Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy											DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 2: *Applied Research*				R-1 ITEM NOMENCLATURE PE 0602435N: *Ocean Wrfghtg Env Applied Res*							
COST ($ in Millions)	**FY 2009 Actual**	**FY 2010 Estimate**	**FY 2011 Base Estimate**	**FY 2011 OCO Estimate**	**FY 2011 Total Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	51.855	53.727	49.491	0.000	49.491	51.279	52.052	53.703	54.989	Continuing	Continuing
0000: *Ocean Wrfghtg Env Applied Res*	47.467	48.548	49.491	0.000	49.491	51.279	52.052	53.703	54.989	Continuing	Continuing
9999: *Congressional Adds*	4.388	5.179	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	34.941

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 (Feb 2009). 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.

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy	DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 2: *Applied Research*	**R-1 ITEM NOMENCLATURE** PE 0602435N: *Ocean Wrfghtg Env Applied Res*

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

B. Program Change Summary ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	51.538	48.750	0.000	0.000	0.000
Current President's Budget	51.855	53.727	49.491	0.000	49.491
Total Adjustments	0.317	4.977	49.491	0.000	49.491
• Congressional General Reductions		-0.223			
• Congressional Directed Reductions		0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds		5.200			
• Congressional Directed Transfers		0.000			
• Reprogrammings	0.862	0.000			
• SBIR/STTR Transfer	-0.545	0.000			
• Program Adjustments	0.000	0.000	49.491	0.000	49.491
• Rate/Misc Adjustments	0.000	0.000	0.000	0.000	0.000

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2009	FY 2010
Project: 9999: *Congressional Adds*		
Congressional Add: *Autonomous Marine Sensors and Networks for Rapid Littoral Assessment*	1.596	2.390
Congressional Add: *Underwater Imaging and Communications Using Lasers*	0.000	1.992
Congressional Add: *Unmanned Undersea Vehicle Submerged Long Range Positioning*	0.000	0.797
Congressional Add: *Extended Underwater Optical Imaging*	1.994	0.000
Congressional Add: *Littoral Battlespace Sensing (LBS) & Autonomous Underwater Vehicle System (UAV)*	0.798	0.000
Congressional Add Subtotals for Project: 9999	4.388	5.179
Congressional Add Totals for all Projects	4.388	5.179

Change Summary Explanation

Technical: Not applicable.

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy	DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 2: *Applied Research*	**R-1 ITEM NOMENCLATURE** PE 0602435N: *Ocean Wrfghtg Env Applied Res*

Schedule: Not applicable.

FY11 from previous President's Budget is shown as zero because no FY11-15 data was presented in President's Budget 2010.

Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602435N: *Ocean Wrfghtg Env Applied Res*	PROJECT 0000: *Ocean Wrfghtg Env Applied Res*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
0000: *Ocean Wrfghtg Env Applied Res*	47.467	48.548	49.491	0.000	49.491	51.279	52.052	53.703	54.989	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 Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Coastal Geosciences/Optics	5.587	5.926	6.653	0.000	6.653
The goal of this activity is to determine the sources, distribution, and natural variability (concentration					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602435N: *Ocean Wrfghtg Env Applied Res*	PROJECT 0000: *Ocean Wrfghtg Env Applied Res*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
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 2009 Accomplishments:* - 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 efforts to develop visible/near infrared hyperspectral imagery algorithms for autonomous, near real time, retrieval of environmental products, such as diver visibility, bottom type and reflectivity, and bathymetry. - Continued efforts to develop automatic coordination and utilization of distributed web services. - Completed tracking analysis of small satellite calibration targets to determine atmospheric drag due to neutral density via Light Detection And Ranging (LIDAR) remote sensing. - Initiated effort to understand and predict how power harvesting from the seabed is controlled by sediment geochemistry, microbiology, physical properties, and energetics. - Initiated 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. - Initiated effort to develop an intelligent decluttering algorithm (or system of algorithms) that accounts for both global and local clutter metrics in complex, multivariate displays. - Initiated effort to develop a next generation atmospheric correction algorithm which will greatly enhance ocean passive retrievals including ocean color and visibility, bathymetry and sea surface					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602435N: *Ocean Wrfghtg Env Applied Res*	PROJECT 0000: *Ocean Wrfghtg Env Applied Res*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
temperature. *FY 2010 Plans:* - Continue all efforts of FY 2009 less those noted as completed above. - Complete effort to develop visible/near infrared hyperspectral imagery algorithms for autonomous, near real time, retrieval of environmental products, such as diver visibility, bottom type and reflectivity, and bathymetry. - Complete effort to develop automatic coordination and utilization of distributed web services. - Complete bioluminescence sensor effort with emphasis on needs of the Special Warfare (SPECWAR) forces and Naval Oceanographic Office survey capabilities, and use of the bioluminescence sensors in joint field measurements with ocean sensors to determine persistence of the bioluminescence signal and the ocean factors controlling the persistence. - Initiate development of riverine expert system for environmental characterization. *FY 2011 Base Plans:* - Continue all efforts of FY 2010 less those noted as completed above.					
Marine Mammals and Biology This activity consolidates and expands research conducted in previous years in Coastal Geosciences/ Optics and the Physical Oceanography Activities and expands these efforts. The sensitivity of Marine Mammals to sound produced by Naval operations and training will continue. This program is to assure that Navy decisions can be based on entifically defensible positions.The goal of this activity is to support: (1) marine 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; (3) research on the bio-acoustic properties, use of sound for detection of, and effects of sound on fish and lesser marine organisms; and (4) research on optically important biota in the coastal ocean in support of Naval Mine, Undersea, and Special Warfare (including oceanic bioluminescence and the development and testing	5.157	4.999	4.998	0.000	4.998

Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602435N: *Ocean Wrfghtg Env Applied Res*	PROJECT 0000: *Ocean Wrfghtg Env Applied Res*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
of bioluminescence sensors). The marine mammals research conducted in this PE represents part of a total effort executed in coordination with complementary research performed in PE 0602747N. FY 2009 reflects the realignment of funds from the Coastal Geosciences/Optics R2 Activity to fund expansion of the marine mammal noise study/mitigation effort per CNO requirement and to reflect an overall trend in program direction toward ocean sciences. *FY 2009 Accomplishments:* - Continued at-sea demonstration of radar and acoustics systems to monitor marine mammals in fleet activities. This effort moves to the Marine Mammals and Biology R2 activity in FY 2009. - Completed an accelerated effort for marine mammal detection involving signal processing of surface radar and the use of autonomous vehicles to allow passive acoustic and electromagnetic detection and monitoring of marine mammals off ranges during fleet ASW experimentation exercises and demonstrations when sound is transmitted underwater. (This effort transitioned from the Coastal Geosciences/Optics R2 activity). - Initiated multi-investigator, coordinated field research to test responses of marine mammals (especially beaked whales) to controlled sound exposures. - Initiated 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. - Initiated research examining hearing sensitivity of marine mammals (including temporary and permanent threshold shifts). - Initiated research efforts examining distributions and abundances of marine mammals relative to prey fields and basic oceanographic parameters. - Initiated development of and evaluate models that predict time- and space-dependent sound fields produced by anthropogenic noise sources and mammal responses to the noise. - Initiated development and testing of multi-frequency acoustic technologies for detection, identification and enumeration of fish.					

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APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602435N: *Ocean Wrfghtg Env Applied Res*	PROJECT 0000: *Ocean Wrfghtg Env Applied Res*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Initiated research to examine sensitivity of fish to anthropogenic sound. - Initiated research leading to better predictability of bioluminescent and pigment-bearing planktonic organisms. *FY 2010 Plans:* - Continue all efforts of FY 2009 less those noted as completed above. *FY 2011 Base Plans:* - Continue all efforts of FY 2010. - Initiate research on the physiology and stress of marine mammals in the wild.					
Marine Meteorology 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. *FY 2009 Accomplishments:* Continued developments in atmospheric effects on EMs and EOs because of the central importance of EM and EO propagation to many modern warfare systems. - Continued development of an EO propagation model that accounts for the atmospheric effects of	10.459	10.861	10.312	0.000	10.312

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APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602435N: *Ocean Wrfghtg Env Applied Res*	PROJECT 0000: *Ocean Wrfghtg Env Applied Res*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
near-surface refraction, scintillation, aerosol extinction, illumination and target, background and sensor characteristics for incorporation into EO tactical decision aids and for supporting warfare systems development. - Continued application of predictability concepts to optimize use of new-generation satellite data to target observation selection for maximum forecast impact in military areas of interest. - Continued exploitation of optimal methods for capturing uncertainty of environmental predictions on regional and local scales for reliability estimates of tactical parameters. - Continued program to develop the ability to assimilate data from the next generation of operational weather satellites to benefit real-time analysis of the battlespace environment as well as improving the global forecasting skill. - Continued development and validation of the Advanced Propagation Model to account for atmospheric effects on EM radiation, in particular, by the addition of the capability to describe high frequency radio frequencies. - Continued development of new methods, which account for a wider range of atmospheric conditions, for determination of refractivity from clutter as an inverse method of obtaining the critical refractivity properties of the atmosphere that affect EM propagation. - Continued effort to exploit probabilistic parameter ensembles for model improvement and construct a basis for observation-informed stochastic model integration. - Continued effort to improve understanding of atmospheric physical processes in the Arctic. - Continued effort to optimize rapid environmental assessment using coupled air-sea systems to support multiple warfare and mission areas, with a particular emphasis on Special Warfare. - Continued the development of a real-time meteorological and oceanographic battlespace characterization capability (NOWCAST) that collects, processes and exploits on-scene environmental data for rapid environmental assessment. The system will combine high-resolution atmospheric forecast information with 4-D data assimilation of on-scene observations (radar, satellite, conventional observations, etc) for customized display at time and space scales relevant for tactical operation support. - Continued the development of global and mesoscale aerosol/radiation models that account for the					

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APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602435N: *Ocean Wrfghtg Env Applied Res*	PROJECT 0000: *Ocean Wrfghtg Env Applied Res*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
major sources (desert dust, sea spray, biomass burning, industrial pollution) of visibility degradation in the atmosphere and integrate with numerical weather prediction systems for an aerosol predictive capability that can support militarily relevant time and space scales. - Continued development of methods to retrieve and assimilate remotely-sensed aerosol data into aerosol prediction models. - Completed the development and validation of a next-generation TC model that can analyze, initialize, and predict TC position, structure and intensity, using a high-resolution (< 3 km) mesoscale model. The development will leverage emerging data assimilation and modeling techniques as well as observational results from the scientific community to build upon existing modeling capabilities.					
FY 2010 Plans: - Continue all efforts of FY 2009 less those noted as completed above. - Complete development of new methods, which account for a wider range of atmospheric conditions, for determination of refractivity from clutter as an inverse method of obtaining the critical refractivity properties of the atmosphere that affect EM propagation. - Complete effort to optimize rapid environmental assessment using coupled air-sea systems to support multiple warfare and mission areas, with a particular emphasis on Special Warfare. - Complete the development of a real-time meteorological and oceanographic battlespace characterization capability (NOWCAST) that collects, processes and exploits on-scene environmental data for rapid environmental assessment. The system will combine high-resolution atmospheric forecast information with 4-D data assimilation of on-scene observations (radar, satellite, conventional observations, etc) for customized display at time and space scales relevant for tactical operation support. - Complete effort to exploit probabilistic parameter ensembles for model improvement and construct a basis for observation-informed stochastic model integration. - Complete effort to improve understanding of atmospheric physical processes in the Arctic. - Complete tracking analysis of small satellite calibration targets to determine atmospheric drag due to neutral density via LIDAR remote sensing.					

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APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602435N: *Ocean Wrfghtg Env Applied Res*	PROJECT 0000: *Ocean Wrfghtg Env Applied Res*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: - Continue all efforts of FY 2010 less those noted as completed above. - Continue effort to optimize rapid environmental assessment using coupled air-sea systems to support multiple warfare and mission areas, with a particular emphasis on Special Warfare. - Complete development of new methods, that account for a wider range of atmospheric conditions, for determination of refractivity from clutter as an inverse method of obtaining the critical refractivity properties of the atmosphere that affect EM propagation. - Complete development of an EO propagation model that accounts for the atmospheric effects of near-surface refraction, scintillation, aerosol extinction, illumination and target, background and sensor characteristics for incorporation into EO tactical decision aids and for supporting warfare systems development. - Initiate development of a next-generation coupled mesoscale model that can analyze and predict ocean-atmosphere processes at resolutions suitable for simulating coastal ocean circulations, waves, and detailed marine atmospheric boundary layer structure to extend existing modeling capabilities to tactically useful resolutions (<1 km). -Initiate development a of next generation mesoscale model that includes coupling of the physics between the ocean-land-atmosphere-ice and two-way interaction with larger scales for higher resolution local atmospheric prediction, optimal forcing of coastal ocean prediction systems, and improved representation of mesoscale affects on global predictions. -Initiate developemnt of a next-generation, higher resolution, higher altitude, coupled global numerical weather prediction model to include advanced physics, advanced numerical methods and advanced data assimilation methods, and conduct testing and validation to investigate its suitability for replacement of current prediction systems. -Develop, test and validate a next-generation TC prediction system that can analyze, initialize, and predict TC track, structure and intensity, using a high-resolution mesoscale model coupled to the ocean waves and currents. The development will include advanced data assimilation and modeling techniques as well as new methods of retrieving observations from remote sensing.					

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APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602435N: *Ocean Wrfghtg Env Applied Res*	PROJECT 0000: *Ocean Wrfghtg Env Applied Res*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
National Oceanographic Partnership Program (Nopp)	8.201	9.089	9.085	0.000	9.085

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 acquisition, storage and processing tools required to affect it, modernization of ocean research and observation infrastructure, and marine mammal-related research.

FY 2009 Accomplishments:
- Continued marine mammal program on noise mitigation
- Continued The Partnership for Advancing Interdisciplinary Global Modeling.
- Continued Global Ocean Data Assimilation Experiment (GODAE) including assessment of GODAE boundary conditions for use in coastal ocean predictions.
- Continued new methods for detection of fish, fish populations and mapping of fish habitat.
- 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 and completed wireless communications for the coastal ocean.

FY 2010 Plans:
- Continue all efforts of FY 2009.
- Continue real-time forecasting system of winds, waves and surge in TCs.
- Complete The Partnership for Advancing Interdisciplinary Global Modeling.
- Complete Global Ocean Data Assimilation Experiment (GODAE) including assessment of GODAE boundary conditions for use in coastal ocean predictions.

Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602435N: *Ocean Wrfghtg Env Applied Res*	PROJECT 0000: *Ocean Wrfghtg Env Applied Res*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Complete new methods for detection of fish, fish populations and mapping of fish habitat. - Initiate effort to develop global ocean models with sufficient resolution to accurately simulate tides and internal waves to improve the fidelity of ocean prediction systems. *FY 2011 Base Plans:* - Continue all efforts of FY 2010 less those noted as completed above.					
Ocean Acoustics 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 protectionoperations. 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. Increase from FY 2009 to FY 2010 reflects increased level of investment in ocean acoustics research. *FY 2009 Accomplishments:* - 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 TDA that can predict the dynamic oceanographic characteristics of shallow-water internal waves and their effects on underwater acoustic signals.	6.956	7.450	7.025	0.000	7.025

Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602435N: *Ocean Wrfghtg Env Applied Res*	PROJECT 0000: *Ocean Wrfghtg Env Applied Res*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- 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. - 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 glider ocean sampling strategies to minimize acoustic detection range uncertainty for anti-submarine warfare predictions. - Continued development of a broadband, bistatic reverberation time-series simulator for rangedependent underwater environments. - Continued development of an ocean magnetic prediction system for magnetic fields generated by high amplitude internal waves, internal bores, and internal solitary waves. - Completed Rim of the Pacific 2008 (RIMPAC08) new ASW metrics to plan ASW mission and assess ASW system performance. *FY 2010 Plans:* - Continue all efforts of FY 2009. - Complete development of glider ocean sampling strategies to minimize acoustic detection range uncertainty for anti-submarine warfare predictions. - Complete development of a broadband, bistatic reverberation time-series simulator for rangedependent underwater environments.					

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APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602435N: *Ocean Wrfghtg Env Applied Res*	PROJECT 0000: *Ocean Wrfghtg Env Applied Res*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: - Continue all efforts of FY 2010, unless noted as completed above.					
Physical Oceanography	11.107	10.223	11.418	0.000	11.418
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 column structure. These predictions, custom databases, adaptive sampling schemes and data programs serve ASW, Naval Special Warfare (NSW), Sea-Basing, and mine warfare needs. Increase from FY 2010 to FY 2011 due to ramping up emerging physical oceanography technologies programs. *FY 2009 Accomplishments:* - 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					

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APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602435N: *Ocean Wrfghtg Env Applied Res*	PROJECT 0000: *Ocean Wrfghtg Env Applied Res*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
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 system 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 air-sea 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 development of the knowledge layer of the internal wave tactical decision aid. - Continued development and testing of optimizing remote environmental monitoring units and other autonomous devices for NSW-Meteorological and Oceanographic Command (METOC) uses in assessing METOC conditions and providing data for assimilation. - Continued the development of synthetic aperture radar 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. - 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 developments in atmospheric and ocean model NOWCAST/forecast systems at a variety of scales (global, regional, semi-enclosed seas, local) including relocateable and nested models dependent on other priorities in this area.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Continued development of predictive capability of internal wave affects on the battlespace, including affects on acoustic transmission. - Continued the development of the coupled Delft3d-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 effort to develop a coupled, high-resolution, comprehensive ocean prediction system for the study of complex air-sea processes. - Completed development and testing of glider uses in ASW METOC, adaptive sampling, and NSW support. Acquisition Workforce Fund: - Funded DoD Acquisition Workforce Fund. *FY 2010 Plans:* - Continue all efforts of FY 2009 less those noted as completed above. - Complete effort to develop a coupled, high-resolution, comprehensive ocean prediction system for the study of complex air-sea process. - Complete development and testing of glider uses in ASW METOC, adaptive sampling, and NSW support. *FY 2011 Base Plans:* - Continue all efforts of FY 2010 less those noted as completed above.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Complete effort to obtain tidal constituents in estuaries combining sequential remote sensing imagery, tide gauge data and numerical model simulations. - Complete effort to develop and put in place the algorithms, data processing systems, product validation, mission planning and post-processing resources to exploit the science data stream from the HICO spaceborne hyperspectral imager.					
Accomplishments/Planned Programs Subtotals	47.467	48.548	49.491	0.000	49.491

C. Other Program Funding Summary ($ in Millions)

N/A

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 2011 Navy			DATE: February 2010
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COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
9999: *Congressional Adds*	4.388	5.179	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	34.941

A. Mission Description and Budget Item Justification

Congressional Interest Items not included in other Projects.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010
Congressional Add: Autonomous Marine Sensors and Networks for Rapid Littoral Assessment *FY 2009 Accomplishments:* This effort supported research into the development of small, low-power sensors to use on small autonomous underwater vehicles designed for clandestine rapid environmental assessment and continued development of advanced underwater sensing systems and associated systems. *FY 2010 Plans:* Continues support of Autonomous Marine Sensors and Networks for Rapid Littoral Assessment research.	1.596	2.390
Congressional Add: Underwater Imaging and Communications Using Lasers *FY 2010 Plans:* This effort supports Underwater Imaging and Communications Using Lasers research.	0.000	1.992
Congressional Add: Unmanned Undersea Vehicle Submerged Long Range Positioning	0.000	0.797

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010
FY 2010 Plans: This effort supports Unmanned Undersea Vehicle Submerged Long Range Positioning research.		
Congressional Add: Extended Underwater Optical Imaging *FY 2009 Accomplishments:* This effort supported the development of future concepts designed to optically image objects underwater at ranges currently not achievable and communicate underwater with optical signals. Laboratory tank experiments were directed at optimizing the architecture of compact underwater imaging sensors and tests of optical communications concepts.	1.994	0.000
Congressional Add: Littoral Battlespace Sensing (LBS) & Autonomous Underwater Vehicle System (UAV) *FY 2009 Accomplishments:* This effort supported research into the effective utilization of Autonomous Underwater Vehicle (AUVs. The understanding of operational metrics, manpower requirements, training, and CONOPS has been increased through AUV experimentation and leveraging commercial AUV user experience. Through this research, additional knowledge has been gained relating to mission planning, data quality control, data assimilation, and shipboard communications - all critical elements of the Oceanographer of the Navy's Littoral Battlespace Sensing - Unmanned Underwater Vehicle (LBS-UUV) program.	0.798	0.000
Congressional Adds Subtotals	4.388	5.179

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

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E. Performance Metrics

Congressional Interest Items not included in other Projects.