-situ acoustic data into an acoustic model used for autonomous system decision support. - Complete effort to develop a new through-the-sensor environmental characterization capability for multistatic sonobuoy systems. ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016 less those noted as completed above. - Complete effort to reduce acoustic propagation forecast error through a coupled ocean-acoustic assimilative model. ***FY 2017 OCO Plans:*** N/A					
Title: Physical Oceanography ***Description:*** The goal of this activity is to develop naval tactical uses of knowledge of the physics of the ocean within the BSE. This is achieved through the development of predictive models of the water mass structure, waves, currents, and air-sea interactions and developing measurement/observation technology. Other applications utilize knowledge of the interaction of the water column hydrodynamics and the acoustics to predict the undersea transmission characteristics and sources of uncertainty in these statistics. Utilizing knowledge of the ocean surface physics, the physical oceanography program seeks to exploit the combination of remotely sensed data, in-situ data, and adaptively sampled data to optimize predictions of ocean currents and water	10.170	10.455	10.847	0.000	10.847

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
column structure. These predictions, custom databases, adaptive sampling schemes and data programs serve ASW, Naval Special Warfare (NSW), Sea-Basing, and mine warfare needs. ***FY 2015 Accomplishments:*** - Initiated the effort to develop the Navy's coupled ocean-atmosphere variational data assimilation (DA) system. - Continue the development of the calibration of ocean forcing and its uncertainty using satellite flux estimates and ocean observations propagated through the ocean physics to the surface - Continued to employ ocean models to complete 3-D acoustic simulations of space-time coherence of the acoustic field, which is a primary characteristic related to detection performance of acoustic systems. - Continued development of mass conserving baroclinic finite element models using discontinuous Galerkin methods. - Continued to extend current theory dealing with tidal variations in sound-speed to sound-speed events with strong range dependence. - Continued the development of a data assimilative nearshore modeling capability using measurements to guide hydrodynamic forecasts including data sampling strategies and model sensitivity to data. - Continued new ocean mixed-layer algorithms for generation of synthetic profiles which has led to the operational implementation of a new Navy Ocean Sound Speed Prediction (NOSSP) system at the Naval Oceanographic Office. - Continued the integration of hyperspectral imagery into underwater autonomous vehicles and derive river environmental properties through a combination of models and observations. - Continued the development and implementation of new techniques for parameterizing fluxes of mass and energy across the airsea interface in coupled ocean-atmosphere models, to improve operational predictions of the BSE. - Continued development and testing of acoustic communications, disposable environmental instruments, and Unmanned Undersea Vehicles (UUV) and gliders for NSW mission support. - Continued developing Delft3-D-Coupled Ocean Atmosphere Mesoscale Prediction System (COAMPS) to include new options for riverine input and transport and behavior of contaminants in support of NSW mission planning. - Continued the development of synthetic aperture radar (SAR) and hyperspectral imagery exploitation for NSW and Marine Expeditionary Forces as well as the support of new riverine units. - Continued studies of the monitoring and evaluation of ocean currents and water mass properties near topographic control points in marginal seas.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Continued to develop improved ocean wave prediction, especially shoaling waves, based on the extensive basic research measurement programs in this area over the past decade. - Continued development of predictive capability of internal wave affects on the battlespace, including affects on acoustic transmission. - Continued the development of the coupled Delft3-D-COAMPS model within the larger naval forecast system for use in NSW mission planning. - Continued the development of adaptive sampling algorithms for minimizing acoustic uncertainty using persistent, reconfigurable sampling by UUVs. - Continued on-board processing of METOC data on gliders/UUV for exfiltration consistent with operational concept of operations. - Continued the custom installation of adaptive sampling algorithms for minimizing acoustic uncertainty using persistent, reconfigurable sampling by UUVs using Naval Oceanographic (NAVO) modeling systems. - Continued an effort to utilize data from new mooring technologies in combination with AUV data to develop practical methodologies to identify and extract the AUV-data spectral content that is not accurately represented in operational systems currently assimilating these data. - Continued an effort to quantitatively determine how the optical properties of the upper ocean's organic constituents modify physical processes, such as the depth penetration of shortwave radiation into the ocean, and integrate a representation of bio-optical variability into the coupled ocean/atmosphere modeling framework. - Complete the development of the Navy's first high-resolution fully coupled relocatable ice-ocean-atmosphere (IOA) prediction system by building coupling software to couple the Community Ice Code (CICE) ice model into the COAMPS system, evaluating the results and then demonstrating the capability. - Complete the effort to extend the predictability of currents, waves and density structure in the coastal ocean by building a coupled 4D-VAR data assimilation capability for coupled ocean-wave models and use this ability to define prediction sensitivity to targeted observations.					
FY 2016 Plans: - Continue all efforts of FY 2015 less those noted as completed above. - Complete the development of the calibration of ocean forcing and its uncertainty using satellite flux estimates and ocean observations propagated through the ocean physics to the surface. - Initiate multi-scalable visuzalization tools using GPU's, tablets and remote sensing data. - Initiate testing of Air-Deployed Ocean Profiler in research and fleet test. - Initiate development of a coupled atmosphere-ocean-cryosphere-wave prediction system capable of forecasts from the submesoscale to decadal.					

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602435N / *Ocean Wrfghtg Env Applied Res*	**Project (Number/Name)** 0000 / *Ocean Wrfghtg Env Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total
- Initiate development of a high resolution Arctic ice/ocean/weather/wave prediction system that can assimilate SAR data. - Initiate Synthetic Aperture Radar Data Assimilation for Tropical Storm Forecasts - Initiate Expendable Expeditionary Data Fusion Development ***FY 2017 Base Plans:*** - Continue all efforts of FY 2016 less those noted as completed above. - Complete the effort to develop the Navy's coupled ocean-atmosphere variational data assimilation (DA) system. - Initiate the development and testing of the Remote Ocean Sampling System for air-sea surface flux sampling - Initiate the development of advanced autonomy for operations of gliders and uuv's in extreme environments - Initiate the development of ocean drifters with stable salinity sensors and high resolution turbulence sensors ***FY 2017 OCO Plans:*** N/A					
Accomplishments/Planned Programs Subtotals	43.303	42.252	42.618	0.000	42.618

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

All Science and Technology model improvements undergo a rigorous validation verification and evaluation against quantifiable metrics before being accepted for transition into operations. In Marine Meteorology, for example, typical improvements over the past decade have amounted to a gain in skill of one forecast-day (i.e., the 4-day forecast is now as skillful as the 3-day forecast of a decade ago), and tropical cyclone forecast track error has been reduced by 50%. It is expected that future increases in skill will continue at or above this pace.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy			Date: February 2016
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602435N / *Ocean Wrfghtg Env Applied Res*	Project (Number/Name) 9999 / *Congressional Adds*	

COST ($ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
9999: *Congressional Adds*	0.000	19.340	30.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	49.340

A. Mission Description and Budget Item Justification

The AGOR Mid-Life Refit FY15 funding will support the overhaul, re-fit and upgrade of Navy research vessel THOMAS G THOMPSON (AGOR 23). In FY15 funds will be awarded to the University of Washington, the operator of THOMPSON, to support the competitive selection of a US shipyard which will implement the design plans. The THOMPSON will enter the shipyard in November 2015 to begin the refit.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016
Congressional Add: AGOR Mid-life Refit	19.340	30.000
FY 2015 Accomplishments: The AGOR Mid-life Refit FY15 funding was combined with FY13 funding, and was awarded to the University of Washington...." to manage the overhaul, re-fit and upgrade of Navy research vessel THOMAS G THOMPSON (AGOR 23). The University of Washington issued a Request for Proposals for a shipyard to conduct the overhaul, re-fit and upgrade work, scheduled to begin May 2016. Bids were evaluated, and the winning shipyard will be announced before the end of FY15. Deliverables will support environmental compliance requirements regarding ballast water treatment, marine sanitation, engine exhaust, incinerator exhaust, air conditioning refrigerants, and oily-water separation. Additional deliverables will overcome obsolescence of diesel engine and electrical system components, and enhanced the ship safety with piping replacements in the ship's firemain and ballast water systems.		
FY 2016 Plans: The AGOR Mid-Life Refit FY16 funding represents an increase of $10M more than FY15, and provides full funding in this FY for the second vessel, AGOR 24 Roger Revelle. A contract with the University of California-San Diego's Scripps Institution of Oceanography will be developed to manage the project during FY16, with a major shipyard overhaul preliminarily planned for FY18. Deliverables will support environmental compliance requirements regarding ballast water treatment, marine sanitation, engine exhaust, incinerator exhaust, air conditioning refrigerants, and oily-water separation. Additional deliverables will overcome obsolescence of diesel engine and electrical system components, and enhanced the ship safety with piping replacements in the ship's firemain and ballast water systems.		
Congressional Adds Subtotals	19.340	30.000

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2017 Navy		Date: February 2016
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602435N / *Ocean Wrfghtg Env Applied Res*	**Project (Number/Name)** 9999 / *Congressional Adds*

C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Deliverables will support new environmental compliance requirements regarding ballast water treatment, marine sanitation, engine exhaust, incinerator exhaust, air conditioning refrigerants, and oily-water separation. Additional deliverables will overcome obsolescence of diesel engine and electrical system components, and enhance the ship safety with piping replacements in the ship's firemain and ballast water systems.