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Exhibit R-2, RDT&E Budget Item Justification: PB 2013 Navy										DATE: February 2012	

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 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
Total Program Element	47.231	50.076	49.635	-	49.635	49.878	51.061	52.147	53.167	Continuing	Continuing
0000: *Ocean Wrfghtg Env Applied Res*	47.231	50.076	49.635	-	49.635	49.878	51.061	52.147	53.167	Continuing	Continuing

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 (Sep 2011). 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 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
Previous President's Budget	49.491	50.076	50.553	-	50.553
Current President's Budget	47.231	50.076	49.635	-	49.635
Total Adjustments	-2.260	-	-0.918	-	-0.918
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-1.245	-			
• SBIR/STTR Transfer	-0.763	-			
• Program Adjustments	-	-	-1.398	-	-1.398
• Rate/Misc Adjustments	-	-	0.480	-	0.480
• Congressional General Reductions Adjustments	-0.252	-	-	-	-

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

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PROJECT
0000: *Ocean Wrfghtg Env Applied Res*

COST ($ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
0000: *Ocean Wrfghtg Env Applied Res*	47.231	50.076	49.635	-	49.635	49.878	51.061	52.147	53.167	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 2011	FY 2012	FY 2013
Title: Coastal Geosciences/Optics	6.382	7.788	7.907

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 2011 to FY 2012 funding increase is due to additional efforts associated with ASW Surveillance, and Littoral Geosciences/Optics.

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2011	FY 2012	FY 2013
FY 2011 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 effort to understand and predict how power harvesting from the seabed is controlled by sediment geochemistry, microbiology, physical 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 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 temperature. - Continued development of riverine expert system for environmental characterization. - Initiated 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. - Initiated development of new data storage topologies and ensemble methods for irregular, multi-resolution, geophysical data. ***FY 2012 Plans:*** - Continue all efforts of FY 2011 less those noted as completed above. ***FY 2013 Plans:*** - Continue all efforts of FY 2012. - Complete 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. - Initiate studies for rapidly relocatable prediction models for riverine, estuarine and nearshore environments.			
Title: Marine Mammals and Biology ***Description:*** 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 scientifically 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	4.794	5.090	4.895

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2011	FY 2012	FY 2013
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 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. 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 2011 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 to examine sensitivity of fish to anthropogenic sound. - Continued research leading to better predictability of bioluminescent and pigment-bearing planktonic organisms. - Initiated research on the physiology and stress of marine mammals in the wild. *FY 2012 Plans:* - Continue all efforts of FY 2011. *FY 2013 Plans:* - Continue all efforts of FY 2012.			
Title: Marine Meteorology *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	9.649	9.349	9.972

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2011	FY 2012	FY 2013
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 2011 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 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 the development of global and mesoscale aerosol/radiation models that account for the 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. - Continued effort to optimize rapid environmental assessment using coupled air-sea systems to support multiple warfare and mission areas. - Completed 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. - Completed 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. - Initiated 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).			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2011	FY 2012	FY 2013
-Initiated development of a 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. -Initiated development 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. - Initiated an effort to develop an explicit, interactive cloud-radiation modeling approach to simulate primary cloud dynamics for NWP, and lay the foundation for interactive studies of greenhouse gases and anthropogenic and natural aerosols that have been proven to be critical for climate change. -Developed, tested and validated 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 included advanced data assimilation and modeling techniques as well as new methods of retrieving observations from remote sensing. *FY 2012 Plans:* -Continue all efforts of FY 2011 less those noted as completed above. -Initiate development of a coupled atmosphere-ocean-cryosphere-wave prediction system capable of forecasts from the submesoscale to decadal. -Initiate development of a high resolution Arctic ice/ocean/weather/wave prediction system that can assimilate synthetic aperture radar data. *FY 2013 Plans:* - Continue all efforts of FY 2012 less those noted as completed above. - Complete development, testing and validation of 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 included advanced data assimilation and moveling techniques as well as new methods of retrieving observations from remote sensing. - Complete an effort to develop an explicit, interactive cloud-radiation modeling approach to simulate primary cloud dynamics for NWP, and lay the foundation for interactive studies of greenhouse gases and anthropogenic and natural aerosols that have been proven to be critical for climate change.			
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-	8.715	9.299	8.983

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2011	FY 2012	FY 2013
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 2011 Accomplishments:* - Continued marine mammal program on noise mitigation. - 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 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. *FY 2012 Plans:* - Continue all efforts of FY 2011. - Complete marine mammal program on noise mitigation. - Initiate development of improving wind-wave predictions: global to regional scales. *FY 2013 Plans:* - Continue all efforts of FY 2012 less those noted as completed above. - Complete development of sensors for sustained, autonomous measurement of chemical or biological parameters in the ocean. - Complete marine mammal program on methods for detection and tracking of marine mammals and mapping their habitat. - Complete real-time forecasting system of winds, waves and surge in TCs. - Initiate study of arctic processes. - Initiate development of global and climate prediction studies.			
Title: Ocean Acoustics *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	6.739	6.676	6.829

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2011	FY 2012	FY 2013
advantage over potential adversaries using undersea acoustic systems. Results of this activity support acoustic sensor and system development, performance prediction, and tactical decision aids. *FY 2011 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. - 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 an ocean magnetic prediction system for magnetic fields generated by high amplitude internal waves, internal bores, and internal solitary waves. - Initiated effort to exploit acoustic noise shielding effects of complex geologic structures on ocean basin margins to enhance performance of buried passive acoustic sensors. - Initiated effort to improve representation of ocean uncertainty in acoustic propagation models using a multiscale ocean data assimilation algorithm. *FY 2012 Plans:* - Continue all efforts of FY 2011. *FY 2013 Plans:* - Contine all efforts of FY 2012.			
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	10.952	11.874	11.049

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2011	FY 2012	FY 2013
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. *FY 2011 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 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 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 (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. - 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.			

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- 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. - Completed effort to obtain tidal constituents in estuaries combining sequential remote sensing imagery, tide gauge data and numerical model simulations. - Completed 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 Hyperspectral Imager for the Coastal Ocean (HICO) spaceborne hyperspectral imager. - Initiated 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. - Initiated 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. *FY 2012 Plans:* - Continue all efforts of FY 2011 less those noted as completed above. - Complete development of the knowledge layer of the internal wave tactical decision aid. - Complete development and testing of optimizing remote environmental monitoring units and other autonomous devices for NSW-METOC uses in assessing METOC conditions and providing data for assimilation. - Complete 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. - Initiate multi-scalable visualization 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. - Initiate development of a high resolution Arctic ice/ocean/weather/wave prediction system that can assimilate SAR data. *FY 2013 Plans:*			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2011	FY 2012	FY 2013
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Accomplishments/Planned Programs Subtotals	47.231	50.076	49.635

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

Not applicable.

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.