Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Navy											Date: March 2019	
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 4: *Advanced Component Development & Prototypes (ACD&P)*					R-1 Program Element (Number/Name) PE 0603207N *I Air/Ocean Tactical Applications*							
COST ($ in Millions)	**Prior Years**	**FY 2018**	**FY 2019**	**FY 2020 Base**	**FY 2020 OCO**	**FY 2020 Total**	**FY 2021**	**FY 2022**	**FY 2023**	**FY 2024**	**Cost To Complete**	**Total Cost**
Total Program Element	616.037	47.422	29.747	32.643	2.400	35.043	36.157	36.269	37.143	37.882	Continuing	Continuing
2341: *METOC Data Acquisition*	172.047	5.276	3.471	4.662	2.400	7.062	6.089	6.181	7.858	8.016	Continuing	Continuing
2342: *METOC Data Assimilation and Mod*	251.206	20.959	17.441	21.168	-	21.168	22.355	22.382	22.004	22.438	Continuing	Continuing
2343: *Tactical METOC Applications*	163.724	11.448	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	175.172
2344: *Precise Time and Astrometry*	15.533	4.992	4.556	2.467	-	2.467	3.293	3.209	3.079	3.141	Continuing	Continuing
2363: *Remote Sensing Capability Development*	11.128	3.874	0.324	0.327	-	0.327	0.328	0.328	0.000	0.000	0.000	16.309
3207: *Fleet Synthetic Training*	2.399	0.243	0.266	0.283	-	0.283	0.305	0.326	0.332	0.339	Continuing	Continuing
3404: *Tactical Environmental Support*	0.000	0.315	2.595	2.619	-	2.619	2.643	2.672	2.684	2.738	Continuing	Continuing
3405: *Decision Support Products & Dissemination*	0.000	0.315	1.094	1.117	-	1.117	1.144	1.171	1.186	1.210	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Air Tactical Applications (AOTA) Program Element (PE) is aligned with the Navy's maritime strategy to enhance the future mission capabilities of the Navy-Marine Corps Meteorological and Oceanographic (METOC) Team supporting naval warfighters worldwide. New state-of-the art government and commercial technologies are identified, transitioned, demonstrated and then integrated into Combat Systems and programs of record to provide capabilities that provide real-time and near-real-time operational effects of the physical environment on the performance of combat forces and their new and emerging platforms, sensors, systems and munitions. The AOTA program element focuses on sensing and characterizing and predicting the littoral and deep-strike battlespace in the context of regional conflicts and crisis response scenarios.

Projects in this PE transition state-of-the art sensing, assimilation, modeling and decision aid technologies from government and commercial sources. Unique project development efforts include atmospheric and oceanographic data assimilation techniques, forecast models, data base management systems and associated software for use in mainframe, desktop and laptop computers. Model data, products and services can be used by forward-deployed personnel or in a reach-back mode to optimize sensor placement and force allocation decisions. Global Geospatial Information and Services efforts within this program address the bathymetric needs of the Navy. Also developed are algorithms to process new satellite sensor data for integration into Navy and Marine Corps decision support systems and for display as part of the common operational and tactical pictures. In addition, the projects provide for demonstration and validation of specialized atmospheric and oceanographic instrumentation and measurement techniques, new sensors, communications and interfaces. Included are new capabilities to assess, predict and enhance the

performance of current and emerging undersea warfare and mine warfare weapons systems. AOTA capabilities are designed to support the latest versions of the Global Command and Control System and specific unit-level combat systems. This PE develops technological upgrades for the U.S. Naval Observatory's Master Clock system to meet requirements of Department of Defense communications, cryptographic, intelligence, geolocation, and targeting systems; develops near-real-time earth orientation predictions; develops very precise determination of positions of both faint and bright stars; and supports satellite tracking and space debris studies.

Major emphasis areas include the Naval Integrated Tactical Environmental System Next Generation (NITES-Next) and the METOC Data Acquisition, the METOC Data Assimilation & Modeling, the Precise Timing and Astrometry, the Fleet Synthetic Training, the Tactical Environmental Support, Decision Support Products & Dissemination, the Earth System Prediction Capability projects, and the Remote Sensing Capability Development.

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 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Previous President's Budget	48.365	29.747	33.642	-	33.642
Current President's Budget	47.422	29.747	32.643	2.400	35.043
Total Adjustments	-0.943	0.000	-0.999	2.400	1.401
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.943	0.000			
• Program Adjustments	0.000	0.000	-0.344	-	-0.344
• Rate/Misc Adjustments	0.000	0.000	-0.655	2.400	1.745

Change Summary Explanation

The FY2020 funding request for project 2341 was reduced by $0.58 million to account for the availability of prior year execution balances. Funding increases for project 2341 are for the development of automated mission planning and route selection aids in support of TRITON MQ-4C hazardous weather avoidance(Priority T-1a); allowing evaluation of the utility of SPIRE ionospheric data for modeling the ionosphere.

The FY2020 funding request for project 2342 was reduced by $1.685 million to account for the availability of prior year execution balances. Funding increases for project 2342 are for the global Navy Earth System Model as it transitions from Initial Operational Capability (IOC) to its Full Operational configuration and maturation of the Regional Arctic Prediction System and the Navy's Environmental Prediction sysTem Using the NUMA corE (NEPTUNE) next generation dynamic core.

The FY2020 funding request for project 2344 was reduced by $0.479 million to account for the availability of prior year execution balances

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy			Date: March 2019
Appropriation/Budget Activity 1319 / 4	R-1 Program Element (Number/Name) PE 0603207N / *Air/Ocean Tactical Applications*	Project (Number/Name) 2341 / *METOC Data Acquisition*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
2341: *METOC Data Acquisition*	172.047	5.276	3.471	4.662	2.400	7.062	6.089	6.181	7.858	8.016	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

The major work of the Meteorology and Oceanography (METOC) Data Acquisition Project is to provide future mission capabilities to warfighters allowing them to detect and monitor the conditions of the physical environment throughout the entire battlespace. The most promising new sensor technologies (including unmanned vehicles, tactical sensor exploitation, in-situ sensors) are transitioned from the government's and commercial industry's technology base. These new sensor technologies are demonstrated, validated and integrated into operational programs for warfighters. These new sensor capabilities provide timely and accurate METOC data to operational and tactical commanders. METOC data requirements have evolved with emphasis on naval warfare shifting to littoral and deep strike battlespace. The need to accurately characterize dynamic conditions are crucial in planning and executing warfare operations and effectively allocating force weapon and sensor systems. Routinely available data sources, such as climatology, oceanographic and meteorological numerical models are necessary but not sufficient to support the littoral and deep strike regions. Operational sensors are deployed great distances from the target area of interest. The challenge is to collect and disseminate METOC data in variable and dynamic littoral environmental conditions or in denied, remote or inaccessible areas over extended periods of time.

This project: 1) provides the means to rapidly and automatically acquire a broad array of METOC data using off-board and on-board sensors; 2) provides an on-scene assessment capability for the tactical commander; 3) provides the tactical commander with real-time METOC data and products for operational use; 4) demonstrates and validates the use of tactical workstations and desktop computers for processing and display of METOC data and products; 5) demonstrates and validates techniques which employ data compression, connectivity and interface technologies to obtain, store, process, distribute and display these METOC data and products; 6) develops new charting and bathymetric survey techniques necessary to reduce the existing shortfall in coastal hydrographic survey requirements; 7) develops an expanded database for predictive METOC models in areas of interest; and 8) supports the development of radar weather using through-the-sensor techniques. Major emphasis area Tactical Oceanographic Capabilities project.

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Title: Meteorological and Oceanographic (METOC) Data Acquisition	5.276	3.471	4.662	2.400	7.062
Articles:	-	-	-	-	-
Description: Efforts falling within the Meteorology and Oceanography (METOC) Collections Project provide future scientific and technological warfighting capabilities that detect and continuously monitor environmental (atmospheric, sea surface, oceanographic and seabed) conditions throughout the battlespace. The Navy's mission continues to require focus on blue-water operations, littoral and deep-strike (inland) battlespaces. Each of these operating areas (and the transitions between them) has its own dynamic and complex environmental characteristics and behaviors that require modifying METOC Collections and associated sensing strategies					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2341 / *METOC Data Acquisition*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
and methodologies. Without reliable characterization of ocean and atmosphere in these operating areas, the Navy risks ineffective allocation and employment of warfighters and weapon systems, and the sensors that fully enable them. Fleet Naval METOC has updated the definition and structure of the METOC program along the lines of operational mission needs. This update focuses on the operational characteristics of Tasking, Collection, Processing, Exploitation, and Dissemination (TCPED) of METOC data and information. Identified efforts supporting METOC are realigned to projects and activities that align to the TCPED updated program structure. ***FY 2019 Plans:*** Continue all efforts of FY18 less those noted as completed. The effort also plans to focus on each category as described below: - Continue: Implement a "rapid innovation" weather-ocean capability that emphasizes observing systems. - Continue: Assimilate satellite optical data streams into the Coupled Ocean-Atmosphere Mesoscale Prediction System ocean model component. - Complete: Test, validate, and transition new components for data assimilation capabilities for global and mesoscale atmospheric models that address multiple scales. - Complete: Supplement efforts in a FY17-19 Rapid Transition Project to solve the overall Forward ocean data assimilation problem and integrate results into Anti-submarine Warfare Tactical Decision Aids. - Complete: Provide technical support to passive microwave and weather satellite follow-on remote sensing projects for all phases of pre- and post-launch sensor calibration, algorithm validation, data exploitation, dissemination and quality control of critical synoptic atmospheric and geophysical environmental data products. - Complete: Develop and test a Navy Coupled Ocean Data Assimilation-based capability for forward platforms to assimilate collected oceanographic data into an oceanographic model field in an acoustically consistent way. - Complete: Develop, validate and transition bias correction for extended-range forecasts in the global and regional coupled systems, using information from the satellite observations to measure the bias and guide the correction. - Complete: Collect in-situ transmission loss from tactical platforms in support of a Low Frequency Bottom Loss database. - Complete: Develop a methodology for creating a bottom backscattering database in Deep Water, i.e., water depths deeper than the continental rise, and apply the methodology to regions of operational interest to create a Prototype Deep Ocean Bottom Scattering database.					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2341 / *METOC Data Acquisition*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
- Complete: Characterize/assess biological scattering and attenuation at tactical frequencies, known to have a significant impact on mid-frequency active sonar systems.					
FY 2020 Base Plans: Continue with implementing a "rapid innovation" weather-ocean capability that emphasizes observing systems. Continue assimilating satellite optical data streams into the Coupled Ocean-Atmosphere Mesoscale Prediction System ocean model component. The effort will also focus on each category as described below: Forward-based Navy coupled ocean data assimilation (NCODA). Emphasize Compression Integration, Integration of NCODA-Forward processing and algorithms, Modifications to bathythermograph (BT) Manager, integration of the BT-SSP (sound speed profile) and BT Manager modules, New Data Visualization. Develop automated mission planning and route selection aids in support of TRITON MQ-4C hazardous weather avoidance (Priority T-1a). Weather variables will include probability of icing, turbulence, thunderstorms, and cross-winds at air base for both takeoff and landing. Increases automation of Aerographers Mate (AG) mission planning, route selection, and weather briefing materials that will improve C2 and vehicle autonomy with greater platform-to-operator (AG) ratio, and automated planning (Priority T-1b). Improves platform-to-operator ratio supports guidance that many METOC billets supporting TRITON will not be renewed in FY19. Towed Array Ballasting System Construct prototype and integrate onto operational platform. Acoustic Towed Array Miniaturization Construct "build 2, 45mm footprint" into three prototype arrays with 3-different node spacings. Signal Processing Fully implement R-Theta algorithm. Remote Sea-Test Demonstrate technology in ONR-sponsored West Pacific sea-test. The capability delivered will be to provide operational high-resolution satellite visible/infrared (Vis/IR) and passive microwave (PMW) sea ice concentration retrievals for improved sea ice forecasts and safe navigation in the Arctic. Users will be sea ice forecasters and personnel operating in the ice environment either surface or subsurface.					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2341 / *METOC Data Acquisition*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
The utility of SPIRE ionospheric data for modeling the ionosphere was evaluated in two parts split across fiscal year FY18 and FY19. In part 2 (FY19), a representative sample of SPIRE data (which includes at a minimum two contiguous days of data) acquired and ingested into an ionospheric data assimilative model. The performance of the model runs with SPIRE data will be compared to the performance of model runs without SPIRE data to demonstrate the overall impact of the data. Since it is anticipated that the volume of SPIRE data will grow substantially, the impact of the SPIRE data will be measured as a function of the density of SPIRE data samples in the vicinity of the independent ionospheric observations. This will provide for an estimation of the utility of larger constellations of SPIRE satellites with higher sample densities than the representative SPIRE data used in this study. Conclude the effort to Collect in-situ transmission loss (TL) from tactical platforms in support of Naval Oceanographic Office's (NAVOCEANO's) Low Frequency Bottom Loss (LFBL) database that developed efficient algorithm to perform inversion of TL data to produce geo-acoustic parameters of the local environment. ***FY 2020 OCO Plans:*** N/A ***FY 2019 to FY 2020 Increase/Decrease Statement:*** Funding increases from FY 2019 to FY 2020 for the development of automated mission planning and route selection aids in support of TRITON MQ-4C hazardous weather avoidance(Priority T-1a); allowing evaluation of the utility of SPIRE ionospheric data for modeling the ionosphere. The FY 2020 funding request for project 2341 was reduced by $0.58 million to account for the availability of prior year execution balances.					
Accomplishments/Planned Programs Subtotals	5.276	3.471	4.662	2.400	7.062

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
• RDTEN/0604218N/2345: *FLEET METOC EQUIPMENT*	0.755	0.672	0.217	-	0.217	0.620	0.577	0.487	0.497	Continuing	Continuing

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2341 / *METOC Data Acquisition*

D. Acquisition Strategy

Acquisition, management and contracting strategies are to support the Meteorological and Oceanographic (METOC) Data Acquisition Project to develop, demonstrate, and validate METOC data collection methods and sensors, and to evolve the ability to provide timely and accurate METOC data and products to the Tactical Commander, all with management oversight by the Navy.

E. Performance Metrics

Goal: Develop techniques and tools to acquire Meteorological and Oceanographic (METOC) data to improve the accuracy of global and regional scale meteorological and oceanographic forecast models. Wherever applicable, and based on favorable Science & Technology (S&T) assessments, tasks shall leverage or transition existing Small Business Innovative Research and/or RDT&E Budget Activity (BA) 2 and 3 S&T work. Metric -- Tasks will address no less than 75% of applicable capability gaps and requirements.

Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2341 / *METOC Data Acquisition*

Product Development ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
METOC (DATA) Collections	WR	NRL : Washington, DC	80.932	0.432	Nov 2017	0.431	Nov 2018	2.510	Dec 2019	-		2.510	Continuing	Continuing	Continuing
METOC Future Mission Capabilities	WR	SSC PAC : California	23.063	0.000		0.000		0.050	Oct 2019	-		0.050	Continuing	Continuing	Continuing
METOC Future Mission Capabilities	Various	Various : Various	45.516	0.000		0.000		0.000		-		0.000	Continuing	Continuing	Continuing
Tactical Oceanography Capabilities / Undersea Warfare (TOC USW)	Various	Various : Various	5.764	0.000		0.000		0.000		-		0.000	Continuing	Continuing	Continuing
Littoral Battlespace Sensing - Autonomous Undersea Vehicle	Various	Various : Various	8.422	0.000		0.000		0.000		-		0.000	Continuing	Continuing	Continuing
Tactical Oceanography Capabilities / Undersea Warfare (TOC USW)	WR	NSWC : Bethesda, MD	1.193	0.000		0.000		0.000		-		0.000	Continuing	Continuing	Continuing
METOC Future Mission Capabilities	C/FP	APPLIED SCIENCE ASSOCIATED : RHODE ISLAND	0.226	0.000		0.000		0.200	Oct 2019	-		0.200	Continuing	Continuing	Continuing
METOC (DATA) Collections	C/FP	University of Washington : Seattle, WA	0.000	0.050	Nov 2017	0.470	Nov 2018	0.102	Oct 2019	-		0.102	Continuing	Continuing	Continuing
METOC (DATA) Collections	C/FP	METRON : Reston, VA	0.000	0.314	Nov 2017	0.110	Dec 2018	0.300	Dec 2019	-		0.300	Continuing	Continuing	Continuing
METOC Future Mission Capabilities	C/FP	SAIC : Virginia	1.781	0.000		0.000		0.000		-		0.000	Continuing	Continuing	Continuing
METOC Future Mission Capabilities	C/FP	CSC : Virginia	0.731	0.000		0.000		0.700	Dec 2019	-		0.700	Continuing	Continuing	Continuing
METOC (DATA) Collections	WR	NRL : Monterry,CA Stennis Space Center, MS	0.000	1.689	Nov 2017	0.915	Dec 2018	0.300	Dec 2019	-		0.300	Continuing	Continuing	Continuing
METOC Future Mission Capabilities	C/CPFF	GDIT : Virginia	0.138	0.000		0.000		0.000		-		0.000	Continuing	Continuing	Continuing

Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy			Date: March 2019
Appropriation/Budget Activity 1319 / 4	R-1 Program Element (Number/Name) PE 0603207N / *Air/Ocean Tactical Applications*	Project (Number/Name) 2341 / *METOC Data Acquisition*	

Product Development ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
METOC (DATA) Collections	C/FP	Penn State University : PA	0.000	2.791	Nov 2017	1.545	Dec 2018	0.000		-		0.000	Continuing	Continuing	Continuing
		Subtotal	167.766	5.276		3.471		4.162		-		4.162	Continuing	Continuing	N/A

Support ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
METOC Future Mission Capabilities	C/CPIF	Various : Various	2.672	0.000		0.000		0.000		2.400	Oct 2019	2.400	0.000	5.072	-
Littoral Battlespace Sensing - Autonomous Undersea Vehicle	C/FP	SAIC : Virginia	0.600	0.000		0.000		0.000		-		0.000	0.000	0.600	-
Tactical Oceanography Capabilities / Undersea Warfare (TOC USW)	WR	SSC PAC : California	0.247	0.000		0.000		0.000		-		0.000	0.000	0.247	-
METOC Future Mission Capabilities	C/CPFF	PSS/BAH : California	0.066	0.000		0.000		0.000		-		0.000	0.000	0.066	-
		Subtotal	3.585	0.000		0.000		0.000		2.400		2.400	0.000	5.985	N/A

Test and Evaluation ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
METOC Future Mission Capabilities	Various	Various : Various	0.200	0.000		0.000		0.200	Nov 2019	-		0.200	0.000	0.400	-
		Subtotal	0.200	0.000		0.000		0.200		-		0.200	0.000	0.400	N/A

Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy			Date: March 2019
Appropriation/Budget Activity 1319 / 4	R-1 Program Element (Number/Name) PE 0603207N / *Air/Ocean Tactical Applications*	Project (Number/Name) 2341 / *METOC Data Acquisition*	

Management Services ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Acquisition Workforce	Various	Not Specified : Not Specified	0.096	0.000		0.000		0.050	Oct 2019	-		0.050	0.000	0.146	-
METOC Future Mission Capabilities Management Support	C/FP	BAH : Virginia	0.400	0.000		0.000		0.250	Oct 2019	-		0.250	0.000	0.650	-
		Subtotal	0.496	0.000		0.000		0.300		-		0.300	0.000	0.796	N/A

	Prior Years	FY 2018		FY 2019		FY 2020 Base		FY 2020 OCO		FY 2020 Total	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals	172.047	5.276		3.471		4.662		2.400		7.062	Continuing	Continuing	N/A

Remarks

Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2341 / *METOC Data Acquisition*

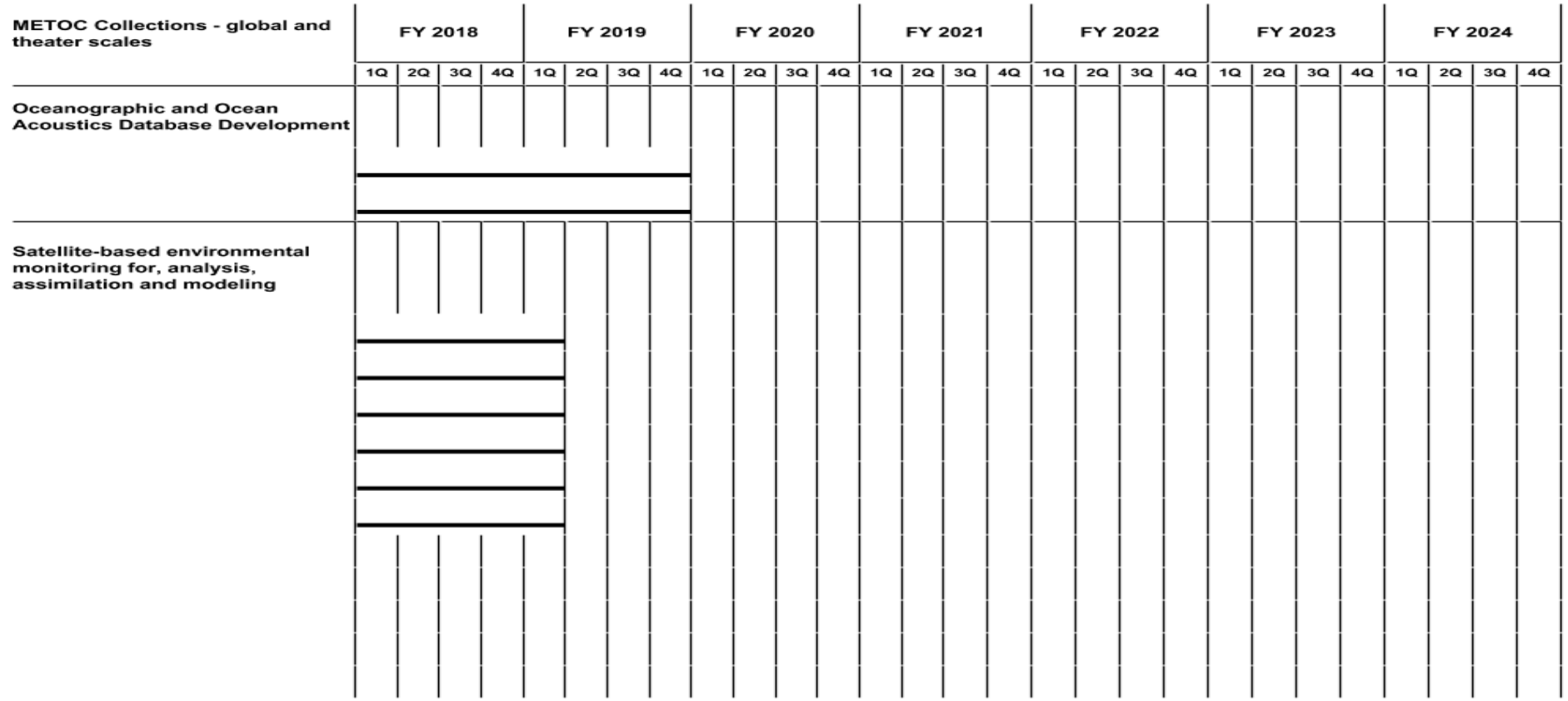

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Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2341 / *METOC Data Acquisition*

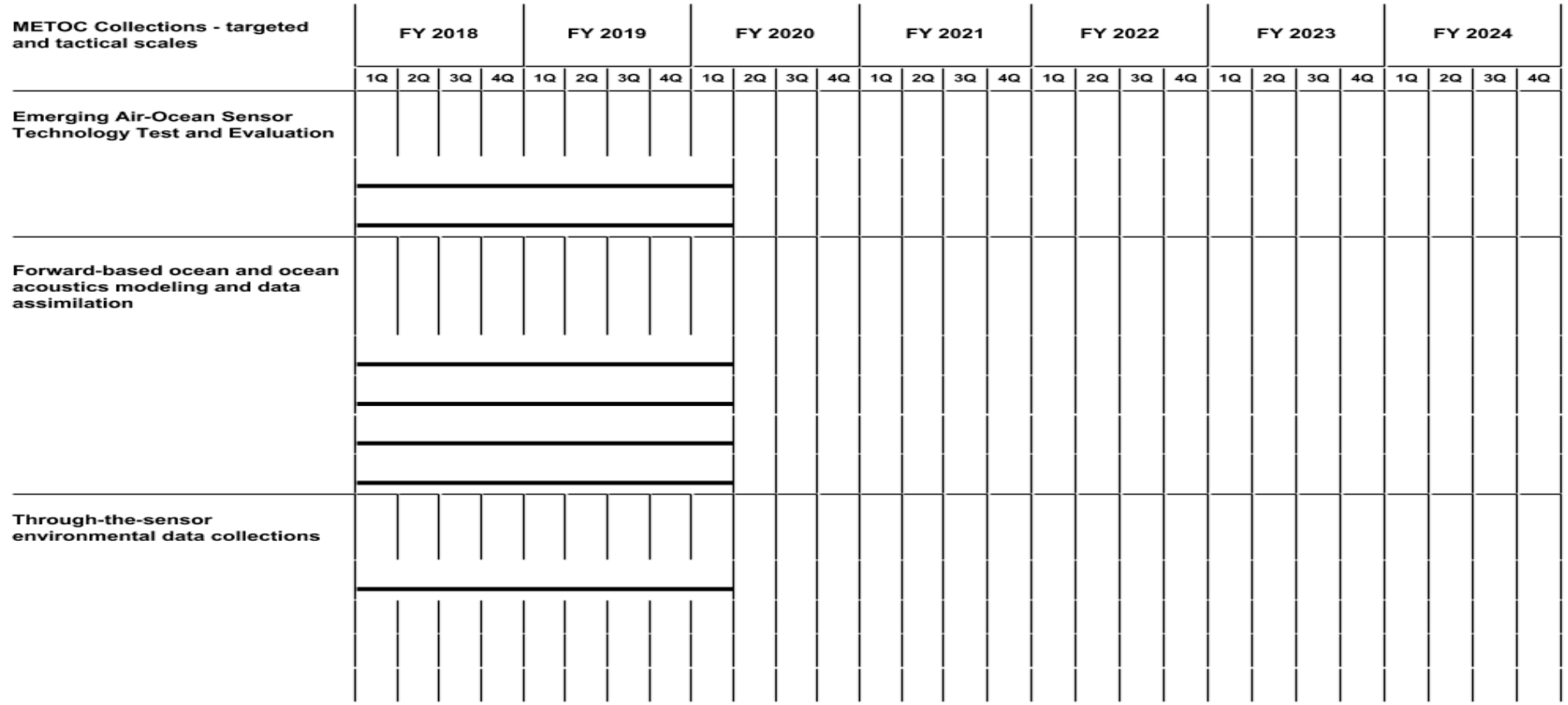

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Exhibit R-4A, RDT&E Schedule Details: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2341 / *METOC Data Acquisition*

Schedule Details

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
METOC Collections - global and theater scales				
Oceanographic and Ocean Acoustics Database Development: Deep Ocean Bottom Backscattering Database -- ARL-PSU	1	2018	4	2019
Oceanographic and Ocean Acoustics Database Development: Deep Ocean Bottom Backscattering Database -- NPS	1	2018	4	2019
Oceanographic and Ocean Acoustics Database Development: "Use of Mobile Acoustic Source for In-situ Transmission	1	2018	1	2019
Satellite-based environmental monitoring for, analysis, assimilation and modeling: Atmospheric Data Assimilation -- NRL-MRY	1	2018	1	2019
Satellite-based environmental monitoring for, analysis, assimilation and modeling: "DoD MW Sensors Special Sensor Microwave Imager Sounder (SSMIS),	1	2018	1	2019
Satellite-based environmental monitoring for, analysis, assimilation and modeling: Operational Satellite Sea Ice Products -- NRL-DC	1	2018	1	2019
Satellite-based environmental monitoring for, analysis, assimilation and modeling: Satellite Optical Data for Coupled Ocean-Atmosphere Models -- NRL-SSC	1	2018	1	2019
Satellite-based environmental monitoring for, analysis, assimilation and modeling: RTP: Flux Correction for Coupled System Extended Forecasts using Satellite Observations -- NRL-MRY	1	2018	1	2019
Satellite-based environmental monitoring for, analysis, assimilation and modeling: RTP: Flux Correction for Coupled System Extended Forecasts using Satellite Observations -- NRL-SSC	1	2018	1	2019
METOC Collections - targeted and tactical scales				
Emerging Air-Ocean Sensor Technology Test and Evaluation: ESTTE - LBS-G AN (Ambient Noise) -- SSC-PAC	1	2018	1	2020

Exhibit R-4A, RDT&E Schedule Details: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2341 / *METOC Data Acquisition*

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
Emerging Air-Ocean Sensor Technology Test and Evaluation: ESTTE - SHARC RFR -- Various	1	2018	1	2020
Forward-based ocean and ocean acoustics modeling and data assimilation: NCODA-Forward Collaborative Integration -- METRON Scientific Solutions, Inc.	1	2018	1	2020
Forward-based ocean and ocean acoustics modeling and data assimilation: NCODA-Forward Collaborative Integration -- NRL-DC	1	2018	1	2020
Forward-based ocean and ocean acoustics modeling and data assimilation: NCODA-Forward Collaborative Integration -- NSWCCD / METRON	1	2018	1	2020
Forward-based ocean and ocean acoustics modeling and data assimilation: RTP: An NCODA-based Capability for Forward Ocean Data Assimilation -- NRL-SSC	1	2018	1	2020
Through-the-sensor environmental data collections: P-8 Environmental Data Sensing -- SSC-LANT	1	2018	1	2020

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy			Date: March 2019
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COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
2342: *METOC Data Assimilation and Mod*	251.206	20.959	17.441	21.168	-	21.168	22.355	22.382	22.004	22.438	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

The Battlespace Data Assimilation and Prediction Project (2342) enables the future warfighter to leverage observed environmental data gathered under Project 2341 (METOC Data Acquisition) by assimilating data into and fusing them with sophisticated high-resolution (spatial and temporal) assessment and prediction models made possible by high-performance computing. These models gain increasing importance as weapons and sensors grow in sophistication and complexity, making them all the more sensitive to the effects of the natural environment. Meteorology and Oceanography (METOC) Processing enables full understanding of the limitations and constraints imposed by ocean and atmosphere, in space and time, thus quantifying and minimizing their impact on weapons, sensors, and mission. However, METOC Processing itself is limited by the temporal and spatial resolutions at which data are collected and numerically analyzed and predicted. Thus Projects 2341 and 2342 must remain aggressive in delivering higher and higher resolutions, demanding greater and greater computational and database capacities. METOC Processing efforts must also rise to the challenge of assimilating smaller-scale phenomena, particularly in the littorals, and predicting their spatial and temporal effects, as stated by Fleet and Force Commanders who require remote autonomous, clandestine, littoral battlespace sensing in near-shore areas to enable Sea Shield & Sea Basing. This next step in the Information Warfare (IW) Tasking, Collection, Processing, Exploitation and Dissemination (TCPED) continuum, METOC Processing, is critical to fully characterize the physical battlespace environment in real-time and in predictive/forecasting modes, and gives the warfighter a decisive advantage in the complex blue-water, littoral and deep-strike battlespaces.

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Title: Battlespace Data Assimilation and Prediction	10.314	8.443	21.168	0.000	21.168
Articles:	-	-	-	-	-
Description: The Battlespace Data Assimilation and Prediction Project (2342) enables the future warfighter to leverage observed environmental data gathered under Project 2341 (METOC Collections) by assimilating data into and fusing them with sophisticated high-resolution (spatial and temporal) assessment and prediction models made possible by high-performance computing. These models gain increasing importance as weapons and sensors grow in sophistication and complexity, making them all the more sensitive to the effects of the natural environment. METOC Processing enables full understanding of the limitations and constraints imposed by ocean and atmosphere, in space and time, thus quantifying and minimizing their impact on weapons, sensors and mission. However, METOC Processing itself is limited by the temporal and spatial resolutions at which data are collected and numerically analyzed and predicted. Thus Projects 2341 and 2342 must remain aggressive in delivering higher and higher resolutions, demanding greater and greater computational and database capacities.					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2342 / *METOC Data Assimilation and Mod*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
METOC Processing efforts must also rise to the challenge of assimilating smaller-scale phenomena, particularly in the littorals, and predicting their spatial and temporal effects, as stated by Fleet and Force Commanders who require remote autonomous, clandestine, littoral battlespace sensing in near-shore areas to enable Sea Shield & Sea Basing. This next step in the TCPED continuum, METOC Processing, is critical to fully characterize the physical battlespace environment in real-time and in predictive / forecasting modes, and gives the warfighter a decisive advantage in the complex blue-water, littoral and deep-strike battlespaces. ***FY 2019 Plans:*** - Complete: Advance the use of satellite observations targeting battlespace environment characterization, supporting global and mesoscale models currently at resolutions of 5-30km horizontally; with vertical extents from the surface and boundary layer, through the models depth which reaches up to ~80km. - Complete: Advance the capability and forecast skills of the Navy's global numerical weather prediction system NAVGEM and to transition improvements and new technologies into operational NAVGEM. - Complete: Work toward transition of emerging short term (5 day) high-resolution analysis and forecast capabilities to Fleet Numerical Meteorology and Oceanography Center (FNMOC) that address small-scale (meso- and micro-scale) atmospheric, coupled (atmospheric-land-ocean-wave), tropical cyclone, and mesoscale ensemble prediction using the current small-scale Coupled Ocean/Atmosphere Mesoscale Prediction System (COAMPS?). - Complete: Deliver capability to rapidly relocate and exercise a high-resolution coupled air-ocean-wave environmental assimilation and prediction system. - Complete: Improve the passive acoustic model, NSPE, and uBand and provide ongoing NSPE and uBand support to operational community, with special focus on guiding implementation within the Ocean Observing Systems (OOS) Performance Prediction & Mitigation project. - Complete: Work toward transition of product algorithms to improve environmental characterization and tropical cyclone structural and intensity analysis through sensor data visualization, customized imagery, automated sensor data fusion, and automated image analysis. - Complete: Take advantage of real-time spectrum operations (RTSO)-based through-the-sensor (TTS) observations to improve the characterization of the electromagnetic environment. - Complete: Work toward transition of a high resolution global weather prediction system NAVGEM with resolution of approximately T1023L100 (13 km horizontal resolution and 100 vertical layers) that is highly competitive in predictive skill with other operational global NWP systems.					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2342 / *METOC Data Assimilation and Mod*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
- Complete: Work toward transition of a probabilistic tropical cyclone forecasting system, which represents the key uncertainties associated with initial and boundary conditions, based on a COAMPS-TC ensemble and fully integrated into the COAMPS-OS. - Complete: Work toward delivery of a global Naval ocean/ice nowcasting and forecasting capability based on the Hybrid Coordinate Ocean Model (HYCOM) two-way coupled to the Community Ice Code (CICE) and using the Navy Coupled Ocean Data Assimilation (NCODA) that runs daily at production centers. - Complete: Work toward delivery of an in-situ submarine (BQH-9) capability to produce an estimate of the seabed bottom loss (BL), and deliver data to NAVO for inclusion in the HFBL database. - Complete: Improve the accuracy of Tactical Decision Aids (TDA) acoustic performance calculations in support of surface ship operations by reconciling Fleet sonar data with the Ocean-Atmosphere Master Library (OAML) models and databases, and also starts to test candidate parameterizations for the high-frequency bottom loss (HFBL) database. - Complete: Work toward implementation of new remote sensing data assimilation and determine impacts on NAAPS (aerosol) forecast skill and deliver code to FNMOC. - Complete: Post-process the first moment of NUOPC ensemble forecasts of low-level temperature and humidity, with comparative analysis of EM/EO conditions in raw and bias-corrected grids. - Complete: Prepare the Navy Aerosol Analysis and Prediction System (NAAPS) to run using fields from NAVGEM v2.0. - Complete: Leverage an existing prototype of a probabilistic aerosol forecasting system that has been ported to the Navy DoD Supercomputing Resource Center (DSRC) computers and continue work towards developing it as a quasi- operational system. - Complete: Develop an improved boundary roughness reflection loss (or forward loss) model that will improve accuracy in propagation and reverberation modeling with particular focus on mid frequencies (1-3 kHz). - Continue: Reduce NAVGEM's error in the calculations of the EAAMF, which are provided to the Naval Observatory for calculation of the changes in the length of day (LOD). - Complete: Improve the hydrodynamic and wave prediction capability of the Coupled Atmosphere-Ocean Mesoscale Prediction System (COAMPS) for the coastal ocean (shelf- break to estuarine and surf zone) environment. - Complete: Improve short-term (7day) forecast skill of global and regional scale ocean and coupled numerical weather prediction by transitioning capabilities to derive, assimilate, and evaluate the impact of assimilating sea surface temperature (SST) and ancillary data from satellite retrievals. - Complete: Develop methodologies for retrieval, quality control, and gridded analysis of remotely sensed satellite observations for measurement of latent, sensible, radiation and momentum fluxes.					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2342 / *METOC Data Assimilation and Mod*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
- Complete: Provide mission planners and operators with operationally relevant ocean color data and products. - Complete: Improve short term (5-7 day) forecast skill of sea ice predictions by assimilating current and future satellite derived ice products into the Navy's operational ice forecast systems. - Complete: Migrate the OAML library, administrative, and management functions to a cloud-based approach. - Complete: Improve short-term (7 day) forecast skill of global and regional scale ocean and coupled NWP by transitioning capabilities to NAVOCEANO and other operational centers to assimilate satellite and in situ observations in a manner that realistically projects high resolution altimeter and other surface information into the sparsely sampled ocean interior. - Complete: Provide operational multi-sensor high-resolution satellite visible/near-infrared/infrared (Vis/NIR/IR) and passive microwave (PMW) sea ice concentration retrievals for improved sea ice forecasts and safe navigation in both the Arctic and Antarctic. - Complete: Leverage swell data from the Sentinel-1A satellite to generate a monthly climatology of ocean swell, useful as a first guess of the expected climate in mission-critical regions determined in consultation with Navy forecasters; also leverage output from the global wave model run in hind-cast mode to augment the ocean swell database. - Complete: Work toward transition of a 4DVar (4-Dimensional Variance) data assimilation capability with highly nonlinear ocean circulation regimes such as western boundary currents; test 4DVar with very high resolution configurations of regional domains; estimate an analysis error covariance; initialize an ensemble forecast. - Complete: Improve the state of the art of tropical cyclone (TC) forecast guidance and tactical applications for operational decision makers.					
FY 2020 Base Plans: The effort plans to focus on each category as described below : Complete: Reduce Navy Global Environmental Model's (NAVGEM) error in the calculations of the Effective Atmospheric Angular Momentum Functions (EAAMF), which are provided to the Naval Observatory for calculation of the changes in the length of day (LOD). Complete: Naval Research Laboratory (NRL) will transition the 3-grid WaveWatch3 real-time system to replace two existing operational global WaveWatch3 systems (one used now by Fleet Numerical Meteorology and Oceanography Center (FNMOC)-Monterey (MRY) and the other used now by FNMOC-John C. Stennis Space Center (SSC)). Transition will include a Validation Test Report. The majority of the required labor is associated with preparation of this report. NRL will also assist FNMOC with Operational Test (OPTEST). Complete: Leverage a coupled ocean and atmospheric modeling and assimilation system based on Coupled Ocean/Atmosphere Mesoscale Prediction System (COAMPS), Navy Coastal Ocean Model (NCOM) and a					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2342 / *METOC Data Assimilation and Mod*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
range-dependent acoustic model (RAM). Operationalize the forward coupled ocean-acoustic system at Naval Oceanographic Office (NAVO)/FNMOC which will provide a number of advantages over current capabilities. Reduce runtime for acoustic simulations, reduce error due to the coupling of the models, reduce manpower due to the automation, and provide uncertainty estimates via uband. Complete: Develop and transition to the Fleet Numerical Meteorology and Oceanography Center (FNMOC) the Navy Ionosphere Model for Operations (NIMO), which consists of a physics-based model of the ionosphere and a data assimilation capability that will provide a real-time electron density specification on a global grid with the ability to specify high-resolution configurable regional grids. NIMO will also provide a 24-hour forecast of electron density climatology. The Ionospheric Data Assimilation 4-D (IDA4D) will be coupled with the Navy's Highly Integrated Thermosphere/Ionosphere Demonstration System (Navy-HITIDES) to form NIMO. NIMO and associated data preprocessors will be optimized to run efficiently on the Navy DoD Supercomputing Resource Centers (DSRC). NIMO will form the basis of a future Navy operational ionospheric forecasting system, running at multiple resolutions and fully coupled to operational atmospheric forecast models. Complete: Develop, test, and transition for operational implementation a strongly coupled ocean-atmosphere 4D-Var assimilation system for COAMPS. The new system will provide a unique capability that enables the observations from the atmosphere (ocean) to directly improve the analysis/forecast in the ocean (atmosphere). The US Navy will own the superior capability of accurately and efficiently characterizing the battlespace environment at the ocean-atmosphere interface once the proposed system becomes operational. The coupled DA system will be demonstrated in COAMPS-OS (on-scene) and verified with propagation products as well as traditional metrics. Complete: Substantially increase the skill of the COAMPS-TC (tropical cyclone) model in the prediction of rapid intensification (RI) events and inner-core structure (6.4), and to elucidate the nature of the relationship between inner-core structure and TC intensification prediction and predictability (6.2). Our approach includes (1) Model development Resolution increases and physics improvements for COAMPS-TC, (2) Data assimilation New capabilities for initializing COAMPS-TC, (3) TC structure guidance development structure assessment and prediction, (4) TC forecast post-processing exploiting statistically-corrected RI forecasts for increased skill. Through a synergistic combination of advancements to the COAMPS-TC model, the data assimilation system used to initialize the model, and the aids utilized by the operational warning centers to estimate TC inner-core structure characteristics (subsequently fed into the COAMPS-TC initial state), we aim to address the #1 research priority of both Joint Typhoon Warning Center (JTWC) and National Hurricane Center (NHC) Rapid intensification prediction. Complete: Develop and transition a global ensemble aerosol prediction system, including data assimilation, to FNMOC. This system will provide a new probabilistic aerosol prediction and product capability for enhanced					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2342 / *METOC Data Assimilation and Mod*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
aerosol data assimilation and downstream Electro-Optical (EO) attenuation modeling. This work leverages BA2 (budget activity 2) efforts that helped optimize the use of ensemble data assimilation methods for aerosol prediction. The Navy Aerosol Analysis Prediction System (ENAAPS) system and Data Assimilation Research Testbed (DART) were ported and tested on Navy DSRC machines as a near-real-time (NRT) system and implemented using Cylc (Cylc [pronounced silk] is a workflow engine for cycling systems - it orchestrates distributed suites of interdependent cycling tasks that may continue to run indefinitely). Under the Rapid Transition Project (RTP), the system will be thoroughly tested for NRT applications with a focus on how the ensemble performs in the forecast, including the ensemble mean and spread. Means for improving system performance will also be tested and implemented as part of NRT ENAAPS, including bias correction, new observations for assimilation, and evaluation of the NAVGEM ensemble impact on ENAAPS forecasts. Complete: Develop and test a Navy Coupled Ocean Data Assimilation (NCODA) -based capability for forward platforms (NCODA-forward) to assimilate collected oceanographic data (e.g. eXpendable BathyThermographs (XBTs), glider, etc./temperature, salinity, etc.) into an oceanographic model field (NCOM or Hybrid Coordinate Ocean Model (HYCOM)) in an acoustically consistent way for operational and tactical analysis and predictions. The proposed capability will provide an estimate of the uncertainty associated with the assimilation process that allows the user to know when the process is reliable and flag cases where the model data cannot be appropriately reconciled with respect to the observations. Production of such uncertainty fields will be used to derive sampling plans to confirm or exclude suspected outliers and reduce excessive uncertainty. Supporting capabilities must also be developed as part of the system to improve compression algorithms to allow more data (temperature, salinity, wind, model error estimates) to be sent to forward platforms and to provide capabilities to assess acoustic integrity of the assimilation process for frequencies of interest. Complete: Implement middle atmosphere processes into a fully coupled global atmosphere/wave/ocean/ land/ice prediction system providing daily predictions out to 16 days, weekly predictions out to 32 days and weekly ensemble predictions to 90 days. Predictions will provide environmental information to meet Navy and Department of Defense (DoD) operations and planning needs throughout the globe from undersea to the upper atmosphere and from the tropics to the poles. The system will be implemented on Navy operational computer systems, and the necessary processing infrastructure will be put in place to provide products for Navy fleet user consumption. Develop an improved algorithm for estimating near-shore bathymetry from Synthetic Aperture Radar (SAR) imagery that would be incorporated into NAVO's operational implementation (using future Commander Naval Meteorology and Oceanography Command (CNMOC) funding). Algorithm improvements have been identified under previous work funded by NRL and CNMOC, and shown to perform significantly better than the existing operational capability on a small test set. The goal of this program is to incorporate those improvements into					

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B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
a single system suitable for transition and test it on a larger range of operational data. Specific tasks of this program, based on previously developed improvements, would be (1) incorporate a dynamic box capability based on instantaneous wave parameters; (2) incorporate an automated wave group amplitude metric to determine when to use bathymetry estimates within small spatial extents; (3) determine source and mitigation of wave noise in new "Undispersion" algorithm; (4) perform validation studies using existing test sets; and (5) write report for NAVO implementation. Test assimilation of updated Naval Oceanographic Office (NAVOCEANO) derived swath ice concentration from NOAA-20 VIIRS and AMSR2 into the GOFS 3.1 system. Investigate ability to assimilate sea ice thickness observations and transition into NCODA system. Test sea ice thickness assimilation in GOFS 3.1 and GOFS 3.5 systems. Establish a geologically consistent physics-based seafloor prediction capability coupled with existing operational oceanic and atmospheric prediction systems. This seafloor prediction capability, based on the NRLs Global Predictive Seafloor Model (GPSM) foundation, will produce a geologically and geo-acoustically consistent replacement for the current high-frequency bottom loss (HFBL) values at any point on the seafloor for transition to NAVO. Characterize forecast dropouts, based on 500mb Anomaly Correlation (AC) methods, in the Navy Global Environmental Model (NAVGEM), including forecast statistics, common properties and causes. Develop and implement a fully coupled global atmosphere/wave/ocean/land/ice prediction system providing daily high- resolution deterministic 16-day and lower-resolution ensemble predictions at longer lead times. Optimize scripting for the deterministic and ensemble systems to better manage cycling tasks for model components and data assimilation, resulting in increased modularity, better parallelism, easier debugging through error trapping, and greater reuse. Develop an ensemble prediction system for a fully coupled global atmosphere/wave/ ocean/land/sea ice coupled model for predictions out to 90 days. Develop a fully- coupled data assimilation capability to optimize the use of the observations across fluid interfaces, eliminating the transient inconsistences, increasing forecast skill and representing coupled uncertainties. Evaluate and demonstrate the capabilities of a new generation of atmospheric dynamical systems that allow for variable resolution on the sphere, are highly scalable, and eliminate or mitigate spurious problems near the poles of the globe. Further develop, validate, and evaluate the capability of a fully coupled regional Arctic prediction system. Develop, integrate, and test improvements to the computational performance of models within the Navy global coupled forecast system as well as the coupling infrastructure to ensure that operational partners will meet their production schedules using available computational resources. Improve capabilities for supporting long range Navy planning (lead times of one week and longer). Develop and transition for operational implementation a high resolution global weather prediction system NAVGEM with resolution of approximately T1023L100 (13 km horizontal resolution and 100 vertical layers) that is highly competitive in predictive skill with other operational					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2342 / *METOC Data Assimilation and Mod*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
global numerical weather prediction (NWP) systems. Define, develop, and implement consistent quantitative skill metrics to assess the advancements in the Earth System Prediction Capability (ESPC), taking into account the applications and lead-times for which the ESPC environmental information will be used. Evaluate and validate multi-model extended-range forecasts produced from interagency projects such as the North American Multi-model Ensemble (NMME). Develop the NAVGEM global model to include inline aerosols to simulate aerosol life cycle and perform aerosol direct radiative heating of the atmosphere. Participate in the NMME by re-forecasting the global coupled (NAVGEM-HYCOM- Los Alamos sea ice model (CICE)) Navy ESPC model for years 1999 to 2015. Accelerate the rate of improvement in the US National ESPC and National Unified Operational Prediction Capability (NUOPC), focusing primarily on the current and future generation global modeling enterprise. Develop the NAVGEM global model to address middle atmosphere processes associated with sudden stratospheric warming and extended range prediction. ***FY 2020 OCO Plans:*** N/A ***FY 2019 to FY 2020 Increase/Decrease Statement:*** FY 2020 increase is associated with increased investment in the global Navy Earth System Model as it transitions from Initial Operational Capability (IOC) to its Full Operational configuration. This includes development and transition of an improved weather model (NAVGEM 3.0) and a greatly improved ocean model (GOFS 4.0) aligned with Task Force Ocean priorities and investment. Additionally increased investment will be focused on maturation of the Regional Arctic Prediction System and the Navy's Environmental Prediction sysTem Using the NUMA corE (NEPTUNE) next generation dynamic core projected for operations by 2025. FY 2020 funding realigned within this project (2342) from Earth System Prediction Capability (ESPC) to Battlespace Data Assimilation and Prediction to synchronize ESPC modeling efforts with other non-ESPC modeling efforts under this project and to better align the modeling efforts for Air/Ocean Tactical Applications.					
Title: Earth System Prediction Capability (ESPC)	10.645	8.998	0.000	0.000	0.000
Articles:	-	-	-	-	-
Description: The Navy Earth System Prediction Capability (ESPC) program will provide a more accurate, longer range, global ocean and atmospheric forecast system for decision support to DoD Maritime Operations through the development of an integrated, coupled atmosphere, ocean, sea ice, land and near-space prediction system with improved deterministic and probabilistic skill over the current operational modeling suite. It will result in increased accuracy for lead times of 1-30 days as well as a new capability for accurate forecasts in the Arctic					

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B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
at all lead times. Additionally it will seek to develop more computationally efficient environmental prediction for emerging architectures and provide Navy Research and Development (R&D) support to the National ESPC. ***FY 2019 Plans:*** - Continue: Characterize forecast dropouts, based on 500mb Anomaly Correlation (AC) methods, in the Navy Global Environmental Model (NAVGEM), including forecast statistics, common properties and causes. - Continue: Develop and implement a fully coupled global atmosphere/wave/ocean/land/ice prediction system providing daily high- resolution deterministic 16-day and lower-resolution ensemble predictions at longer lead times. - Continue: Optimize scripting for the deterministic and ensemble systems to better manage cycling tasks for model components and data assimilation, resulting in increased modularity, better parallelism, easier debugging through error trapping, and greater reuse. - Continue: Develop an ensemble prediction system for a fully coupled global atmosphere / wave / ocean / land / sea ice coupled model for predictions out to 90 days. - Continue: Develop a fully- coupled data assimilation capability to optimize the use of the observations across fluid interfaces, eliminating the transient inconsistences, increasing forecast skill and representing coupled uncertainties. - Continue: Evaluate and demonstrate the capabilities of a new generation of atmospheric dynamical systems that allow for variable resolution on the sphere, are highly scalable, and eliminate or mitigate spurious problems near the poles of the globe. - Continue: Further develop, validate, and evaluate the capability of a fully coupled regional Arctic prediction system. - Continue: Develop, integrate, and test improvements to the computational performance of models within the Navy global coupled forecast system as well as the coupling infrastructure to ensure that operational partners will meet their production schedules using available computational resources. - Continue: Improve capabilities for supporting long range Navy planning (lead times of one week and longer). - Continue: Develop and transition for operational implementation a high resolution global weather prediction system NAVGEM with resolution of approximately T1023L100 (13 km horizontal resolution and 100 vertical layers) that is highly competitive in predictive skill with other operational global NWP systems. - Continue: Define, develop and implement consistent quantitative skill metrics to assess the advancements in the Earth System Prediction Capability (ESPC), taking into account the applications and lead-times for which the ESPC environmental information will be used.					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
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B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
- Continue: Evaluate and validate multi-model extended-range forecasts produced from interagency projects such as the North American Multi-model Ensemble (NMME). - Continue: Develop the NAVGEM global model to include inline aerosols to simulate aerosol life cycle and perform aerosol direct radiative heating of the atmosphere. - Continue: Participate in the North American Multi-Model Ensemble (NMME) by re-forecasting the global coupled (NAVGEM-HYCOM-CICE) Navy ESPC model for years 1999 to 2015. - Continue: Accelerate the rate of improvement in the US National Earth System Prediction Capability (ESPC) and National Unified Operational Prediction Capability (NUOPC), focusing primarily on the current and future generation global modeling enterprise. - Continue: Develop the NAVGEM global model to address middle atmosphere processes associated with sudden stratospheric warming and extended range prediction. ***FY 2020 Base Plans:*** Starting in FY 2020, the Earth System Prediction Capability System is migrated into the Battlespace Data Assimilation and Prediction activity to more align with the modeling efforts for Air/Ocean Tactical Applications. ***FY 2020 OCO Plans:*** N/A ***FY 2019 to FY 2020 Increase/Decrease Statement:*** FY20 funding realigned within this project (2342) from Earth System Prediction Capability (ESPC) to Battlespace Data Assimilation and Prediction to synchronize ESPC modeling efforts with other non-ESPC modeling efforts under this project and to better align the modeling efforts for Air/Ocean Tactical Applications.					
Accomplishments/Planned Programs Subtotals	20.959	17.441	21.168	0.000	21.168

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
• RDTEN/0604218N/2345: *FLEET METOC EQUIPMENT*	0.755	0.672	0.217	-	0.217	0.620	0.577	0.487	0.497	Continuing	Continuing

Remarks

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D. Acquisition Strategy

Acquisition, management and contracting strategies are to support the Meteorological and Oceanographic (METOC) Data Assimilation and Modeling Project to develop, demonstrate, and validate METOC data assimilation and environmental prediction capabilities, enabling timely and accurate delivery of METOC prediction data and products to the Tactical Commander, all with management oversight by the Navy.

E. Performance Metrics

Goal: Develop techniques and tools to assimilate Meteorological and Oceanographic (METOC) data in order to improve the accuracy of global and regional scale meteorological and oceanographic forecast models. Data assimilation is expanded to include new in-situ and remotely-sensed data types, based on operational need. Tasks are directed toward advanced software enabling assimilation of disparate sources on non-synoptic time scales. Acoustic, atmospheric, and oceanographic model development, prototyping and transition is focused on improved model physics, increased resolution, and computational efficiency.
Metric: Tasks will address no less than 75% of applicable capability gaps and requirements.

Goal (ESPC): Develop a more accurate global ocean, atmosphere, wave and sea ice forecast system with longer skillful forecast times from weeks to seasons through integrating and coupling atmosphere, ocean, ice, land and near-space forecast models into a seamless deterministic and ensemble prediction system that significantly improves skill over the current modeling suite. Additionally develop a common modeling architecture to improve cross-Agency collaboration, and greatly more efficient environmental modeling and computational architectures to allow for real-time operational prediction at comparable skill level to international competitors.

Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy			Date: March 2019
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Product Development ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
METOC Future Mission Capabilities	WR	NRL : Washington DC	127.957	0.845	Nov 2017	0.852	Nov 2018	3.450	Nov 2019	-		3.450	Continuing	Continuing	Continuing
METOC Future Mission Capabilities	Various	Various : Various	46.068	0.000		0.000		0.000		-		0.000	0.000	46.068	-
METOC Space-Based Sensing Capabilities	WR	NRL : Washington, DC	17.092	0.000		0.000		0.000		-		0.000	Continuing	Continuing	Continuing
Tactical Oceanography Capabilities / Undersea Warfare	WR	NRL : Washington, DC	9.480	0.000		0.000		0.000		-		0.000	Continuing	Continuing	Continuing
Tactical Oceanography Capabilities / Undersea Warfare	C/FP	University of Texas : TX	1.163	0.100	Nov 2017	0.000		0.150	Nov 2019	-		0.150	0.000	1.413	-
Tactical Oceanography Capabilities / Undersea Warfare	WR	NSWC Carderock : West Bethesda, MD	2.090	0.000		0.000		0.150	Dec 2019	-		0.150	Continuing	Continuing	Continuing
Tactical Oceanography Capabilities / Undersea Warfare	WR	NAVOCEANO : Mississippi	0.549	0.000		0.000		0.500	Mar 2020	-		0.500	0.000	1.049	-
Tactical Oceanography Capabilities / Undersea Warfare	C/FP	University of Washington : Seattle, WA	0.850	0.000		0.000		0.000		-		0.000	Continuing	Continuing	Continuing
Tactical Oceanography Capabilities / Undersea Warfare	C/FP	Johns Hopkins University : MD	0.431	0.000		0.000		0.030	Mar 2020	-		0.030	Continuing	Continuing	Continuing
Tactical Oceanography Capabilities / Undersea Warfare	C/FP	SAIC/QNA : Various	1.876	0.000		0.000		0.000		-		0.000	Continuing	Continuing	Continuing
METOC Future Mission Capabilities	C/FP	SAIC/QNA : Various	3.096	0.000		0.000		0.000		-		0.000	Continuing	Continuing	Continuing
Tactical Oceanography Capabilities / Undersea Warfare	C/FP	Penn Sate University : Pennsylvania	0.125	0.000		0.000		0.000		-		0.000	0.000	0.125	-

Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy			Date: March 2019
Appropriation/Budget Activity 1319 / 4	R-1 Program Element (Number/Name) PE 0603207N / *Air/Ocean Tactical Applications*	Project (Number/Name) 2342 / *METOC Data Assimilation and Mod*	

Product Development ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Tactical Oceanography Capabilities / Undersea Warfare	WR	SSC LANT : North Charleston	0.050	0.000		0.000		0.000		-		0.000	0.000	0.050	-
Tactical Oceanography Capabilities / Undersea Warfare	C/FP	SPA : Virginia	0.375	0.000		0.000		0.000		-		0.000	0.000	0.375	-
METOC SUPPORT SPACE-SOFTWARE DEVELOPMENT	WR	NRL : WASHINGTON DC	0.515	0.000		0.000		0.000		-		0.000	Continuing	Continuing	Continuing
Tactical Oceanography Capabilities / Undersea Warfare	C/FP	METRON : Virginia	0.385	0.000		0.000		0.150	Oct 2019	-		0.150	0.000	0.535	-
Tactical Oceanography Capabilities / Undersea Warfare	C/FP	Vencore : Virginia	0.239	0.000		0.000		0.000		-		0.000	0.000	0.239	-
METOC Battlespace Data Assimilation and Prediction	WR	NRL : Monterey, CAl Stennis Space Center,MS	0.000	7.695	Nov 2017	7.194	Dec 2018	4.500	Nov 2019	-		4.500	0.000	19.389	-
Earth Systems Prediction Capability (ONR)	WR	NRL : Washington DC	23.314	8.685	Nov 2017	6.611	Dec 2018	8.569	Dec 2019	-		8.569	Continuing	Continuing	Continuing
ESPC	Various	Various : Various	7.667	0.681	Nov 2017	0.981	Dec 2018	0.000		-		0.000	Continuing	Continuing	Continuing
CHIEF OF NAVAL OPERATIONS SPEED TO FLEET INITIATIVE	WR	NRL : WASHINGTON DC	0.850	0.000		0.000		0.000		-		0.000	1.130	1.980	-
		Subtotal	244.172	18.006		15.638		17.499		-		17.499	Continuing	Continuing	N/A

Support ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
METOC Future Mission Capabilities	Various	Various : Various	0.795	0.000		0.000		0.000		-		0.000	0.000	0.795	-

Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy			Date: March 2019
Appropriation/Budget Activity 1319 / 4	R-1 Program Element (Number/Name) PE 0603207N / *Air/Ocean Tactical Applications*	Project (Number/Name) 2342 / *METOC Data Assimilation and Mod*	

Support ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Littoral Battlespace Sensing - Autonomous Undersea Vehicle	C/FP	SAIC : Virginia	0.473	0.000		0.000		0.000		-		0.000	0.000	0.473	-
Tactical Oceanography Capabilities / Undersea Warfare	C/FP	SAIC : Virginia	0.634	0.000		0.000		0.000		-		0.000	0.000	0.634	-
METOC Future Mission Capabilities	C/FP	SAIC : VIRGINIA	0.115	0.100	Nov 2017	0.100	Dec 2018	0.300	Feb 2020	-		0.300	Continuing	Continuing	Continuing
METOC SUPPORT SPACE-PROGRAM SUPPORT	WR	SSC PACIFIC : SAN DIEGO, CA	0.090	0.100	Nov 2017	0.100	Dec 2018	0.641	Feb 2020	-		0.641	Continuing	Continuing	Continuing
Earth System Modeling Framework - Common Software Architecture	Various	Various : Boulder, CO; Various	0.000	0.660	Nov 2017	0.660	Nov 2018	0.641	Nov 2019	-		0.641	0.000	1.961	-
Program Support and Subject Matter Expertise	Various	UW-APL : Seattle, WA	1.563	0.358	Nov 2017	0.358	Dec 2018	0.425	Dec 2019	-		0.425	Continuing	Continuing	Continuing
		Subtotal	3.670	1.218		1.218		2.007		-		2.007	Continuing	Continuing	N/A

Test and Evaluation ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Data Analytics and Machine Learning	TBD	Charles River : Boston, MA	0.000	0.234	Nov 2017	0.323	Dec 2018	0.500	Feb 2020	-		0.500	0.000	1.057	-
		Subtotal	0.000	0.234		0.323		0.500		-		0.500	0.000	1.057	N/A

Management Services ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Acquisition Workforce	Various	Various : Various	0.090	0.000		0.000		0.000		-		0.000	0.000	0.090	-

Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2342 / *METOC Data Assimilation and Mod*

Management Services ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
METOC Space-Based Sensing Capabilities	Various	Various : Various	1.350	0.000		0.000		0.000		-		0.000	0.000	1.350	-
Tactical Oceanography Capabilities / Undersea Warfare	WR	SSC PAC : San Diego, CA	1.316	0.000		0.000		0.000		-		0.000	Continuing	Continuing	Continuing
METOC Future Mission Capabilities	C/FP	PSS/BAH : San Diego, CA	0.216	0.000		0.000		0.000		-		0.000	0.000	0.216	-
METOC Space-Based Sensing Capabilities	C/FP	BAH : VIRGINIA	0.142	0.100	Nov 2017	0.100	Nov 2018	0.400	Mar 2020	-		0.400	Continuing	Continuing	Continuing
METOC Space-Based Sensing Capabilities	WR	SSC PAC : SAN DIEGO, CA	0.213	1.339	Nov 2017	0.100	Nov 2018	0.400	Mar 2020	-		0.400	Continuing	Continuing	Continuing
METOC Acquisition Management	C/CPFF	PSS/BAH : SAN DIEGO, CA	0.037	0.062	Nov 2017	0.062	Nov 2018	0.362	Nov 2019	-		0.362	Continuing	Continuing	Continuing
		Subtotal	3.364	1.501		0.262		1.162		-		1.162	Continuing	Continuing	N/A

	Prior Years	FY 2018		FY 2019		FY 2020 Base		FY 2020 OCO		FY 2020 Total	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals	251.206	20.959		17.441		21.168		-		21.168	Continuing	Continuing	N/A

Remarks

Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2342 / *METOC Data Assimilation and Mod*

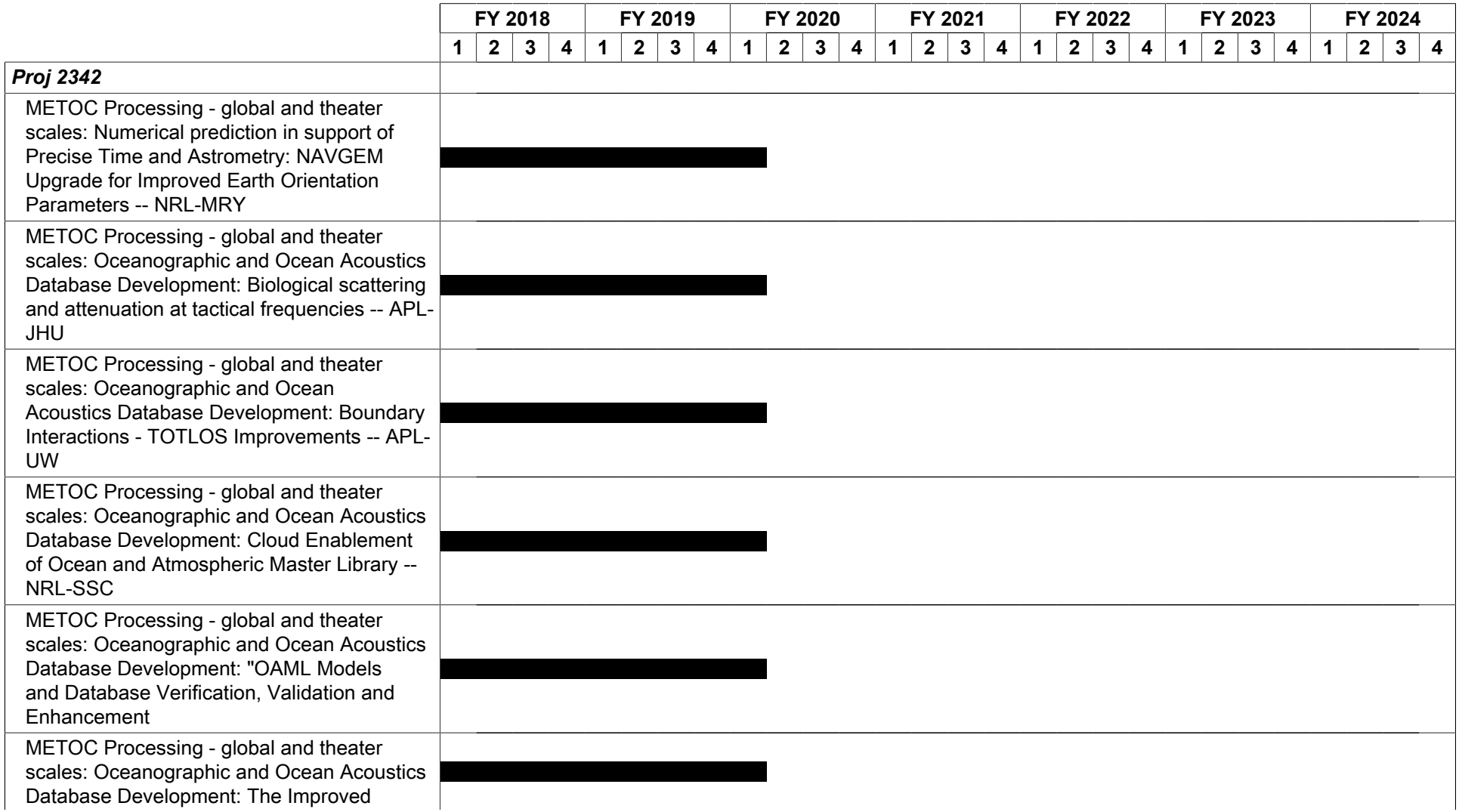


Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2342 / *METOC Data Assimilation and Mod*

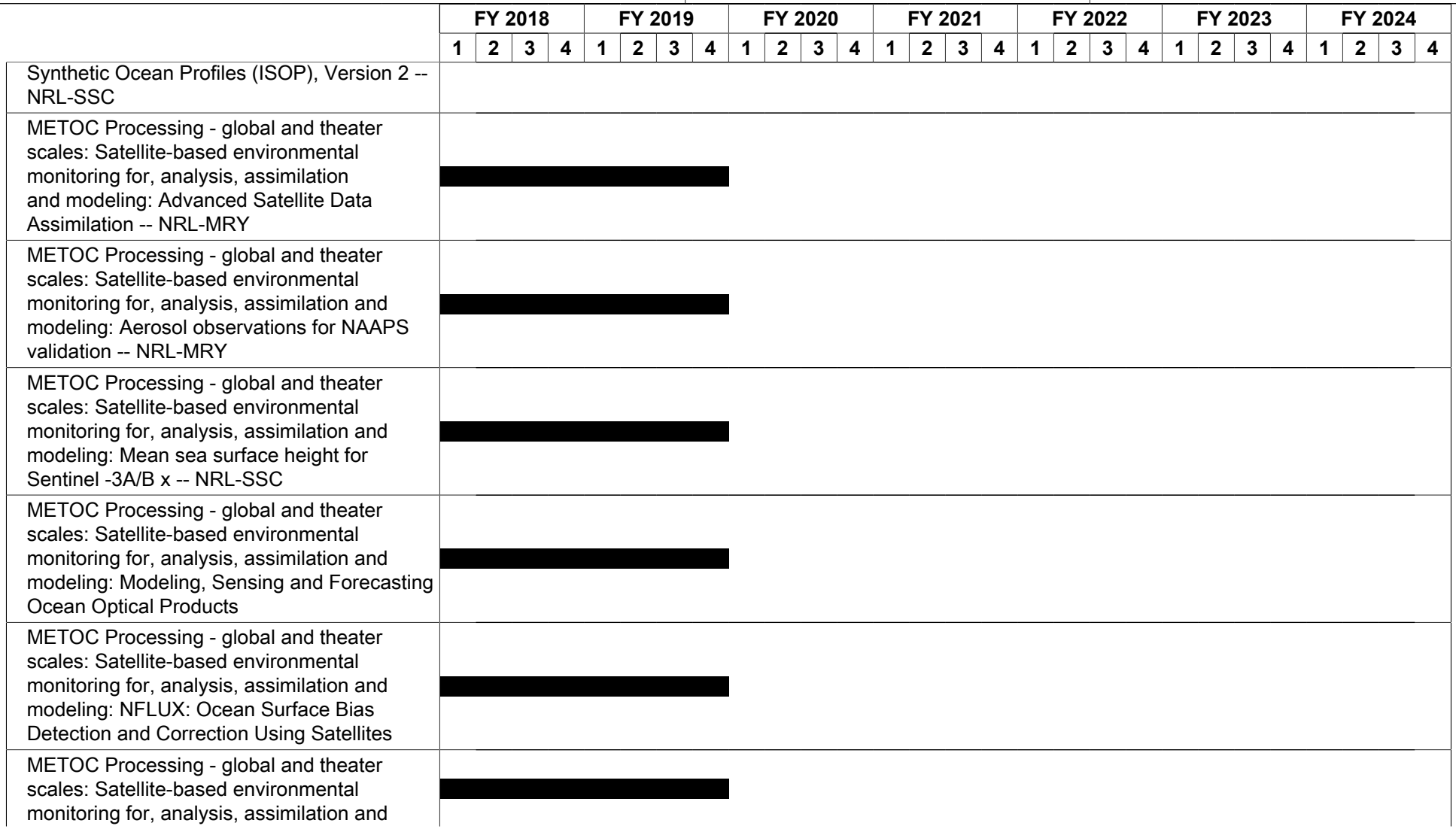


Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2342 / *METOC Data Assimilation and Mod*

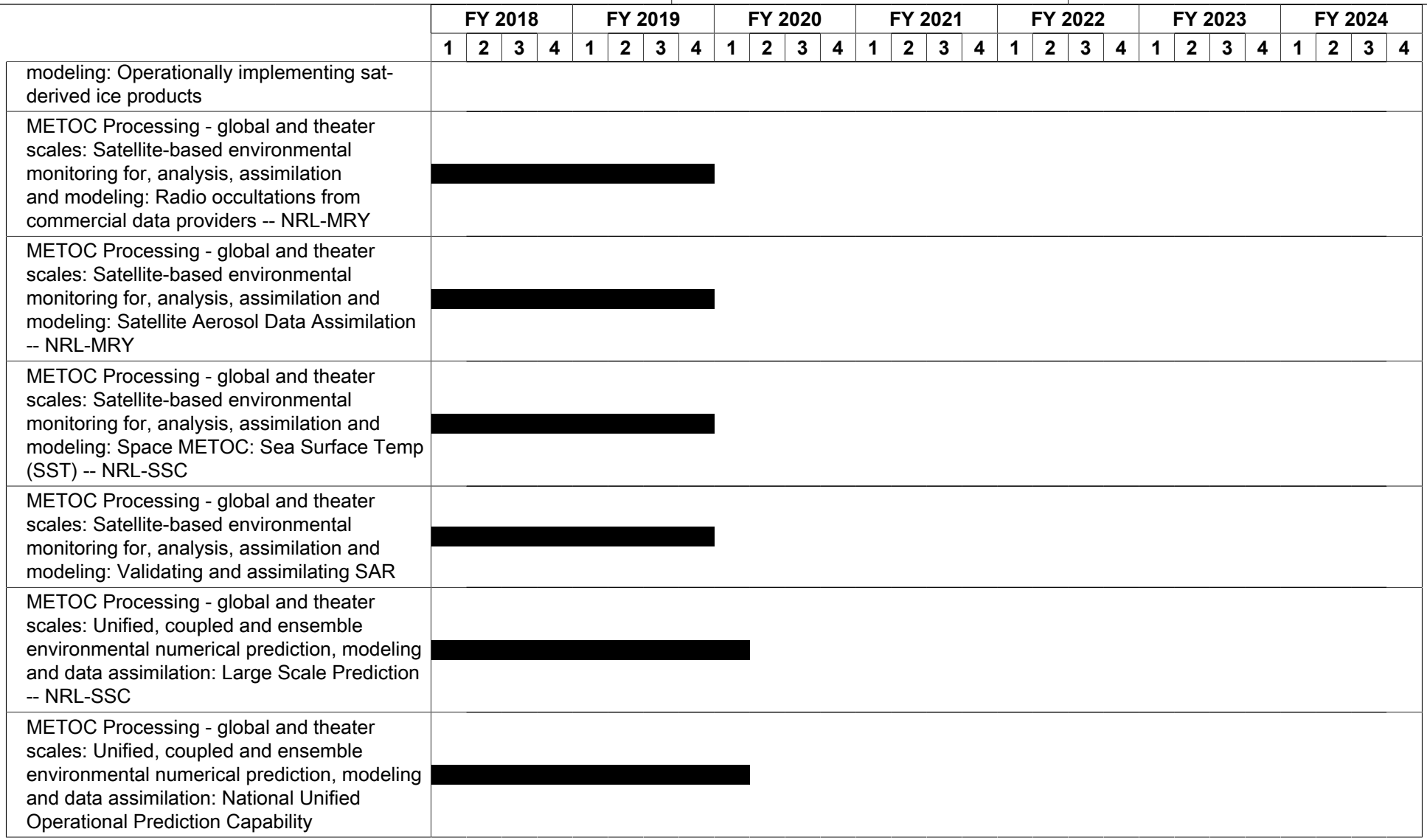


Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2342 / *METOC Data Assimilation and Mod*

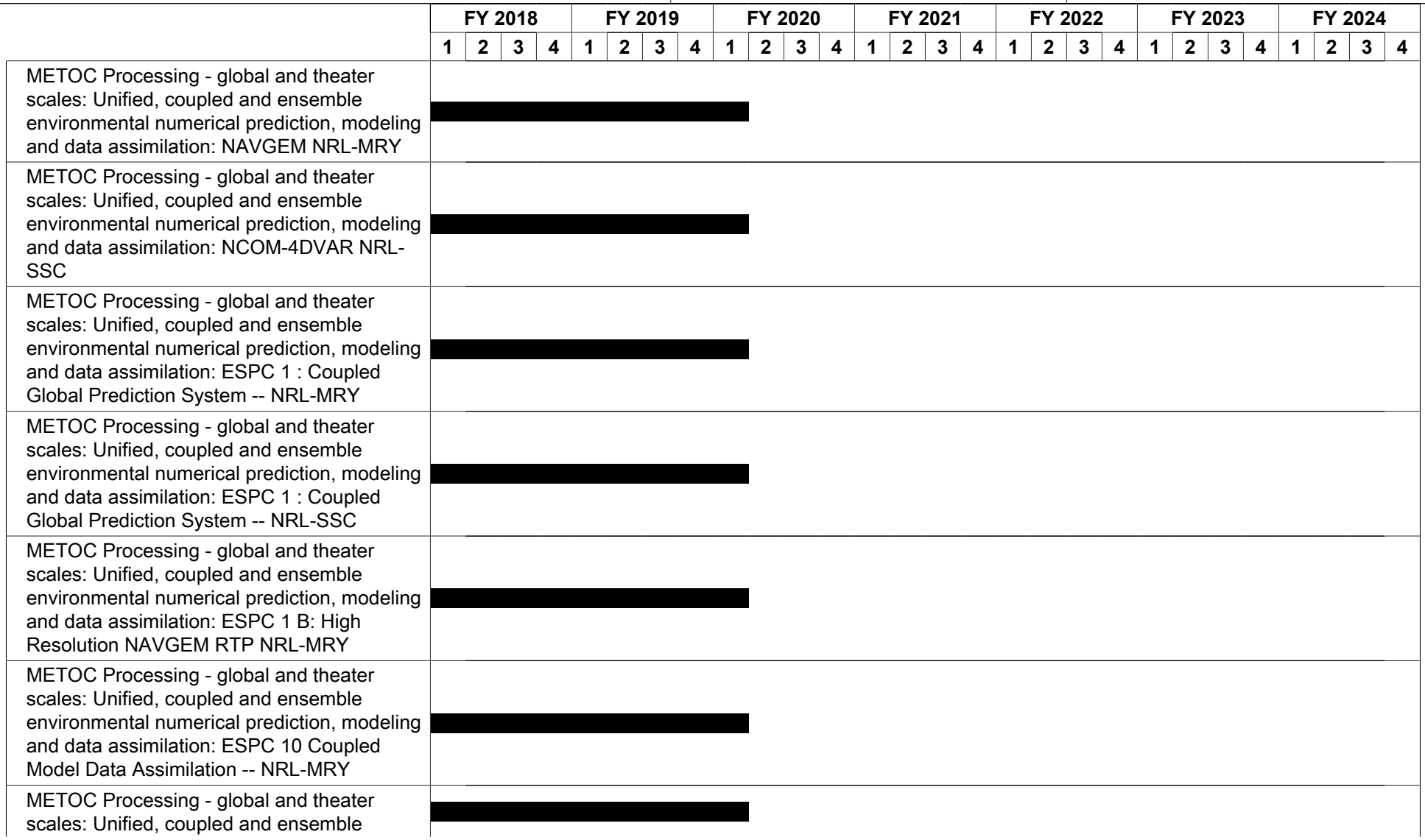


Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2342 / *METOC Data Assimilation and Mod*

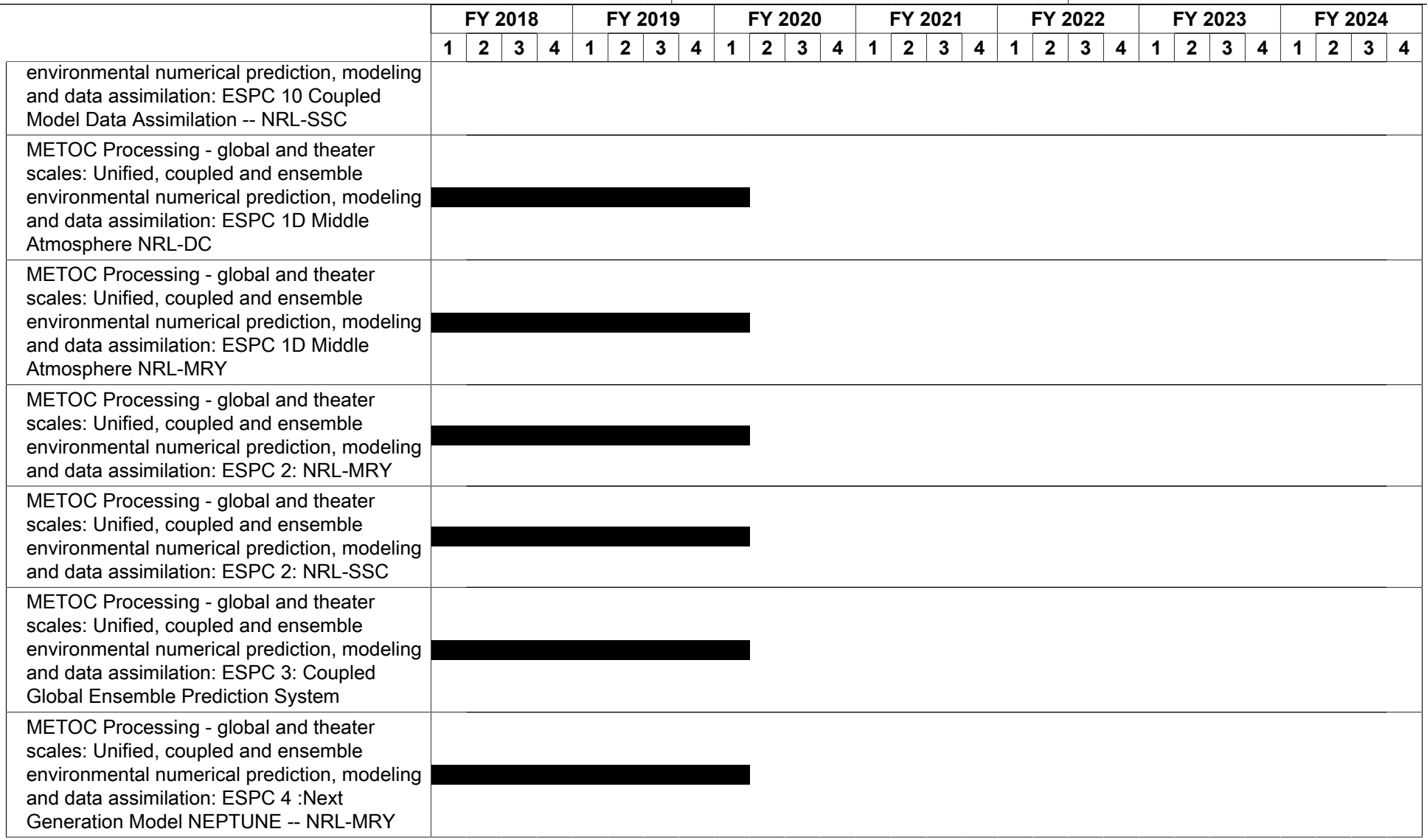


Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2342 / *METOC Data Assimilation and Mod*

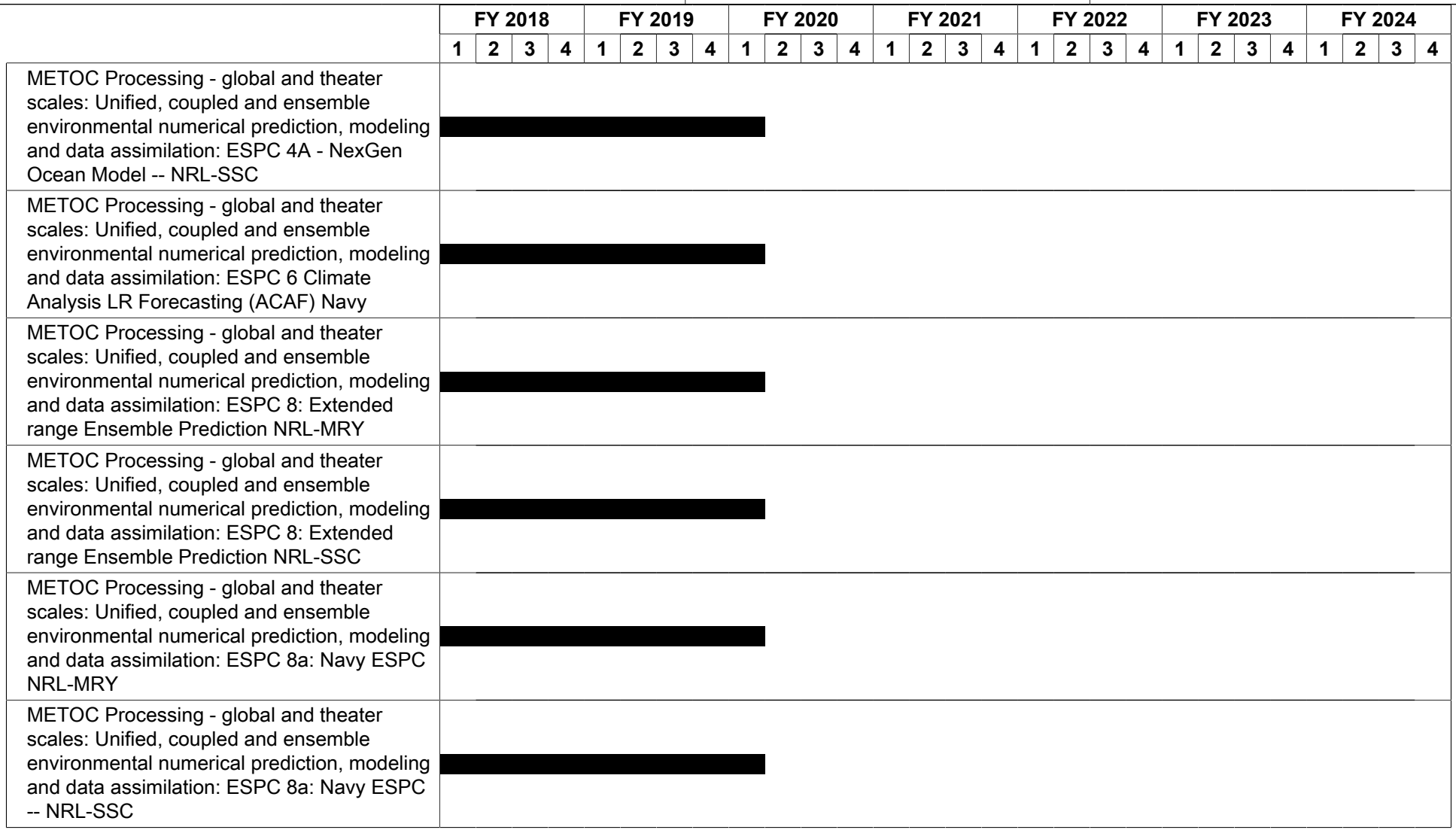


Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2342 / *METOC Data Assimilation and Mod*

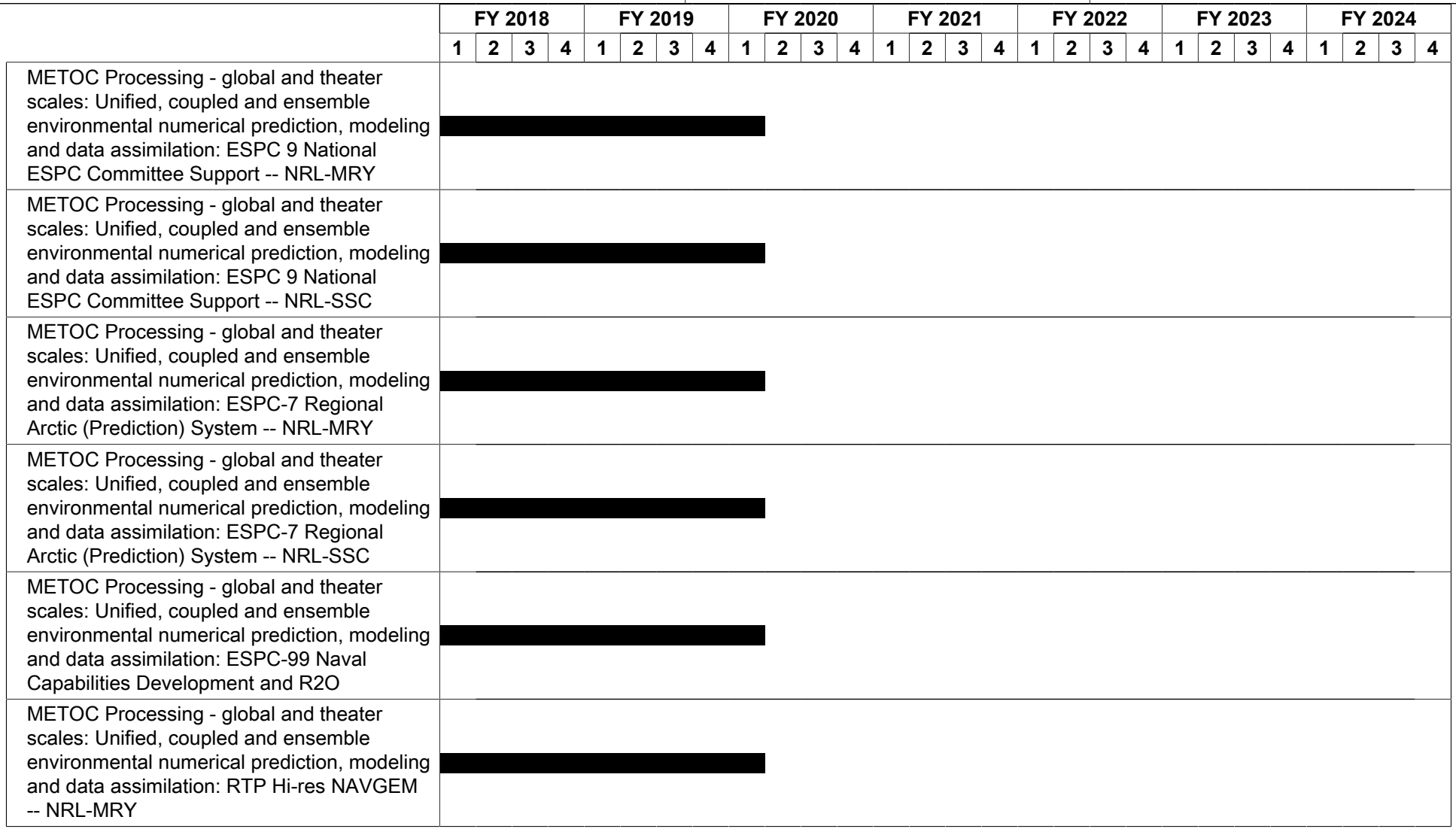


Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2342 / *METOC Data Assimilation and Mod*

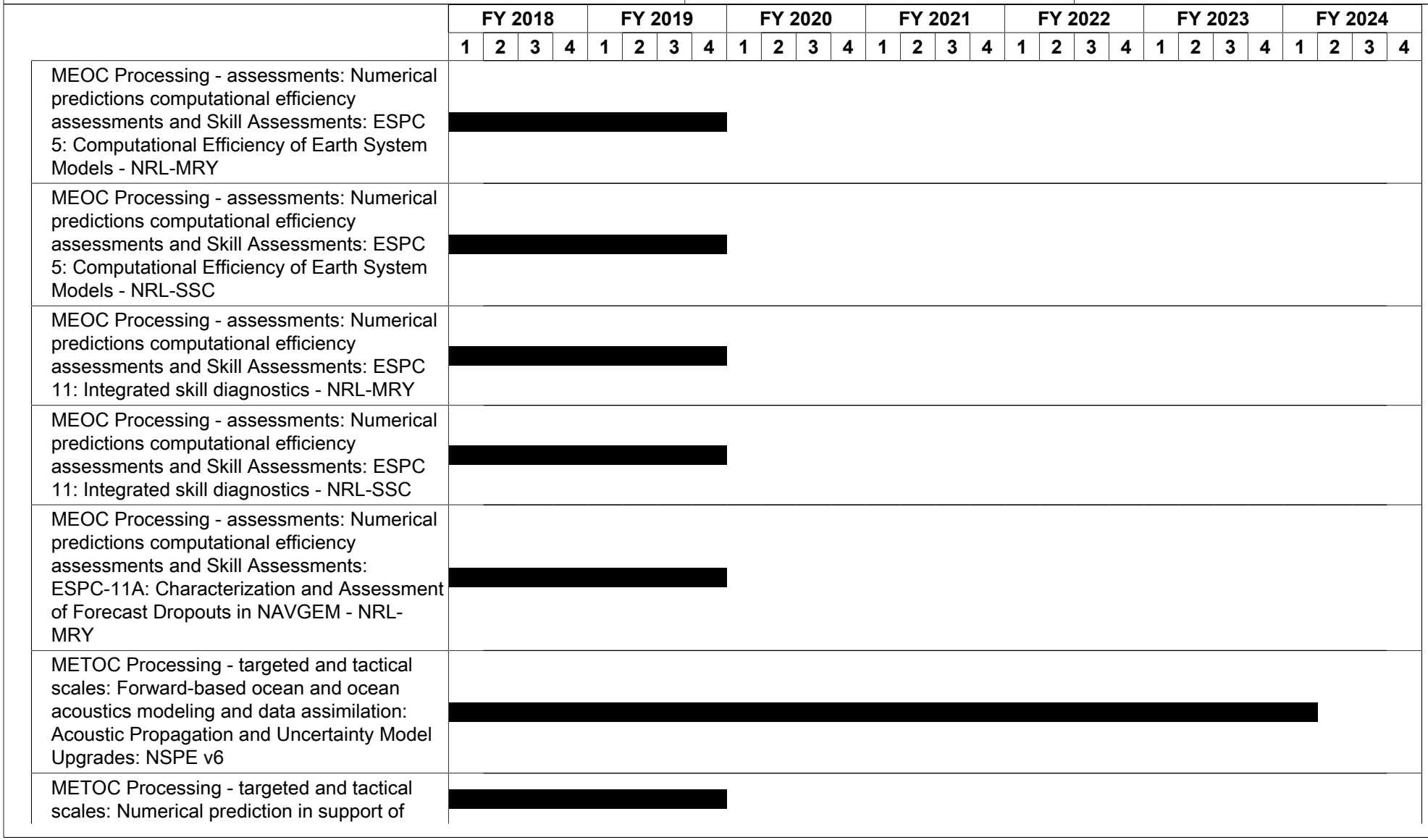


Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2342 / *METOC Data Assimilation and Mod*

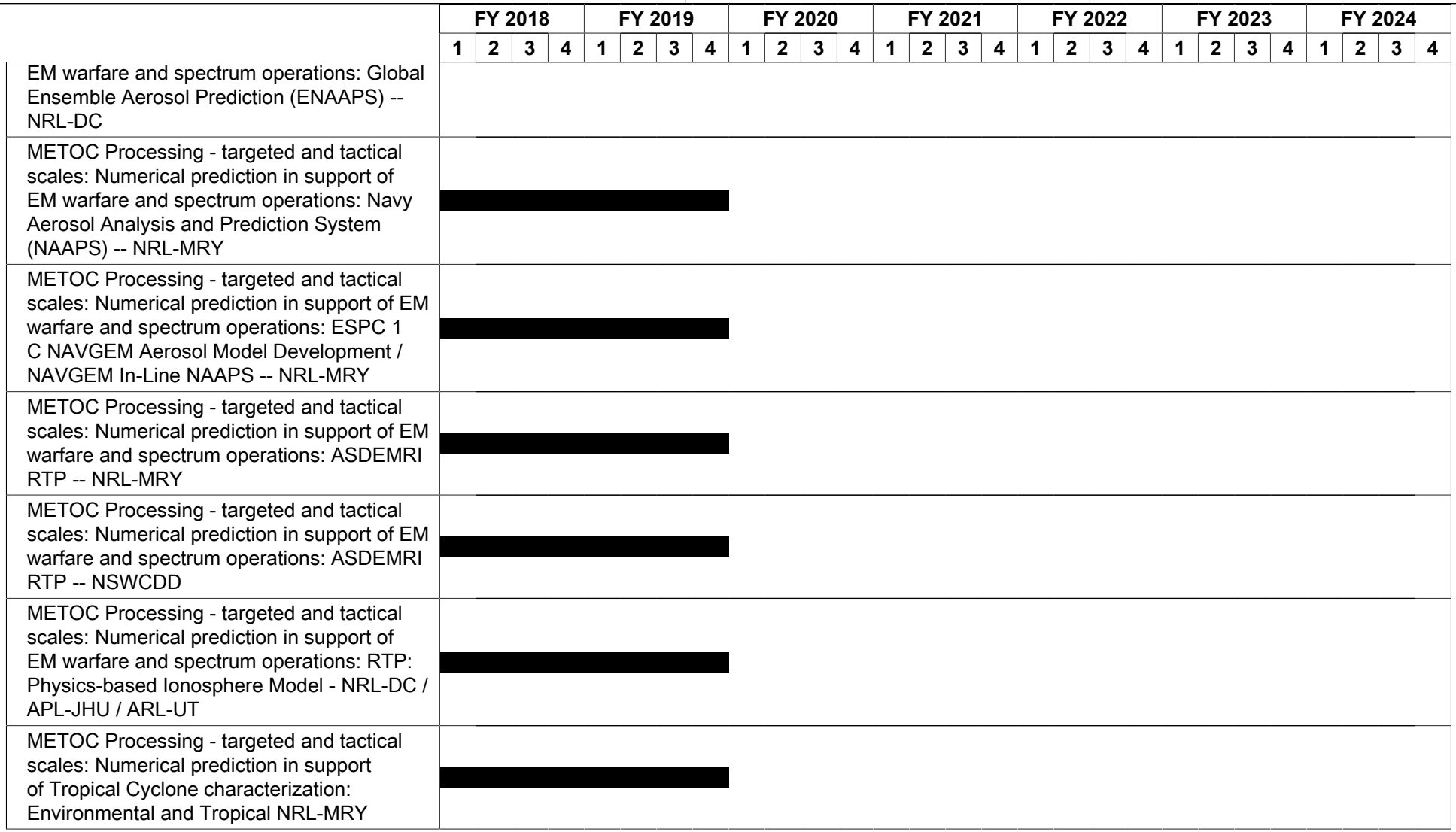


Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2342 / *METOC Data Assimilation and Mod*

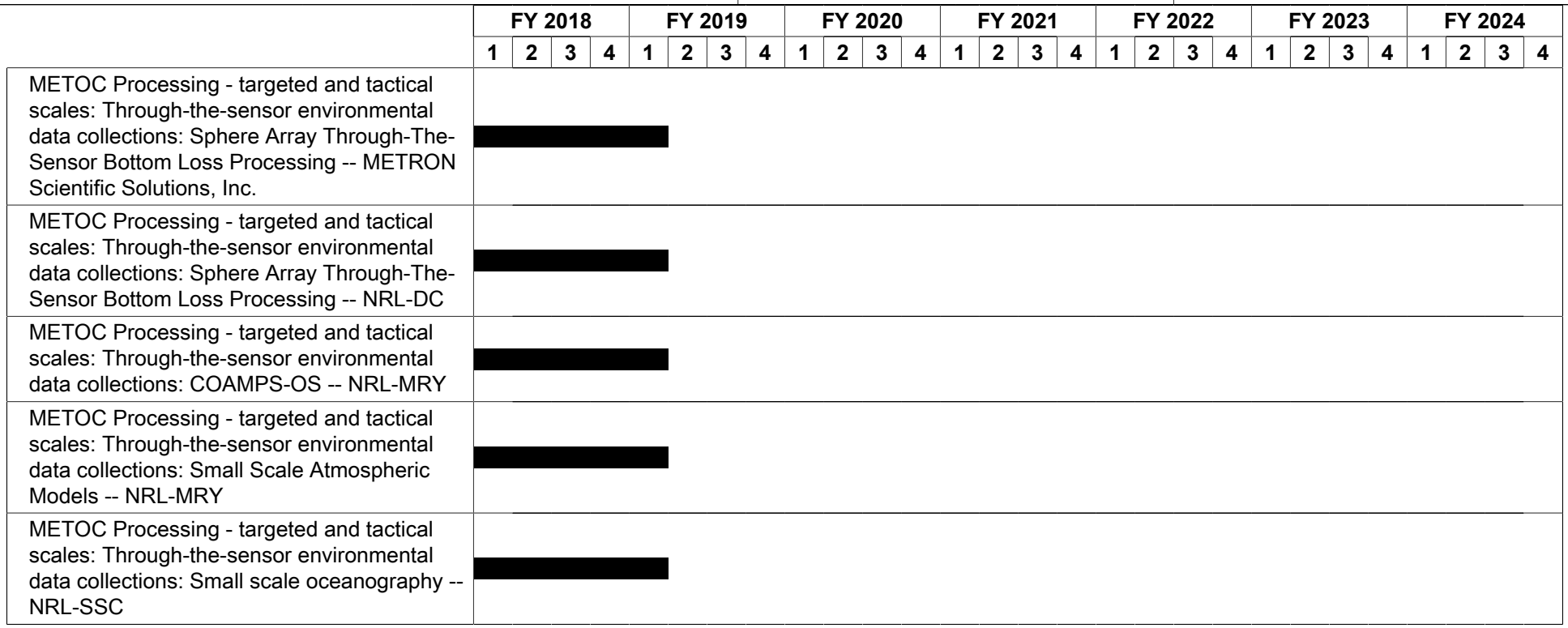


Exhibit R-4A, RDT&E Schedule Details: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2342 / *METOC Data Assimilation and Mod*

Schedule Details

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
Proj 2342				
METOC Processing - global and theater scales: Numerical prediction in support of Precise Time and Astrometry: NAVGEM Upgrade for Improved Earth Orientation Parameters -- NRL-MRY	1	2018	1	2020
METOC Processing - global and theater scales: Oceanographic and Ocean Acoustics Database Development: Biological scattering and attenuation at tactical frequencies -- APL-JHU	1	2018	1	2020
METOC Processing - global and theater scales: Oceanographic and Ocean Acoustics Database Development: Boundary Interactions - TOTLOS Improvements -- APL-UW	1	2018	1	2020
METOC Processing - global and theater scales: Oceanographic and Ocean Acoustics Database Development: Cloud Enablement of Ocean and Atmospheric Master Library -- NRL-SSC	1	2018	1	2020
METOC Processing - global and theater scales: Oceanographic and Ocean Acoustics Database Development: "OAML Models and Database Verification, Validation and Enhancement	1	2018	1	2020
METOC Processing - global and theater scales: Oceanographic and Ocean Acoustics Database Development: The Improved Synthetic Ocean Profiles (ISOP), Version 2 -- NRL-SSC	1	2018	1	2020
METOC Processing - global and theater scales: Satellite-based environmental monitoring for, analysis, assimilation and modeling: Advanced Satellite Data Assimilation -- NRL-MRY	1	2018	4	2019
METOC Processing - global and theater scales: Satellite-based environmental monitoring for, analysis, assimilation and modeling: Aerosol observations for NAAPS validation -- NRL-MRY	1	2018	4	2019

Exhibit R-4A, RDT&E Schedule Details: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2342 / *METOC Data Assimilation and Mod*

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
METOC Processing - global and theater scales: Satellite-based environmental monitoring for, analysis, assimilation and modeling: Mean sea surface height for Sentinel -3A/B x -- NRL-SSC	1	2018	4	2019
METOC Processing - global and theater scales: Satellite-based environmental monitoring for, analysis, assimilation and modeling: Modeling, Sensing and Forecasting Ocean Optical Products	1	2018	4	2019
METOC Processing - global and theater scales: Satellite-based environmental monitoring for, analysis, assimilation and modeling: NFLUX: Ocean Surface Bias Detection and Correction Using Satellites	1	2018	4	2019
METOC Processing - global and theater scales: Satellite-based environmental monitoring for, analysis, assimilation and modeling: Operationally implementing sat-derived ice products	1	2018	4	2019
METOC Processing - global and theater scales: Satellite-based environmental monitoring for, analysis, assimilation and modeling: Radio occultations from commercial data providers -- NRL-MRY	1	2018	4	2019
METOC Processing - global and theater scales: Satellite-based environmental monitoring for, analysis, assimilation and modeling: Satellite Aerosol Data Assimilation -- NRL-MRY	1	2018	4	2019
METOC Processing - global and theater scales: Satellite-based environmental monitoring for, analysis, assimilation and modeling: Space METOC: Sea Surface Temp (SST) -- NRL-SSC	1	2018	4	2019
METOC Processing - global and theater scales: Satellite-based environmental monitoring for, analysis, assimilation and modeling: Validating and assimilating SAR	1	2018	4	2019
METOC Processing - global and theater scales: Unified, coupled and ensemble environmental numerical prediction, modeling and data assimilation: Large Scale Prediction -- NRL-SSC	1	2018	1	2020
METOC Processing - global and theater scales: Unified, coupled and ensemble environmental numerical prediction, modeling and data assimilation: National Unified Operational Prediction Capability	1	2018	1	2020

Exhibit R-4A, RDT&E Schedule Details: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2342 / *METOC Data Assimilation and Mod*

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
METOC Processing - global and theater scales: Unified, coupled and ensemble environmental numerical prediction, modeling and data assimilation: NAVGEM NRL-MRY	1	2018	1	2020
METOC Processing - global and theater scales: Unified, coupled and ensemble environmental numerical prediction, modeling and data assimilation: NCOM-4DVAR NRL-SSC	1	2018	1	2020
METOC Processing - global and theater scales: Unified, coupled and ensemble environmental numerical prediction, modeling and data assimilation: ESPC 1 : Coupled Global Prediction System -- NRL-MRY	1	2018	1	2020
METOC Processing - global and theater scales: Unified, coupled and ensemble environmental numerical prediction, modeling and data assimilation: ESPC 1 : Coupled Global Prediction System -- NRL-SSC	1	2018	1	2020
METOC Processing - global and theater scales: Unified, coupled and ensemble environmental numerical prediction, modeling and data assimilation: ESPC 1 B: High Resolution NAVGEM RTP NRL-MRY	1	2018	1	2020
METOC Processing - global and theater scales: Unified, coupled and ensemble environmental numerical prediction, modeling and data assimilation: ESPC 10 Coupled Model Data Assimilation -- NRL-MRY	1	2018	1	2020
METOC Processing - global and theater scales: Unified, coupled and ensemble environmental numerical prediction, modeling and data assimilation: ESPC 10 Coupled Model Data Assimilation -- NRL-SSC	1	2018	1	2020
METOC Processing - global and theater scales: Unified, coupled and ensemble environmental numerical prediction, modeling and data assimilation: ESPC 1D Middle Atmosphere NRL-DC	1	2018	1	2020
METOC Processing - global and theater scales: Unified, coupled and ensemble environmental numerical prediction, modeling and data assimilation: ESPC 1D Middle Atmosphere NRL-MRY	1	2018	1	2020
METOC Processing - global and theater scales: Unified, coupled and ensemble environmental numerical prediction, modeling and data assimilation: ESPC 2: NRL-MRY	1	2018	1	2020

Exhibit R-4A, RDT&E Schedule Details: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2342 / *METOC Data Assimilation and Mod*

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
METOC Processing - global and theater scales: Unified, coupled and ensemble environmental numerical prediction, modeling and data assimilation: ESPC 2: NRL-SSC	1	2018	1	2020
METOC Processing - global and theater scales: Unified, coupled and ensemble environmental numerical prediction, modeling and data assimilation: ESPC 3: Coupled Global Ensemble Prediction System	1	2018	1	2020
METOC Processing - global and theater scales: Unified, coupled and ensemble environmental numerical prediction, modeling and data assimilation: ESPC 4 :Next Generation Model NEPTUNE -- NRL-MRY	1	2018	1	2020
METOC Processing - global and theater scales: Unified, coupled and ensemble environmental numerical prediction, modeling and data assimilation: ESPC 4A - NexGen Ocean Model -- NRL-SSC	1	2018	1	2020
METOC Processing - global and theater scales: Unified, coupled and ensemble environmental numerical prediction, modeling and data assimilation: ESPC 6 Climate Analysis LR Forecasting (ACAF) Navy	1	2018	1	2020
METOC Processing - global and theater scales: Unified, coupled and ensemble environmental numerical prediction, modeling and data assimilation: ESPC 8: Extended range Ensemble Prediction NRL-MRY	1	2018	1	2020
METOC Processing - global and theater scales: Unified, coupled and ensemble environmental numerical prediction, modeling and data assimilation: ESPC 8: Extended range Ensemble Prediction NRL-SSC	1	2018	1	2020
METOC Processing - global and theater scales: Unified, coupled and ensemble environmental numerical prediction, modeling and data assimilation: ESPC 8a: Navy ESPC NRL-MRY	1	2018	1	2020
METOC Processing - global and theater scales: Unified, coupled and ensemble environmental numerical prediction, modeling and data assimilation: ESPC 8a: Navy ESPC -- NRL-SSC	1	2018	1	2020
METOC Processing - global and theater scales: Unified, coupled and ensemble environmental numerical prediction, modeling and data assimilation: ESPC 9 National ESPC Committee Support -- NRL-MRY	1	2018	1	2020

Exhibit R-4A, RDT&E Schedule Details: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2342 / *METOC Data Assimilation and Mod*

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
METOC Processing - global and theater scales: Unified, coupled and ensemble environmental numerical prediction, modeling and data assimilation: ESPC 9 National ESPC Committee Support -- NRL-SSC	1	2018	1	2020
METOC Processing - global and theater scales: Unified, coupled and ensemble environmental numerical prediction, modeling and data assimilation: ESPC-7 Regional Arctic (Prediction) System -- NRL-MRY	1	2018	1	2020
METOC Processing - global and theater scales: Unified, coupled and ensemble environmental numerical prediction, modeling and data assimilation: ESPC-7 Regional Arctic (Prediction) System -- NRL-SSC	1	2018	1	2020
METOC Processing - global and theater scales: Unified, coupled and ensemble environmental numerical prediction, modeling and data assimilation: ESPC-99 Naval Capabilities Development and R2O	1	2018	1	2020
METOC Processing - global and theater scales: Unified, coupled and ensemble environmental numerical prediction, modeling and data assimilation: RTP Hi-res NAVGEM -- NRL-MRY	1	2018	1	2020
MEOC Processing - assessments: Numerical predictions computational efficiency assessments and Skill Assessments: ESPC 5: Computational Efficiency of Earth System Models - NRL-MRY	1	2018	4	2019
MEOC Processing - assessments: Numerical predictions computational efficiency assessments and Skill Assessments: ESPC 5: Computational Efficiency of Earth System Models - NRL-SSC	1	2018	4	2019
MEOC Processing - assessments: Numerical predictions computational efficiency assessments and Skill Assessments: ESPC 11: Integrated skill diagnostics - NRL-MRY	1	2018	4	2019
MEOC Processing - assessments: Numerical predictions computational efficiency assessments and Skill Assessments: ESPC 11: Integrated skill diagnostics - NRL-SSC	1	2018	4	2019
MEOC Processing - assessments: Numerical predictions computational efficiency assessments and Skill Assessments: ESPC-11A: Characterization and Assessment of Forecast Dropouts in NAVGEM - NRL-MRY	1	2018	4	2019

Exhibit R-4A, RDT&E Schedule Details: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2342 / *METOC Data Assimilation and Mod*

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
METOC Processing - targeted and tactical scales: Forward-based ocean and ocean acoustics modeling and data assimilation: Acoustic Propagation and Uncertainty Model Upgrades: NSPE v6	1	2018	1	2024
METOC Processing - targeted and tactical scales: Numerical prediction in support of EM warfare and spectrum operations: Global Ensemble Aerosol Prediction (ENAAPS) -- NRL-DC	1	2018	4	2019
METOC Processing - targeted and tactical scales: Numerical prediction in support of EM warfare and spectrum operations: Navy Aerosol Analysis and Prediction System (NAAPS) -- NRL-MRY	1	2018	4	2019
METOC Processing - targeted and tactical scales: Numerical prediction in support of EM warfare and spectrum operations: ESPC 1 C NAVGEM Aerosol Model Development / NAVGEM In-Line NAAPS -- NRL-MRY	1	2018	4	2019
METOC Processing - targeted and tactical scales: Numerical prediction in support of EM warfare and spectrum operations: ASDEMRI RTP -- NRL-MRY	1	2018	4	2019
METOC Processing - targeted and tactical scales: Numerical prediction in support of EM warfare and spectrum operations: ASDEMRI RTP -- NSWCDD	1	2018	4	2019
METOC Processing - targeted and tactical scales: Numerical prediction in support of EM warfare and spectrum operations: RTP: Physics-based Ionosphere Model - NRL-DC / APL-JHU / ARL-UT	1	2018	4	2019
METOC Processing - targeted and tactical scales: Numerical prediction in support of Tropical Cyclone characterization: Environmental and Tropical NRL-MRY	1	2018	4	2019
METOC Processing - targeted and tactical scales: Through-the-sensor environmental data collections: Sphere Array Through-The-Sensor Bottom Loss Processing -- METRON Scientific Solutions, Inc.	1	2018	1	2019
METOC Processing - targeted and tactical scales: Through-the-sensor environmental data collections: Sphere Array Through-The-Sensor Bottom Loss Processing -- NRL-DC	1	2018	1	2019
METOC Processing - targeted and tactical scales: Through-the-sensor environmental data collections: COAMPS-OS -- NRL-MRY	1	2018	1	2019

Exhibit R-4A, RDT&E Schedule Details: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2342 / *METOC Data Assimilation and Mod*

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
METOC Processing - targeted and tactical scales: Through-the-sensor environmental data collections: Small Scale Atmospheric Models -- NRL-MRY	1	2018	1	2019
METOC Processing - targeted and tactical scales: Through-the-sensor environmental data collections: Small scale oceanography -- NRL-SSC	1	2018	1	2019

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy			Date: March 2019
Appropriation/Budget Activity 1319 / 4	R-1 Program Element (Number/Name) PE 0603207N / *Air/Ocean Tactical Applications*	Project (Number/Name) 2343 / *Tactical METOC Applications*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
2343: *Tactical METOC Applications*	163.724	11.448	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	175.172
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

Note

Total funding control for Fleet Meteorology & Oceanography (METOC) Equipment (2343) in FY 2019 and beyond was moved from Program Element (PE) 0603207N into PE 0604218N Air Ocean Equipment Engineering Projects as a result of a Budget Activity (BA) reclassification.

A. Mission Description and Budget Item Justification

The Tactical Meteorology and Oceanography (METOC) Applications Project provides cyber secure operational effects decision aid capabilities for Navy and Marine Corps warfighters in the context of Joint Operations in a net-centric environment. This project funds the agile software development of the Naval Integrated Tactical Environmental System Next Generation (NITES-Next) program of record. NITES-Next program identifies and transitions state-of-the-art decision support software technologies from the government and commercial industry's technology base, and then demonstrates and validates these capabilities before fielding. These software decision support tools provide platform, sensor, communications, and weapon systems performance assessments for warfighters in terms of their littoral and deep-strike battlespace environments. These assessments allow mission planners and warfighters, from Unit to Theater level, to optimize their sensor employment on airborne, surface, and subsurface platforms in support of Naval Composite Warfare mission areas including Undersea Warfare (USW), Anti-Submarine Warfare (ASW), Mine Warfare (MIW), Amphibious Warfare (AMW), Anti-Surface Warfare (ASUW), Anti-Air Warfare (AAW), Strike Warfare (STW), Expeditionary Warfare (EXW), Electronic Warfare (EW), Information Operations (IO), Intelligence Operations (INT), Non-Combat Operations (NCO), Command, Control, Communication (CCC), and Naval Special Warfare (NSW). Performance assessments leading to improvements in operational and tactical control are conducted through a two-tiered approach: 1) Meteorological and Oceanographic (METOC) Decision Aids and, 2) Operational Effects Decision Aids (OEDAs). METOC Decision Aides consist of a series of analysis tools which characterize the physical environment conditions of the battlespace based on the best set of physical environment data available at the time (i.e., some combination of historical and/or real-time (or near real-time) in-situ, and numerically modeled forecast data). OEDAs use the METOC Decision Aide information by fusing it with relevant, often-classified, sensor and target data to predict how weapons and sensor systems will perform. Performance results are displayed in tabular and graphic formats integrated into net-centric visualization tools for use by mission planners, and combat/weapon system operators to develop localization plans, USW/AAW/ASUW screens, STW profiles, and AMW ingress and egress points. METOC Decision Aides and OEDAs typically use data derived from sensors developed in Project 2341 (METOC Data Acquisition) and assimilated by software produced by Project 2342 (METOC Data Assimilation and Modeling). METOC Decision Aides and OEDAs also use data obtained through direct interfaces to Navy combat systems. Cyber secure capabilities are a current emphasis required to characterize and/or predict sensor and weapons system performance in the highly complex littoral environments in support of regional conflict scenarios. It addresses multi-warfare areas, particularly shallow water ASW, NSW, and missile and air defense/strike capabilities.

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2343 / *Tactical METOC Applications*

Funding supports development and integration efforts for Meteorological and Oceanographic (METOC) systems to generate and collect METOC data and fuse multiple intelligence inputs to more robustly characterize and predict tactical atmospheric and oceanographic conditions. This integrated METOC picture will support real-time battlespace awareness of propagation conditions affecting signals across the electromagnetic spectrum. METOC data will be fused with other intelligence data and automatically provided to shipboard combat systems to inform kinetic and non-kinetic fires.

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Title: Naval Integrated Tactical Environmental System Next Generation (NITES-Next)	11.448	0.000	0.000	0.000	0.000
Articles:	-	-	-	-	-
FY 2019 Plans: N/A					
FY 2020 Base Plans: N/A					
FY 2020 OCO Plans: N/A					
Accomplishments/Planned Programs Subtotals	11.448	0.000	0.000	0.000	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

The NITES-Next program acquisition, management and contracting strategies are to support the Tactical Meteorology & Oceanography (METOC) Applications project to continue the development of state-of-the-art software capabilities that provide sensor, communication, and weapon system performance assessment capabilities for open ocean and littoral operating environments. The Department of the Navy (DoN) maintains management oversight of the Naval Integrated Tactical Environmental System Next Generation (NITES-Next) program's acquisition and contracting strategies. The Department of the Navy (DoN) requirements for the Naval Integrated Tactical Environmental System Next Generation (NITES-Next) program's acquisition and contracting strategies are based on approved Joint Capabilities Integration and Development System (JCIDS) documentation.

E. Performance Metrics

Goal: Field software decision aid capabilities for Navy and Marine Corps war fighters in order to facilitate the characterization and prediction of the physical environment in the battlespace.

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2343 / *Tactical METOC Applications*

Metric: Meet the performance metrics identified in approved NITES-Next Program's requirements documents (e.g., Concept Definition Document (CDD) and individual Requirements Definition Packages (RDPs)).

Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy			Date: March 2019
Appropriation/Budget Activity 1319 / 4	R-1 Program Element (Number/Name) PE 0603207N / *Air/Ocean Tactical Applications*	Project (Number/Name) 2343 / *Tactical METOC Applications*	

Product Development ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Product Development Prior Year	Various	Various : Various	117.115	0.000		0.000		0.000		-		0.000	0.000	117.115	-
NITES-Next	WR	SSC Pacific : San Diego, CA	23.946	3.491	Dec 2017	0.000		0.000		-		0.000	0.000	27.437	-
NITES-Next	C/FP	SAIC : Virginia	9.916	2.051	Dec 2017	0.000		0.000		-		0.000	0.000	11.967	-
NITES-Next	WR	SSC Atlantic : South Carolina	0.376	0.087	Oct 2017	0.000		0.000		-		0.000	0.000	0.463	-
NITES-Next / Engineering	C/IDIQ	NAVSUP : Pennsylvania	1.300	0.000		0.000		0.000		-		0.000	0.000	1.300	-
NITES-Next / Engineering	C/IDIQ	SSC Pacific : Various	0.225	3.791	May 2018	0.000		0.000		-		0.000	0.000	4.016	-
		Subtotal	152.878	9.420		0.000		0.000		-		0.000	0.000	162.298	N/A

Support ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Support Prior Year	Various	Various : Various	0.720	0.000		0.000		0.000		-		0.000	0.000	0.720	-
NITES-Next	C/FP	SAIC : Virginia	6.415	1.232	Dec 2017	0.000		0.000		-		0.000	0.000	7.647	-
		Subtotal	7.135	1.232		0.000		0.000		-		0.000	0.000	8.367	N/A

Management Services ($ in Millions)

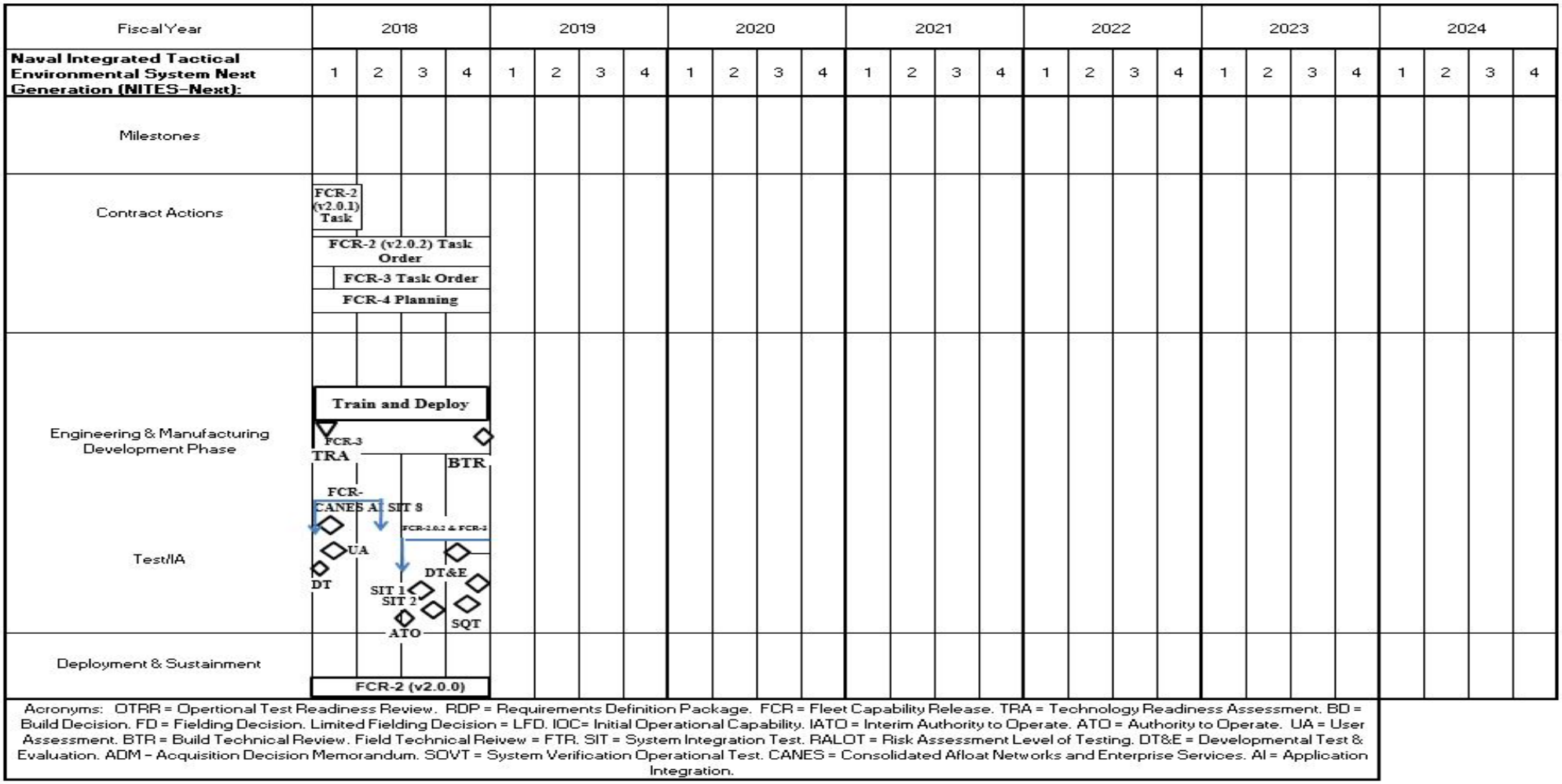
Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Management Services Prior Year	Various	Various : Various	0.031	0.000		0.000		0.000		-		0.000	0.000	0.031	-
NITES-Next	WR	SSC Pacific : San Diego, CA	1.433	0.303	Dec 2017	0.000		0.000		-		0.000	0.000	1.736	-
NITES-Next	C/FP	BAH : San Diego, CA	2.247	0.493	Dec 2017	0.000		0.000		-		0.000	0.000	2.740	-
		Subtotal	3.711	0.796		0.000		0.000		-		0.000	0.000	4.507	N/A

Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy			Date: March 2019
Appropriation/Budget Activity 1319 / 4	R-1 Program Element (Number/Name) PE 0603207N / *Air/Ocean Tactical Applications*	Project (Number/Name) 2343 / *Tactical METOC Applications*	

	Prior Years	FY 2018		FY 2019		FY 2020 Base		FY 2020 OCO		FY 2020 Total	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals	163.724	11.448		0.000		0.000		-		0.000	0.000	175.172	N/A

Remarks

Exhibit R-4, **RDT&E Schedule Profile:** PB 2020 Navy		**Date:** March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2343 / *Tactical METOC Applications*



Acronyms: OTRR = Opertional Test Readiness Review. RDP = Requirements Definition Package. FCR = Fleet Capability Release. TRA = Technology Readiness Assessment. BD = Build Decision. FD = Fielding Decision. Limited Fielding Decision = LFD. IOC= Initial Operational Capability. IATO = Interim Authority to Operate. ATO = Authority to Operate. UA = User Assessment. BTR = Build Technical Review. Field Technical Reivew = FTR. SIT = System Integration Test. RALOT = Risk Assessment Level of Testing. DT&E = Developmental Test & Evaluation. ADM – Acquisition Decision Memorandum. SOVT = System Verification Operational Test. CANES = Consolidated Afloat Networks and Enterprise Services. AI = Application Integration.

Exhibit R-4A, RDT&E Schedule Details: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2343 / *Tactical METOC Applications*

Schedule Details

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
Naval Integrated Tactical Environmental System Next Generation (NITES-Next)				
Milestones: Build Decision (BD) Fleet Capability Release - 3	2	2018	2	2018
Contract Actions: FCR-2 Task Order (v2.0.1)	1	2018	2	2018
Contract Actions: FCR-2 Task Order (v2.0.2)	1	2018	4	2018
Contract Actions: FCR-3 Task Order	1	2018	4	2018
Contract Actions: FCR-4 Planning	1	2018	4	2018
Engineering & Manufacturing Development Phase: Fleet Capability Release - 2 / Train Deploy	1	2018	4	2018
Engineering & Manufacturing Development Phase: Fleet Capability Release - 3 / Train Deploy	1	2018	4	2018
Engineering & Manufacturing Development Phase: Technology Readiness Assessment - 3	1	2018	1	2018
Engineering & Manufacturing Development Phase: Build Technical Review FCR-3	4	2018	4	2018
Test/IA: Fleet Capability Release - 2	1	2018	2	2018
Test/IA: Fleet Capability Release - 3	3	2018	4	2018
Test/IA: System Integration Test - 1 (FCR-3)	3	2018	3	2018
Test/IA: System Integration Test - 2 (FCR-3)	3	2018	3	2018
Test/IA: Authority to Operate FCR-2.0.2	3	2018	3	2018
Test/IA: System Qualification Test FCR-3	4	2018	4	2018
Test/IA: Developmental Test Fleet Capability Release - FCR-2	1	2018	1	2018
Test/IA: Developmental Test Fleet Capability Release - FCR-3	4	2018	4	2018
Test/IA: User Assessment FCR-2	1	2018	1	2018
Test/IA: CANES AI SIT FCR-2	1	2018	1	2018

Exhibit R-4A, RDT&E Schedule Details: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2343 / *Tactical METOC Applications*

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
Test/IA: CANES AI SIT FCR-3	4	2018	4	2018
Test/IA: Deployment and Sustainment: Deployment, fielding and Sustainment (OMN)	1	2018	4	2018

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy			Date: March 2019
Appropriation/Budget Activity 1319 / 4	R-1 Program Element (Number/Name) PE 0603207N / *Air/Ocean Tactical Applications*	Project (Number/Name) 2344 / *Precise Time and Astrometry*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
2344: *Precise Time and Astrometry*	15.533	4.992	4.556	2.467	-	2.467	3.293	3.209	3.079	3.141	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

The Precise Timing and Astrometry (PTA) project funds research and development of improvements for the U.S. Master Clock (MC) System, the DoD Time Transfer capability, the Earth Orientation System, and the Astrometric Observation System. The MC System and Time Transfer provides precise time for use in modern military and National Technical Means (NTM) navigation, guidance, positioning, and tracking systems. The Earth Orientation System provides precise Earth Orientation Parameters for use by the DoD and the national civilian infrastructure to establish the specific orientation of the Earth and to provide input to the terrestrial reference frame. The Astrometric Observation System provides the basic data needed to generate the Celestial Reference Frame (CRF) which is the standard for calibrating all inertial navigation systems, satellite orbits, and earth rotation determinations. Improvement to the MC System, Time Transfer, Earth Orientation, and Astrometric Observation Systems are needed to ensure that new and upgraded DoD and NTM capabilities meet their performance requirements. By DoD Directive 4650.06 and OPNAV9420.1B, the U.S. Naval Observatory (USNO), is responsible for coordinating Precise Time and Time Interval (PTTI) requirements and for maintaining a PTTI reference standard (astronomical and atomic) for use by all DoD, federal agencies, and related scientific laboratories. The Navy is also responsible for providing CRF data for military and NTM navigation, positioning, and guidance capabilities to all DoD via DODI 4650.06 and OPNAV9420.1B.

The PTA research and development efforts are focused on several areas relating to timing and time transfer: (1) Fielding of Rubidium Fountain Atomic Clocks and development of improved Global Positioning System (GPS) Timing Receivers in order to meet the precise timing requirements for the GPS III system; (2) Research & development of the capability of distributing timing signals via Optical fiber lines, as an alternative and backup to GPS time distribution; and (3) Research & development into Optical Clock technology, which is expected to be required for future DoD systems. The PTA research and development effort is also focused on the following areas related to Earth Orientation Parameter (EOP) determination: (1) Upgrade of the Very Long Baseline Interferometry (VBLI) data acquisition system / radio telescope at Kokee Park HI; (2) Development of a Software (SW) Correlator for processing of VLBI data, necessary for the generation of Earth Orientation Parameter (EOP) data; (3) Development of the capability for electronic transmission of the VLBI data from remote VLBI sites to the USNO correlator. The new SW Correlator and the eVLBI infrastructure upgrades are necessary in order to support daily updates of EOP data required by GPS III; (4) Development of an automated end-to-end EOP processing system, which combines input from multiple data sets (e.g. VLBI data, GPS orbit data, and laser ranging data, etc.). Automation is necessary to meet future DoD and GPS requirements; and (5) Modifications to the EOP system for compatibility with the new international standard -'VLBI2010'. The PTA research and development for astrometry focuses on 1) 1.8 meter telescope deployment, 2) research into the development of a GPS-denied reference frame as a navigation solution, 3) visible and infrared (IR) instrumentation development. These activities are necessary for producing CRF products for DoD customers in an era of new surveillance, targeting, intelligence, and reconnaissance technologies and instrumentation.

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Title: Precise Timing and Astronomy	4.992	4.556	2.467	0.000	2.467

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2344 / *Precise Time and Astrometry*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Articles:	-	-	-	-	-
Description: Research and development of improvements for the U.S. Master Clock (MC) System, the DoD Time Transfer capability, the Earth Orientation System, and the Astrometric Observation System.					
FY 2019 Plans: - Critical Design Review (CDR) for transceiver for next generation time transfer - Development of time transfer modem - Two Way Satellite Time Transfer (TWSTT) enhancements - Optical Time Transfer: Fiber and Free Space optical time transfer capability development - Optical Clock Development: characterization of capabilities of thermal calcium beam, frequency comb performance, higher performance development - Transition Earth Orientation Parameters (EOP) automation products to operations (Initial Operating Capability, IOC) - Test GPS-denied reference frame data pipeline - Solar Lunar Almanac Core (SLAC) Shapiro illuminance model study/upgrade - System Requirements Review (SRR) for next generation infrared astrometric camera - Initiate development of prototype optical lattice clock (begin materials study) - Complete 1.8 meter enclosure					
FY 2020 Base Plans: - Continue Critical Design Review (CDR) for transceiver for next generation time transfer - Continue Two Way Satellite Time Transfer (TWSTT) enhancements - Continue Optical Time Transfer: Fiber and Free Space optical time transfer capability development - Optical Clock Development: Assess calcium thermal-beam clock stability,develop spectroscopy on laser-cooled beam - Transition Earth Orientation Parameters (EOP) automation products to operations (Final Operating Capability FOC) - Transition GPS-denied reference frame data pipeline to operations - Continue Solar Lunar Almanac Core (SLAC) Shapiro illuminance model study/upgrade - Continue development of next generation infrared astrometric camera					
FY 2020 OCO Plans:					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2344 / *Precise Time and Astrometry*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
N/A ***FY 2019 to FY 2020 Increase/Decrease Statement:*** Decrease between FY19 and FY20 due to Time Frequency Distribution System, Assured Timing Services, Kokee Park telescope, Celestial Reference Frame Observations and Earth Orientation Parameters Continuity of Operations, Next generation commercial clock, and STELLA/MICA life cycle support requirement adjustments/ changes. The FY2020 funding request for project 2344 was reduced by $0.479 million to account for the availability of prior year execution balances.					
Accomplishments/Planned Programs Subtotals	4.992	4.556	2.467	0.000	2.467

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

The included technology developments are primarily in-house with selected contractor participation.

E. Performance Metrics

(1) Automated Earth Orientation Parameters reach Initial Operational Capability (IOC).
(2) System Requirements Review for next generation infrared astrometric camera
(3) Demonstrate Free Space Time Transfer Capability
(4) Delivery of first Next Generation Time Transfer transceiver--transition to operations.
(5) 1.8 meter Enclosure Fabrication Completion

Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy			Date: March 2019
Appropriation/Budget Activity 1319 / 4	R-1 Program Element (Number/Name) PE 0603207N / *Air/Ocean Tactical Applications*	Project (Number/Name) 2344 / *Precise Time and Astrometry*	

Product Development ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Primary Hardware Development (NPOI) 1.8m Telescope Project (1)	SS/FFP	Lowell Observatory : Flagstaff, AZ	0.200	0.000		0.000		0.000		-		0.000	0.000	0.200	-
Primary Hardware Development (NPOI) 1.8m Telescope (2)	SS/FFP	AZ Embeded System : Not Specified	0.500	0.000		0.000		0.000		-		0.000	0.000	0.500	-
Ancillary Hardware Development 1	Various	U.S. Naval Observatory : Washington, DC	0.155	0.018	Dec 2017	0.060	Dec 2018	0.075	Dec 2019	-		0.075	0.000	0.308	-
Ancillary Hardware Development 2	Various	U.S. Naval Observatory : Washington, DC	0.154	0.018	Jan 2018	0.060	Jan 2019	0.075	Jan 2020	-		0.075	0.000	0.307	-
Ancillary Hardware Development 3	Various	U.S. Naval Observatory : Washington, DC	0.192	0.018	Apr 2018	0.060	Apr 2019	0.075	Apr 2020	-		0.075	0.000	0.345	-
Ancillary Hardware Development 4	Various	U.S. Naval Observatory : Washington, DC	0.097	0.018	Jul 2018	0.060	Jul 2019	0.075	Jul 2020	-		0.075	0.000	0.250	-
Primary Hardware Development for CTD (System Integration)	C/FP	Classified : Not Specified	0.000	0.000		0.000		0.000		-		0.000	0.000	0.000	-
Primary Hardware Development for CTD (RF Interface)	MIPR	Classified : Not Specified	4.980	0.660	Mar 2018	0.000		0.000		-		0.000	0.000	5.640	-
Primary Hardware Development for CTD (Line Interface)	MIPR	Classified : Not Specified	2.219	0.830	Jun 2018	0.000		0.000		-		0.000	0.000	3.049	-
Primary Hardware Development for CTD (Reference Upgrade)	C/FFP	Symmetricom : San Jose, CA	0.400	0.150	Jul 2018	0.000		0.000		-		0.000	0.000	0.550	-
Next Generation Secure Time Transfer	C/FFP	Classified : Not Specified	0.934	0.273	Jul 2018	0.500	Mar 2019	0.158	Mar 2020	-		0.158	0.565	2.430	-
1.8 meter infrared camera development	C/FFP	Classified : Not Specified	0.000	0.000		0.931	Jan 2019	0.414	Jan 2020	-		0.414	4.249	5.594	-

Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2344 / *Precise Time and Astrometry*

Product Development ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Primary Hardware Development (Site Prep)	SS/FFP	NASA/GSFC : HI	0.000	0.100	Jan 2018	0.000		0.000		-		0.000	0.000	0.100	-
Primary Hardware Development (Antenna Receiver Electronics)	C/FFP	NASA : GSFC	1.000	0.000		0.000		0.000		-		0.000	0.000	1.000	-
1.8 meter Telescope Enclosure	C/FFP	NAVFAC SW : Not Specified	0.000	2.153	Mar 2018	0.000		0.000		-		0.000	0.000	2.153	-
Advanced Time and Frequency Tranfer Upgrade	C/FFP	Classified : Not Specified	0.000	0.000		0.500	Jul 2019	0.150	Jul 2020	-		0.150	0.600	1.250	-
Optical Lattice Clocks	C/FFP	Classified : Not Specified	0.000	0.000		0.500	Jul 2019	0.150	Jul 2020	-		0.150	0.600	1.250	-
		Subtotal	10.831	4.238		2.671		1.172		-		1.172	6.014	24.926	N/A

Support ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Development Support (All PTA - Labor) 1	Allot	U.S. Naval Observatory (Civilian Labor) : Washington, DC	0.450	0.078	Dec 2017	0.115	Dec 2018	0.118	Dec 2019	-		0.118	Continuing	Continuing	Continuing
Development Support (All PTA - Labor) 2	Allot	U.S. Naval Observatory (Civilian Labor) : Washington, DC	0.450	0.078	Mar 2018	0.115	Mar 2019	0.118	Mar 2020	-		0.118	Continuing	Continuing	Continuing
Development Support (All PTA - Labor) 3	Allot	U.S. Naval Observatory (Civilian Labor) : Washington, DC	0.450	0.078	Jun 2018	0.115	Jun 2019	0.118	Jun 2020	-		0.118	Continuing	Continuing	Continuing
Development Support (All PTA - Labor) 4	Allot	U.S. Naval Observatory (Civilian	0.450	0.078	Jul 2018	0.115	Jul 2019	0.118	Jul 2020	-		0.118	Continuing	Continuing	Continuing

Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy			Date: March 2019
Appropriation/Budget Activity 1319 / 4	R-1 Program Element (Number/Name) PE 0603207N / *Air/Ocean Tactical Applications*	Project (Number/Name) 2344 / *Precise Time and Astrometry*	

Support ($ in Millions)				FY 2018		FY 2019		FY 2020 Base		FY 2020 OCO		FY 2020 Total			
Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Cost To Complete	Total Cost	Target Value of Contract
		Labor) : Washington, DC													
Software Development (EOP Automation)	C/FFP	U.S. Naval Observatory (Civilian Labor) : Washington, DC	1.380	0.056	Jun 2018	0.537	Jun 2019	0.250	Jun 2020	-		0.250	0.000	2.223	-
Travel 1	Allot	U.S. Naval Observatory (Civilian Travel) : Varies	0.032	0.011	Oct 2017	0.000		0.000		-		0.000	0.000	0.043	-
Travel 2	Allot	U.S. Naval Observatory (Civilian Travel) : Varies	0.032	0.011	Jan 2018	0.000		0.000		-		0.000	0.000	0.043	-
Travel 3	Allot	U.S. Naval Observatory (Civilian Travel) : Varies	0.033	0.011	Apr 2018	0.000		0.000		-		0.000	0.000	0.044	-
Travel 4	Allot	U.S. Naval Observatory (Civilian Travel) : Varies	0.033	0.011	Jul 2018	0.000		0.000		-		0.000	0.000	0.044	-
VLBI2010 Testing and Integration	MIPR	NASA : GSFC	0.905	0.000		0.000		0.000		-		0.000	0.000	0.905	-
Software Development (SW Correlator GUI)	C/FFP	U.S. Naval Observatory : Washington, DC	0.000	0.000		0.000		0.000		-		0.000	0.000	0.000	-
Astrometric Development	C/FFP	U.S. Naval Observatory : Washington, DC	0.487	0.000		0.261	Mar 2019	0.000		-		0.000	0.000	0.748	-
EOP Optimal Estimation	C/FFP	NASA : GSFC	0.000	0.000		0.125	Feb 2019	0.125	Feb 2020	-		0.125	0.500	0.750	-
Foreign GNSS	C/FFP	Classified : Not Specified	0.000	0.000		0.125	Feb 2019	0.125	Feb 2020	-		0.125	0.500	0.750	-
SLAC Software Upgrade	C/FFP	Classified : Not Specified	0.000	0.000		0.377	Mar 2019	0.323	Mar 2020	-		0.323	0.690	1.390	-
Primary Hardware Development (NPOI) 1.8m Telescope Project (2)	SS/FFP	NASA : Varies	0.000	0.342	Feb 2018	0.000		0.000		-		0.000	0.000	0.342	-

Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2344 / *Precise Time and Astrometry*

Support ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
		Subtotal	4.702	0.754		1.885		1.295		-		1.295	Continuing	Continuing	N/A

	Prior Years	FY 2018		FY 2019		FY 2020 Base		FY 2020 OCO		FY 2020 Total	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals	15.533	4.992		4.556		2.467		-		2.467	Continuing	Continuing	N/A

Remarks

Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2344 / *Precise Time and Astrometry*

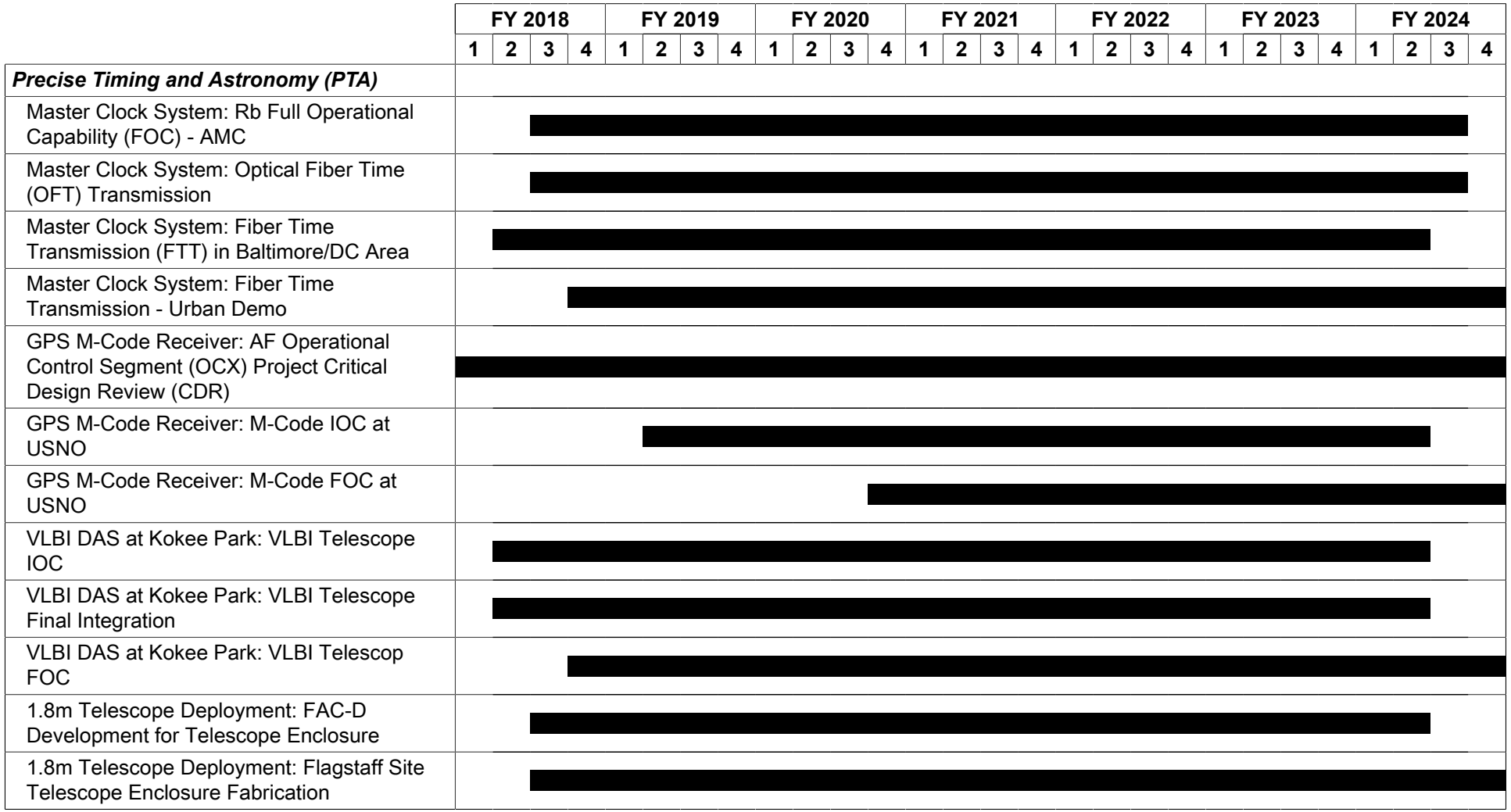


Exhibit R-4A, RDT&E Schedule Details: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2344 / *Precise Time and Astrometry*

Schedule Details

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
Precise Timing and Astronomy (PTA)				
Master Clock System: Rb Full Operational Capability (FOC) - AMC	3	2018	3	2024
Master Clock System: Optical Fiber Time (OFT) Transmission	3	2018	3	2024
Master Clock System: Fiber Time Transmission (FTT) in Baltimore/DC Area	2	2018	2	2024
Master Clock System: Fiber Time Transmission - Urban Demo	4	2018	4	2024
GPS M-Code Receiver: AF Operational Control Segment (OCX) Project Critical Design Review (CDR)	1	2018	4	2024
GPS M-Code Receiver: M-Code IOC at USNO	2	2019	2	2024
GPS M-Code Receiver: M-Code FOC at USNO	4	2020	4	2024
VLBI DAS at Kokee Park: VLBI Telescope IOC	2	2018	2	2024
VLBI DAS at Kokee Park: VLBI Telescope Final Integration	2	2018	2	2024
VLBI DAS at Kokee Park: VLBI Telescop FOC	4	2018	4	2024
1.8m Telescope Deployment: FAC-D Development for Telescope Enclosure	3	2018	2	2024
1.8m Telescope Deployment: Flagstaff Site Telescope Enclosure Fabrication	3	2018	4	2024

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy											Date: March 2019	
Appropriation/Budget Activity 1319 / 4					R-1 Program Element (Number/Name) PE 0603207N / *Air/Ocean Tactical Applications*				Project (Number/Name) 2363 / *Remote Sensing Capability Development*			
COST ($ in Millions)	**Prior Years**	**FY 2018**	**FY 2019**	**FY 2020 Base**	**FY 2020 OCO**	**FY 2020 Total**	**FY 2021**	**FY 2022**	**FY 2023**	**FY 2024**	**Cost To Complete**	**Total Cost**
2363: *Remote Sensing Capability Development*	11.128	3.874	0.324	0.327	-	0.327	0.328	0.328	0.000	0.000	0.000	16.309
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

Note

Total funding control for Fleet Meteorology & Oceanography (METOC) Equipment (2363) in FY19 and beyond was moved from Program Element (PE) 0603207N into PE 0604218N Air Ocean Equipment Engineering Projects as a result of a Budget Activity (BA) reclassification.

A. Mission Description and Budget Item Justification

Remote Sensing Capability Development characterizes the ocean environment using a variety of remote sensing techniques that provide that capability to discriminate atypical oceanographic phenomena from the natural environment that will greatly improve undersea dominance capabilities. The Naval Oceanographic Office will employ oceanographic data to refine and extend environmental characterization of the phenomena and disseminate data to the Fleet.

Remote Sensing Capability Development characterizes ocean environment using a variety of remote sensing techniques that provide that capability to discriminate atypical oceanographic phenomena from the natural environment that will greatly improve undersea dominance capabilities. The Naval Oceanographic Office will employ oceanographic data to refine and extend environmental characterization of the phenomena and disseminate data to the Fleet.

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Title: Remote Sensing Capability Development	3.816	0.000	0.000	0.000	0.000
Articles:	-	-	-	-	-
FY 2019 Plans: N/A					
FY 2020 Base Plans: N/A					
FY 2020 OCO Plans: N/A					
Title: Remote Sensing Capability Dev.	0.058	0.324	0.327	0.000	0.327
Articles:	-	-	-	-	-
Description: Collect remote sensing and ground truth data in various weather and sea states to broaden the range of environmental conditions and reduce uncertainty in environmental prediction. Develop and enhance software algorithms to automatically detect oceanographic phenomena. Integrate algorithms for access over the					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2363 / *Remote Sensing Capability Development*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
network. Enhance existing toolsets to provide users robust applications to assist in their daily tasks. Develop training to provide the user community education on using the different tools and applications. (Details held at a higher classification) ***FY 2019 Plans:*** Increase investment in new technology that allows for an accelerated pace to detect oceanographic phenomena of ocean science transitions in the interest of national security for Task Force Ocean. ***FY 2020 Base Plans:*** Invest in new technology that allows for an accelerated pace to detect oceanographic phenomena of ocean science transitions in the interest of national security for Task Force Ocean. ***FY 2020 OCO Plans:*** N/A ***FY 2019 to FY 2020 Increase/Decrease Statement:*** There is no significant change from FY2019 to FY2020					
Accomplishments/Planned Programs Subtotals	3.874	0.324	0.327	0.000	0.327

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Remote Sensing Capability Development is being managed as a Program Executive Office (PEO) Project, via a Project Definition Document (PDD) construct for acquisition rigor and oversight.
Remote Sensing Capability Development is being managed as a PEO Project leveraging the Rapid Development and Deployment (RDD) construct for rigor and discipline.

E. Performance Metrics

Available in the Project's Requirements Definition Package (RDP).
Classified performance metrics are available in the Project's Requirements Definition Package (RDP) approved 14 July 2015

Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy			Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2363 / *Remote Sensing Capability Development*	

Product Development ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Remote Sensing Capability Development Data Collection	C/FFP	SAIC : Virginia	1.781	0.521	Feb 2018	0.000		0.000		-		0.000	0.000	2.302	-
Remote Sensing Capability Development Data Collection	WR	NRL : Washington, DC	1.942	0.944	Nov 2017	0.000		0.000		-		0.000	0.000	2.886	-
Remote Sensing Capability Development Data Collection	C/FFP	Raytheon : MA	1.070	0.000		0.000		0.000		-		0.000	0.000	1.070	-
Remote Sensing Capability Development Data Collection	WR	NUWC : Keyport, WA	0.232	0.000		0.000		0.000		-		0.000	0.000	0.232	-
Remote Sensing Capability Development Data Collection	C/FFP	Cubic : San Diego, CA	1.041	1.068	Apr 2018	0.000		0.000		-		0.000	0.000	2.109	-
REMOTE SENSING CAPABILITY DEVELOPMENT DATA COLLECTION	Various	VARIOUS : VARIOUS	0.210	0.058	Jan 2018	0.324	Jan 2019	0.327	Nov 2019	-		0.327	5.176	6.095	-
		Subtotal	6.276	2.591		0.324		0.327		-		0.327	5.176	14.694	N/A

Remarks

Due to a change in contract strategy funds were sent to Cubic vice Raytheon beginning in FY17.

Support ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Remote Sensing Capability Development Data Collection	WR	SSC PAC : San Diego, CA	0.967	0.453	Mar 2018	0.000		0.000		-		0.000	0.000	1.420	-
		Subtotal	0.967	0.453		0.000		0.000		-		0.000	0.000	1.420	N/A

Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy			Date: March 2019
Appropriation/Budget Activity 1319 / 4	R-1 Program Element (Number/Name) PE 0603207N / *Air/Ocean Tactical Applications*	Project (Number/Name) 2363 / *Remote Sensing Capability Development*	

Test and Evaluation ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Remote Sensing Capability Development Data Collection	WR	SSC PAC : San Diego, CA	1.922	0.830	Mar 2018	0.000		0.000		-		0.000	0.000	2.752	-
Remote Sensing Capability Development Data Collection	WR	SSC Pacific : SAN DIEGO, CA	1.081	0.000		0.000		0.000		-		0.000	0.375	1.456	-
		Subtotal	3.003	0.830		0.000		0.000		-		0.000	0.375	4.208	N/A

Management Services ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Remote Sensing Capability Development Data Collection	C/FP	BAH : Virginia	0.345	0.000		0.000		0.000		-		0.000	0.000	0.345	-
Remote Sensing Capability Development Data Collection	C/FP	BAH : VA	0.537	0.000		0.000		0.000		-		0.000	0.374	0.911	-
		Subtotal	0.882	0.000		0.000		0.000		-		0.000	0.374	1.256	N/A

	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals	11.128	3.874		0.324		0.327		-		0.327	5.925	21.578	N/A

Remarks

Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2363 / *Remote Sensing Capability Development*

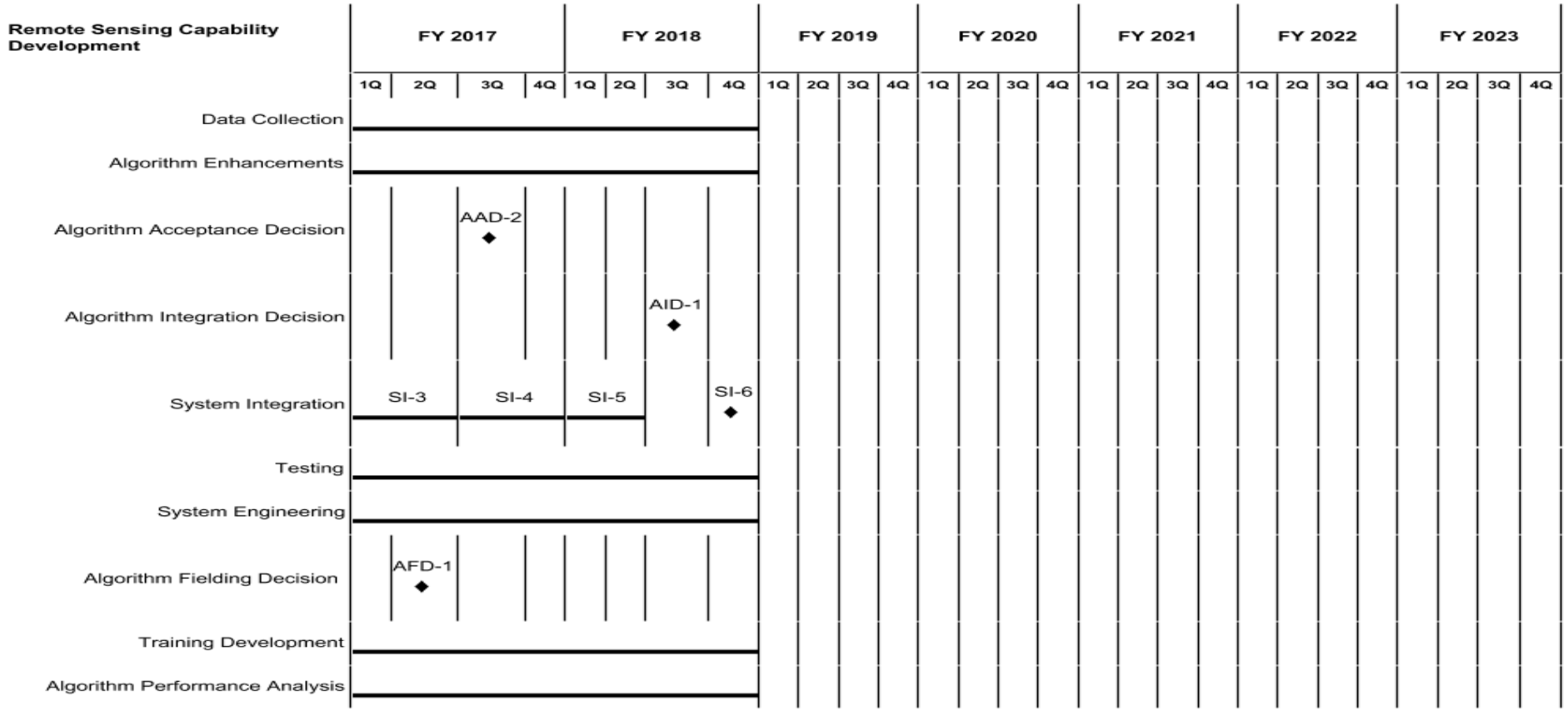


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Exhibit R-4A, RDT&E Schedule Details: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 2363 / *Remote Sensing Capability Development*

Schedule Details

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
Remote Sensing Capability Development				
Data Collection:	1	2018	4	2018
Algorithm Enhancements:	1	2018	4	2018
Algorithm Integration Decision: Algorithm Integration Decision 1	3	2018	3	2018
System Integration: System Integration 5	1	2018	2	2018
System Integration: System Integration 6	4	2018	4	2018
Testing:	1	2018	4	2018
System Engineering:	1	2018	4	2018
Training Development:	1	2018	4	2018
Algorithm Performance Analysis:	1	2018	4	2018
Remote Sensing Capability Dev.				
Data Collection:: Schedule Detail	1	2019	2	2020
Algorithm Development:: Schedule Detail	1	2019	4	2020
Application Development:: Schedule Detail	1	2018	4	2018
System Integration:: Schedule Detail	3	2019	4	2019
Testing:: Schedule Detail	1	2020	4	2020
System Engineering:: Schedule Detail	1	2020	4	2020
Training Development:: Schedule Detail	1	2018	4	2018

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy			Date: March 2019
Appropriation/Budget Activity 1319 / 4	R-1 Program Element (Number/Name) PE 0603207N / *Air/Ocean Tactical Applications*	Project (Number/Name) 3207 / *Fleet Synthetic Training*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
3207: *Fleet Synthetic Training*	2.399	0.243	0.266	0.283	-	0.283	0.305	0.326	0.332	0.339	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

Fleet Synthetic Training (FST) provides Naval Forces with an enhanced in-port training capability. Integrating embedded shipboard training devices, aircraft and submarine simulators into an interoperable network with joint, coalition and interagency partners will provide more effective training for our deploying naval forces.

A key factor in achieving this new way of training our Naval Forces is to ensure that the required training is based on realistic characterizations of the physical environment. This project develops and delivers software that characterizes the ocean and atmospheric environments; adjusts to meet fleet-required training scenarios; allows synthetic training to be conducted in areas of planned and contingency operations and provides sufficient detail to simulate the real-world conditions of the physical environment in those areas of interest.

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Title: Fleet Synthetic Training	0.243	0.266	0.283	0.000	0.283
Articles:	-	-	-	-	-
Description: Ballistic Missile Defense (BMD) Fleet Synthetic Training (FST) at sea effort will provide the capability to conduct integrated Live, Virtual, and Constructive (LVC) single or multi-ship exercises with ships at sea using the Navy Continuous Training Environment (NCTE). This capability will support BMD mission area Fleet training and mission rehearsal in theater, allow ships to participate in Combatant Command (CCMD) mandated BMD exercises while pier-side or underway, as well as enhance BMD training objective accomplishment in current Optimized Fleet Response Plan (O-FRP) underway training events such as Composite Training Unit Exercises (COMPTUEX) and Joint Task Force Exercises (JTFEX). The NCTE and FST directly support Fleet training readiness, strike group and BMD platform deployment certifications.					
FY 2019 Plans: - Implement On-Demand Cloud-Hosting to dynamically scale to workloads, thus making it more efficient, able to scale up for large jobs, and ultimately saving future operating costs. - Develop a service around advanced propagation model which can be called by any simulation in the Navy Continuous Training Environment (NCTE).					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 3207 / *Fleet Synthetic Training*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
- Devise Ensemble Model extensions to enable registration and cataloging of ensemble members and subsequent generation of products from individual members as well as cross-member analysis products (e.g., probability and/or range and mean products). ***FY 2020 Base Plans:*** - Complete On-Demand Cloud-Hosting to dynamically scale to workloads, thus making it more efficient, able to scale up for large jobs, and ultimately saving future operating costs. - Further develop SensorSim to provide increased simulated sensor effects as an external service to provide standard and consistent sensor effect modeling across the NCTE and offer ease of extension and modification. - Research a Search and Rescue (SAR) capability to provide the necessary environmental data in an executable format with existing capabilities or as an interactive tool to allow an end-user to provide inputs such as the location of the incident and entity in the water, then model the drift path of the object or person. - Implement and execute a service around advanced propagation model which can be called by any simulation in the Navy Continuous Training Environment (NCTE). - Develop Fleet Synthetic Training which provides integrated live, virtual, and constructive single or multi-ship exercises in support of Ballistic Missile Defense (BMD). ***FY 2020 OCO Plans:*** N/A ***FY 2019 to FY 2020 Increase/Decrease Statement:*** Increase between FY19 and FY20 enhances advance technology to support Ballistic Missile Defense Fleet Synthetic Training which provides integrated live, virtual, and constructive single or multi-ship exercises.					
Accomplishments/Planned Programs Subtotals	0.243	0.266	0.283	0.000	0.283

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

The included technology developments are primarily in-house with contractor participation through existing vehicles.

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 3207 / *Fleet Synthetic Training*

E. Performance Metrics

1) The Navy will produce meteorological and oceanographic environmental databases for all NCTE exercise areas. Will implement, test, and integrate with Joint Semi Automated Forces (JSAF) and other federates in accordance with requirements.

2) The Navy will complete data and architecture integration, including information assurance compliance for provision of synthetic meteorological and oceanographic data to the NCTE. Data and products will be available via Naval Oceanography Command Portal (NEP-Oc), DVD and/or Machine-to-Machine (M2M) during planning and execution of FST events.

3) The Navy will produce products based on synthetic ocean environment and synthetic satellite/radar imagery based on meteorological environmental data for all NCTE exercise areas. Products are utilized in planning and execution of FST events.

Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy			Date: March 2019
Appropriation/Budget Activity 1319 / 4	R-1 Program Element (Number/Name) PE 0603207N / *Air/Ocean Tactical Applications*	Project (Number/Name) 3207 / *Fleet Synthetic Training*	

Support ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Development Support	WR	AER : VA	0.558	0.083	Jan 2018	0.000		0.106	Jan 2020	-		0.106	Continuing	Continuing	Continuing
Software Development	WR	AER : VA	0.212	0.031	Jan 2018	0.000		0.053	Jan 2020	-		0.053	Continuing	Continuing	Continuing
Configuration Management	WR	AER : VA	0.369	0.039	Jan 2018	0.000		0.043	Apr 2020	-		0.043	0.000	0.451	-
Studies and Analysis	WR	AER : VA	0.469	0.039	Apr 2018	0.000		0.043	Jan 2020	-		0.043	0.000	0.551	-
Award Fees	WR	NAWC TSD (Orlando, FL) : FL	0.093	0.012	Jan 2018	0.000		0.017	Jan 2020	-		0.017	0.000	0.122	-
Technical Data	WR	N/A : N/A	0.119	0.000		0.000		0.000		-		0.000	0.000	0.119	-
		Subtotal	1.820	0.204		0.000		0.262		-		0.262	Continuing	Continuing	N/A

Test and Evaluation ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Operational Test & Evaluation	WR	AER : VA	0.321	0.000		0.000		0.000		-		0.000	0.000	0.321	-
Development Test and Evaluation	WR	AER : VA	0.258	0.039	Jan 2018	0.266	Jan 2019	0.021	Jan 2020	-		0.021	0.000	0.584	-
		Subtotal	0.579	0.039		0.266		0.021		-		0.021	0.000	0.905	N/A

	Prior Years	FY 2018		FY 2019		FY 2020 Base		FY 2020 OCO		FY 2020 Total	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals	2.399	0.243		0.266		0.283		-		0.283	Continuing	Continuing	N/A

Remarks

Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 3207 / *Fleet Synthetic Training*

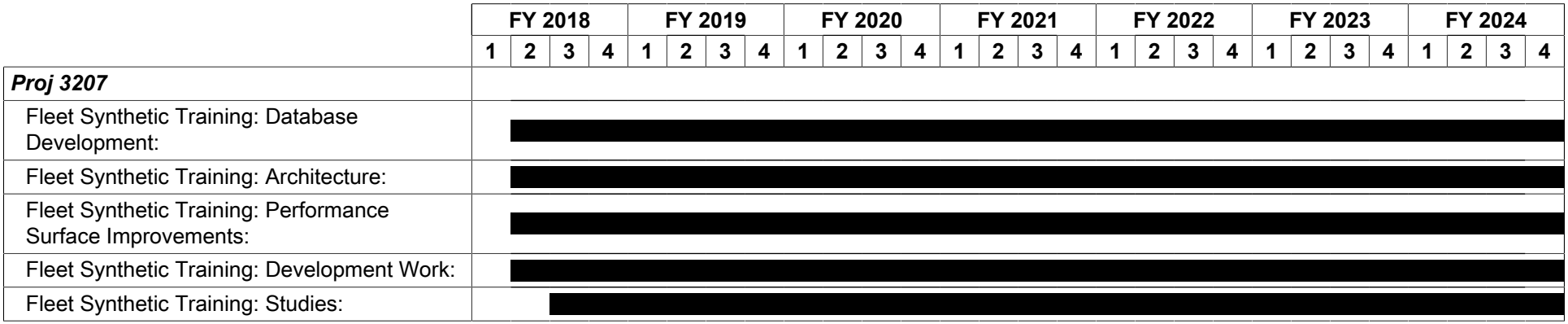


Exhibit R-4A, RDT&E Schedule Details: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 3207 / *Fleet Synthetic Training*

Schedule Details

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
Proj 3207				
Fleet Synthetic Training: Database Development:	2	2018	4	2024
Fleet Synthetic Training: Architecture:	2	2018	4	2024
Fleet Synthetic Training: Performance Surface Improvements:	2	2018	4	2024
Fleet Synthetic Training: Development Work:	2	2018	4	2024
Fleet Synthetic Training: Studies:	3	2018	4	2024

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy			Date: March 2019
Appropriation/Budget Activity 1319 / 4	R-1 Program Element (Number/Name) PE 0603207N / *Air/Ocean Tactical Applications*	Project (Number/Name) 3404 / *Tactical Environmental Support*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
3404: *Tactical Environmental Support*	0.000	0.315	2.595	2.619	-	2.619	2.643	2.672	2.684	2.738	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

The Tactical Environmental Support Project (3404) enables the future warfighter to leverage environmental data gathered, assimilated and predicted under Projects 2341 (METOC Collections) and 2342 (METOC processing) by incorporating them into warfighting technological, net-centric applications that shape the way in which commanders engage the enemy, take full advantage of environmental conditions (and their impacts on systems and sensors) and complete the mission in the most efficient manner feasible. These software decision support tools complement the capabilities found in the Naval Integrated Tactical Environmental System Next Generation (NITES-Next) Program of Record, and provide platform, sensor, communications, and weapon systems performance assessments for littoral and deep-strike warfighters. The following warfighting disciplines benefit directly from these METOC Exploitation capabilities: (1) Undersea Warfare (USW), Anti-Submarine Warfare (ASW), Mine Warfare (MIW), Amphibious Warfare (AMW), Anti-Surface Warfare (ASUW), Anti-Air Warfare, (AAW), Strike Warfare (STW), Expeditionary Warfare (EXW), Electronic Warfare (EW), Information Operations (IO), Intelligence Operations (INT), Non-Combat Operations (NCO), Command, Control, Communication (CCC), and Naval Special Warfare (NSW).

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Title: Tactical Environmental Support	0.315	2.595	2.619	0.000	2.619
Articles:	-	-	-	-	-
Description: The Tactical Environmental Support Project (3404) enables the future warfighter to leverage environmental data gathered, assimilated and predicted under Projects 2341 (METOC Collections) and 2342 (METOC processing) by incorporating them into warfighting technological, net-centric applications that shape the way in which commanders engage the enemy, take full advantage of environmental conditions (and their impacts on systems and sensors) and complete the mission in the most efficient manner feasible. These software decision support tools complement the capabilities found in the Naval Integrated Tactical Environmental System Next Generation (NITES-Next) POR, and provide platform, sensor, communications, and weapon systems performance assessments for littoral and deep-strike warfighters. The following warfighting disciplines benefit directly from these METOC Exploitation capabilities (1) Undersea Warfare (USW), Anti-Submarine Warfare (ASW), Mine Warfare (MIW), Amphibious Warfare (AMW), Anti-Surface Warfare (ASUW), Anti-Air Warfare, (AAW), Strike Warfare (STW), Expeditionary Warfare (EXW), Electronic Warfare (EW), Information Operations (IO), Intelligence Operations (INT), Non-Combat Operations					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 3404 / *Tactical Environmental Support*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
(NCO), Command, Control, Communication (CCC), and Naval Special Warfare (NSW). Accomplishments and plans described below are examples for each effort category. ***FY 2019 Plans:*** - Complete: Provide a new ashore (reach back) radar/radio frequency (RF) and electro-optical (EO) performance products system that is modular, extensible, and high fidelity environmental model-driven that can serve as a replacement for the current tactical decision aids (TDAs) for RF: AREPS (Advanced Refractive Effects Prediction System), and EO: TAWS (Target Acquisition Weapons Software). - Continue: Improve Builder software to include Bragg Line analysis, upgrades to the Ionospheric model and upgrades to output metadata. - Complete: Enhance TrueView/Builder to maximize impact on and relevance to Navy and Marine Corps operations; make it fully compatible with Navy and Marine Corps operational computer systems and networks. - Complete: Leverage The Scalable Tactical Acoustic Propagation Loss Engine (STAPLE) Transitions project to support on-going transition of OAML model and database improvements into STAPLE in order to provide a common core element to a large number of Fleet ASW tactical and high fidelity training systems. - Complete: Improve Parabolic Equation (PE) modeling of passive sonar performance modeling within the TOPSIDE mission planner for regional ASW modeling; improve the physics and utility of the RAM/Seahawk model to extend to higher frequencies. - Complete: Evaluate and develop algorithms that leverage optical remote sensing data from Sentinel-3A, JPSS-1 VIIRS, Sentinel-3B and work toward transition of algorithms. - Complete: Improve the Naval Research Laboratory Atmospheric Acoustic Propagation (NRLAAP) system by developing new multi-vehicle simulation capabilities, incorporating the effects of propagation and ambient noise uncertainty/variability into probability of detection calculations, and improving the efficiency of the model calculations by incorporating advances from the NRL base program "Atmospheric environmental acoustic features for reduction of performance prediction time". - Complete: Work toward EPMA improvements, including: (1) New services to modernize MIW databases for imagery; (2) Refresh of environmental workflows for Bathymetry, Salinity, Temperature, Optics, and Currents; (3) Integration with new Mine Contact Database; (4) Define requirements for integration with Net-Centric Sensor Analysis for Mine Warfare (NSAM), PMS-495, NSWC-PCD; (5) Demonstrate interoperability with latest NSAM service architecture. - Complete: Provide automated mission-relevant water sampling plans with joint optimization of varied observing systems: gliders, profiling floats, shipboard, satellite, buoy, air-deployed, etc.					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 3404 / *Tactical Environmental Support*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
- Complete: Improvement and validation of the Navy Surface Layer Atmospheric Model (NAVSLaM), based on evaluation of recent applied research results and the availability of experimental datasets and produce a sample near-surface Cn2 (turbulence) climatology database for evaluation purposes. - Initiate: Leverage lessons learned from NAVSLaM to create a holistic approach to atmospheric boundary larger turbulence observation, data-basing and modeling, as they pertains to Navy tactical problems. - Initiate: Enhancements to newly fielded RF and EO capability that incorporates Fleet user feedback and tactical lessons learned. - Initiate: Explore synergies with other DoD ocean observation system initiatives in order to rapidly advance and scale-up Navy ocean observation systems, data exfiltration, data assimilation and forward modeling capabilities. - Initiate: Fully explore artificial intelligence (AI) and machine learning aspects of EPMA, to include optimization within private cloud and "big data analytics" architectures. Incorporate "mirrored" test and evaluation computational environments when fielding new EPMA capabilities. - Initiate: Develop technologies that will improve NAVAIR's ability to quickly integrate newly developed NRLAAP capabilities. - Initiate: Explore options in terms of long-term, state-of-the-art maintenance of and improvements to PE and ASW modeling. - Initiate: Explore means of integrating STAPLE with newly developed cloud-based OAML software distribution capability. - Initiate: Make additional modifications to TrueView/Builder in order to meet new Fleet operational and Cyber requirements in an agile manner. - Initiate: Leverage lessons learned from remote sensing data algorithms for use in SmallSats and other newly emerging remote sensing technologies. ***FY 2020 Base Plans:*** In FY 2020 Tactical Environment Support will focus on the Improving the Builder software to include Bragg Line analysis, upgrades to the Ionospheric model and upgrades to output metadata. Leverage lessons learned from NAVSLaM to create a holistic approach to atmospheric boundary larger turbulence observation, data-basing and modeling, as they pertain to Navy tactical problems. Enhancements to newly fielded RF and EO capability that incorporates Fleet user feedback and tactical lessons learned. Explore synergies with other DoD ocean observation system initiatives in order to rapidly advance and scale-up Navy ocean observation systems, data exfiltration, data assimilation and forward modeling capabilities. Fully explore artificial intelligence (AI) and machine learning aspects of EPMA, to include optimization within private cloud and "big data analytics"					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 3404 / *Tactical Environmental Support*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
architectures. Incorporate "mirrored" test and evaluation computational environments when fielding new EPMA capabilities. Develop technologies that will improve NAVAIR's ability to quickly integrate newly developed NRLAAP capabilities. Explore options in terms of long-term, state-of-the-art maintenance of and improvements to PE and ASW modeling. Explore means of integrating STAPLE with newly developed cloud-based OAML software distribution capability. Make additional modifications to TrueView/Builder in order to meet new Fleet operational and Cyber requirements in an agile manner. Leverage lessons learned from remote sensing data algorithms for use in SmallSats and other newly emerging remote sensing technologies. Develop and transition 4D performance surfaces and optimized suite of analyses and forecasts to identify hazardous weather and EM propagation forecasts along Triton UAS flight paths. Sensible weather variables that affect Triton and will be developed include cloud-free line-of-sight, improved turbulence probability, convection and lightning hazard probability, improved flight level winds, and cross-winds at the air base for both takeoff and landing. Algorithms for more physically-based turbulence diagnosis will be developed, along with improve cloud microphysics capable of representing convection and lightning hazards. EM propagation routines will be developed to forecast probability of red detection areas (Priority T-1a, E-1c, and RTP Topic 5). Routines to forecast cloud-free line-of-sight will be developed to forecast EO/IR sensor effectiveness. Integrate Oceanographic and Atmospheric Model Library (OAML) model and database updates into the Scalable Tactical Acoustic Propagation Loss Engine (STAPLE) baseline. Work with the Sensor Optimization Working Group (SOWG) on suitability of OAML updates for Fleet implementation. Provide STAPLE update coordination. Maintain STAPLE configuration management and documentation Incorporate the latest in 6.1/6.2 research into the Navy's operational low-frequency passive acoustic models, Navy Standard Parabolic Equation (NSPE) and Uncertainty Band (uBand). Upgrades to NSPE include ice-					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 3404 / *Tactical Environmental Support*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
covered sea surface elastic effects and a new variable depth grid finite-difference algorithm. Upgrades to uBand include cumulative uncertainty effects, a new input front-end, and several new surface duct treatment algorithms. Modifications to ray path calculations of GRAB-3D for vertical wall scenarios; convert the existing mathematical model to the proposed numerical model accounting for source bearing launch versus target bearing receiving angles; compute the acoustic pressure on a wave at the current source bearing launch angles with Caustic correction; refine/validate CASS-3D with MODSS SDSNE dataset (obtained in Phase I Base); convert validated FORTRAN model to C++ and multi-thread. 6) Develop and document an OAML Submission Plan (OSP), file an ECP, and submit CASS-3D to OAML to begin the approval process Develop techniques to conduct near real-time RF channel estimation using distributed EW/IO receivers in combination with Blue Force emitters of opportunity, and an efficient operator interface and display for interpreting the complex and rapidly changing urface EW environment. PCAP will develop a system that combines previously-developed elements, namely Refractivty Data Fusion (RDF) and Refractivity from Radio (RFR), and makes the information available to an operator in real-time. implement Variable Resolution (VR) BAGs into its survey and production workflow, which will require the development of tools for the exploitation of this new structure. The goal of this effort will be to provide this capability and toolset to NAVOCEANO. The Naval Research Laboratory's (NRL) effort will include the determination of the best approach for design/development of the tools, develop the tools, coordinate appropriate demonstrations to all required parties, and to provide software documentation to the customer. Improve the accuracy of Tactical Decision Aide (TDA) acoustic performance calculations in support of surface ship operations by reconciling Fleet sonar data with the OAML models and databases. Conversely, the Fleet data will be used to validate and upgrade the OAML models and databases. The objective of the effort is to improve the predicted performance of tactical weapon systems by measuring key environmental parameters in the battle space with tactical sensors. This is to be accomplished through the development, demonstration, and transition of new Through-the-Sensor data collection, extraction, processing, and dissemination techniques. System specifications to extract environmental data from tactical warfare sensors for use in on-scene decision aids will be developed. Sensors will include acoustic, oceanographic, and atmospheric environmental sensors. Data transformation goals include environmental data acquisition using					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 3404 / *Tactical Environmental Support*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
advanced data processing techniques and rapid information dissemination capabilities. Data dissemination goals include integrating and exposing sensor data across Navy enclaves. Improve accuracy and efficacy of clutter extraction algorithms and processes utilized in the creation of Clutter databases for NAVO. Process currently utilizes AN/SQQ-89(A) recorded data. This task would also explore feasibility of future real time clutter extraction. Geospatially derived acoustic ground analysis has been shown to yield high correlation with acoustic signal excess range predictions generated from physics-based Transmission-Loss (TL) models. We propose to provide a high-performance tool implementing a promising method by which the integration of empirical geospatial acoustic high/low ground analysis may be used to optimized traditional physics-based sensor performance predictions. These optimizations range from narrowing choices on frequency performance, sensor performance, and range within which TL is computed. The goal of this proposed effort is to improve the accuracy and expand the capabilities of models, algorithms and databases that characterize atmospheric impacts on electromagnetic and electro-optical (EM/EO) sensors, weapons, EW/ES and communications systems. Ultimately, this effort will directly help in providing U.S. warfighters with enhanced battlespace awareness to optimize Electromagnetic Maneuver Warfare (EMW) decision making and planning for the current or predicted environmental conditions. These NPS-developed models, algorithms and databases (including NAVSLaM, EDC, UADC, VRPBA, RSMA-ED, Upper-Air Cn2 models, Cn2 climatology and others) will be submitted to the CNMOC Oceanic and Atmospheric Master Library (OAML) in order to make fully tested, validated, documented and accredited products available "off the shelf" to U.S. DoD researchers and developers of EM/EO prediction TDAs and systems when and as needed. These NPS products are also disseminated to a multitude of U.S. DoD agencies and researchers prior to submission to OAML for research, development, testing and evaluation purposes. Optimize placement of unmanned oceanographic sensors for assimilation into numerical forecasts using technologies such as Guidence for Heterogeneous Observing SysTems (GHOST) developed and maintained by NRL 7300. Optimally integrate the sensor/vehicle allocation, model performance optimization, situational awareness and overall mission planning tasks into capabilities that can be transitioned to the Glider Operations center at NAVOCEANO for use with GHOST guidance. In addition, couple functionality with TOPSIDE software such that the tactical analyst can receive authoritative environmental information to inform operational decisions and to visualize mission definition input as well as platform instruction output from GHOST.					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 3404 / *Tactical Environmental Support*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
work towards transitioning a new probabilistic aerosol forecasting system, ensemble Navy Aerosol Analysis Prediction System (ENAAPS), to operations. ENAAPS was previously ported to the Navy DoD Supercomputing Resource Center (DSRC) computers and developed as a near-real-time (NRT) system run using Cylc with evaluation of the ensemble mean forecast. In the proposed work, new metrics will be developed for evaluating ensemble spread and used to evaluate the NRT 5 day forecasts, bias correction code for post-processing of the ensemble mean forecast will be added to the NRT system, and new probabilistic aerosol products will be developed. ***FY 2020 OCO Plans:*** N/A ***FY 2019 to FY 2020 Increase/Decrease Statement:*** There is not significant change from FY2019 to FY2020.					
Accomplishments/Planned Programs Subtotals	0.315	2.595	2.619	0.000	2.619

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Acquisition, management and contracting strategies are to support the Tactical Environmental Support Project to develop, demonstrate and validate products and decision aids to understand and predict the impact of the environment on military operations.

E. Performance Metrics

Goal: Develop techniques and tools to transform traditional METOC predicted variables into more directly tactially relevant variables, and allow METOC personnel and others to understand the impact of the environment on sensors, communications, and weapons. Focus areas include, but are not limited to, electromagnetic maneuver warfare, electro-optical impacts (of environment on sensors and weapons systems), and anstisubmarine warfare. Metric -- Tasks will address no less than 75% of applicable capability gaps and requirements.

Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 3404 / *Tactical Environmental Support*

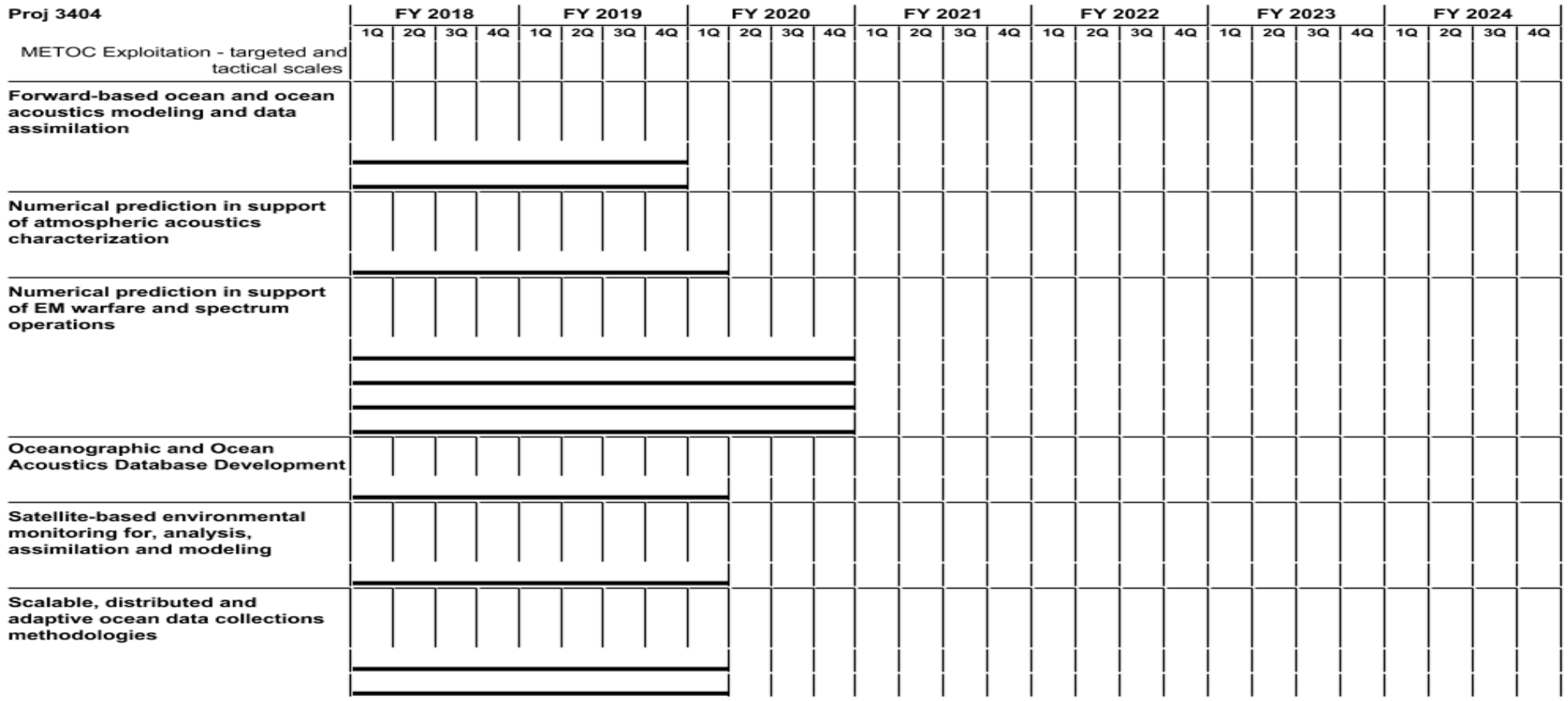
Product Development ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
METOC Tactical Environmental Support	WR	NRL : Washington, DC	0.000	0.133	Nov 2017	2.283	Nov 2018	1.319	Nov 2019	-		1.319	0.000	3.735	-
METOC Tactical Environmental Support	WR	NRL : Monterey, CD Stennis Space Center,MS	0.000	0.182	Nov 2017	0.312	Nov 2018	1.300	Nov 2019	-		1.300	Continuing	Continuing	Continuing
METOC Tactical Environmental Support-Staple Transitions	WR	NSWC Carderock : West Bethesda, MD	0.000	0.000	Nov 2017	0.000		0.000		-		0.000	2.500	2.500	-
METOC Tactical Environmental Support	C/FFP	Various : Various	0.000	0.000	Nov 2017	0.000		0.000		-		0.000	0.075	0.075	-
		Subtotal	0.000	0.315		2.595		2.619		-		2.619	Continuing	Continuing	N/A

	Prior Years	FY 2018		FY 2019		FY 2020 Base		FY 2020 OCO		FY 2020 Total	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals	0.000	0.315		2.595		2.619		-		2.619	Continuing	Continuing	N/A

Remarks

Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 3404 / *Tactical Environmental Support*



2020DON - 0603207N - 3404

Exhibit R-4A, RDT&E Schedule Details: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 3404 / *Tactical Environmental Support*

Schedule Details

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
Proj 3404				
Forward-based ocean and ocean acoustics modeling and data assimilation: STAPLE Transitions -- NSWCCD	1	2018	4	2019
Forward-based ocean and ocean acoustics modeling and data assimilation: TOPSIDE Acoustics Support / Sonar Performance Engine (SPE)/ RAM-Seahawk Upgrade 1.1 (was FY17-TES-09-N) -- OASIS, Inc.	1	2018	4	2019
Numerical prediction in support of atmospheric acoustics characterization: Atmospheric Acoustic Propagation (AAP) -- NRL-MRY	1	2018	1	2020
Numerical prediction in support of EM warfare and spectrum operations: RTP: Electromagnetic Spectrum Performance Products Ashore -- NRL-MRY / NRL-DC / SSC-PAC	1	2018	4	2020
Numerical prediction in support of EM warfare and spectrum operations: Improved Atmospheric Models for Electromagnetic Maneuver Warfare -- NPS	1	2018	4	2020
Numerical prediction in support of EM warfare and spectrum operations: Navy Electro-Optical Sensor Performance Prediction -- NRL-MRY	1	2018	4	2020
Numerical prediction in support of EM warfare and spectrum operations: NEOSPP and EMSPPA and SSCPAC Code 55280 TrueView team efforts -- SSC-PAC	1	2018	4	2020
Oceanographic and Ocean Acoustics Database Development: Environmental Post-Mission Analysis - TTS ocean and atmosphere data collection -- NRL-SSC	1	2018	1	2020
Satellite-based environmental monitoring for, analysis, assimilation and modeling: Preparing Tactical Optical Ocean Products from Satellite Sensors -- NRL-SSC	1	2018	1	2020
Scalable, distributed and adaptive ocean data collections methodologies: CAST: Cooperative Autonomous Sensing Team -- APL-UW	1	2018	1	2020
Scalable, distributed and adaptive ocean data collections methodologies: Guidance for Heterogeneous Observation Systems (GHOST) -- NRL-SSC	1	2018	1	2020

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy			Date: March 2019
Appropriation/Budget Activity 1319 / 4	R-1 Program Element (Number/Name) PE 0603207N / *Air/Ocean Tactical Applications*	Project (Number/Name) 3405 / *Decision Support Products & Dissemination*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
3405: *Decision Support Products & Dissemination*	0.000	0.315	1.094	1.117	-	1.117	1.144	1.171	1.186	1.210	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

Decision Support Products & Dissemination efforts enable the future warfighter to leverage environmental data gathered, assimilated, predicted and exploited by optimizing data formatting, compression, packaging, depiction, data-basing and transfer methodologies that permit the rapid dissemination of actionable battlespace environmental (METOC) information over tactical and reach-back networks. This project ensures warfighters, commanders and those who support them are fully synchronized in terms of environmental data products shared among a multitude of platforms, systems and common operating pictures (COPs). METOC information is highly dynamic. Just as time synchronization is essential to navigation principles, timely METOC knowledge and information are vital to battlespace environmental exploitation, placing the warfighter and support elements in spatial and temporal synchronization, and at a collective advantage, in terms of the current and predicted states of the ocean and atmosphere.

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Title: Decision Support Products & Dissemination	0.315	1.094	1.117	0.000	1.117
Articles:	-	-	-	-	-
Description: The Decision Support Products and Dissemination Project (3405) enables the future warfighter to leverage environmental data gathered, assimilated, predicted and exploited under Projects 2341 (METOC Collections), 2342 (METOC processing) and 3404 (METOC exploitation) by optimizing data formatting, compression, packaging, depiction, data-basing and transfer methodologies that permit the rapid dissemination of actionable battlespace environmental (METOC) information over tactical and reach-back networks. This project ensures warfighters, commanders and those who support them are fully synchronized in terms of environmental data products shared among a multitude of platforms, systems and common operating pictures (COPs). METOC information is highly dynamic. Just as time synchronization is essential to navigation principles, timely METOC knowledge and information synchronization is vital to battlespace environmental exploitation, placing the warfighter and all of those who support him on the "same sheet of music" and at a collective advantage, in terms of the current and predicted states of the ocean and atmosphere. Accomplishments and plans described below are examples for each effort category. ***FY 2019 Plans:***					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 3405 / *Decision Support Products & Dissemination*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
- Continue: Evaluate global ocean analyses and forecasts from different national/international centers, with respect to both hydrographic and acoustic properties. - Continue: Develop ship routing and base preparedness algorithms so that they can be employed on the following systems: the Automated Tropical Cyclone Forecast System (ATCF), the Joint METOC Viewer (JMV), and the Advanced Weather Interactive Processing System Version II (AWIPS II). - Complete: Provide acoustically consistent oceanographic confidence estimates based on current continuous ocean model/data comparisons for the Navy's operational ocean and acoustics communities. - Complete: Mature the Advanced Air ASW Planning abs Evaluation Tool (A3PET) capabilities already demonstrated in the prototype; provide an intuitive, interactive user interface, and provide a service application programming interface (API) for potential programmatic use by backend components in the future. - Initiate: Explore the use of oceanographic confidence estimates derived from model/data comparisons to improve Navy ocean and acoustic models and tactical decision aids. - Initiate: Leverage lessons learned from ocean analysis and forecast evaluations in order to improve databases, data assimilation techniques and ocean and acoustic models in a more synergistic way. - Initiate: Leverage lessons learned from A3PET to create a holistic approach to real-time ASW mission planning and re-tasking by exploring machine learning, high-performance computing, cloud computing and "big data analytics" aspects of the ASW mission planning and associated ocean environment problem.					
FY 2020 Base Plans: Evaluate global ocean analyses and forecasts from different national/international centers, with respect to both hydrographic and acoustic properties. Complete Develop ship routing and base preparedness algorithms so that they can be employed on the following systems the Automated Tropical Cyclone Forecast System (ATCF), the Joint METOC Viewer (JMV), and the Advanced Weather Interactive Processing System Version II (AWIPS II). Explore the use of oceanographic confidence estimates derived from model/data comparisons to improve Navy ocean and acoustic models and tactical decision aids. Initiate Leverage lessons learned from ocean analysis and forecast evaluations in order to improve databases, data assimilation techniques and ocean and acoustic models in a more synergistic way.					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 3405 / *Decision Support Products & Dissemination*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Leverage lessons learned from A3PET to create a holistic approach to realtime ASW mission planning and retasking by exploring machine learning, highperformance computing, cloud computing and "big data analytics" aspects of the ASW mission planning and associated ocean environment problem. Develop a divisionwide system for verification and validation that includes access to statistics for model runs by authorized external users. By leveraging community based tools, we can build a unified verification framework which is consistent across the suite of models and also consistent with our operational partners. Such a framework would allow us to make use of more modern, feature based verification metrics that can assist with identification and diagnosis of specific sources of model error. In addition, this modern framework would allow NRL to better tailor our verification products to inform data assimilation and model development, as well as the needs of the end user. Finally, a consistent model verification framework would aid in collaboration with other U.S. partners (e.g. NCEP, JEDI) who are employing the same community tools. The goal of this project is to create a framework and supporting technologies that will enable sharing and coordination of METOC data across multiple providers, enclaves, and domains. This includes creating a realtime master index of all model output products across multiple providers and domains, a grid generalization system that is able to pull and transform gridded model outputs from multiple sources, and a modular dissemination system that will support a wide variety of METOC data consumers. Each of these components can exist and operate at multiple nodes across agencies and network domains. extend the Adaptive Air ASW Planning and Evaluation Tool (A3PET) realtime ASW missionplanning tool to incorporate critical capabilities request by Fleet Users. This effort will develop additional capability to the existing tool, including modeling of Active Sonobuoys, modeling buoy drift and buoy deployment latency, as well as adding in overlay import/export functionality for more efficient MPRA mission planning. This effort extends the A3PET MPRA mission planning tool capability delivered in FY18.migrate the OAML library, administrative, and management functions to a cloud based approach. This will provide more efficient maintenance and distribution of the databases, algorithms and models. It will also provide better compatibility with future programs.Implement wind probabilities for Southern Hemisphere, SMOS winds and fixes, RI aid upgrades or consensus upgraded into ATCF; Evaluation of FNMOC version of WAVEWATCH ensemble based on JTWC forecasts.Apply and develop machine learning methods to modeling efforts to help identify model environments and scenarios that help validate the model against measured acoustics and/or reconstruct active acoustic events. ***FY 2020 OCO Plans:***					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 3405 / *Decision Support Products & Dissemination*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
N/A ***FY 2019 to FY 2020 Increase/Decrease Statement:*** There is no significant change from FY2019 to FY2020.					
Accomplishments/Planned Programs Subtotals	0.315	1.094	1.117	0.000	1.117

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Acquisition, management and contracting strategies are to support the Decision Support Products & Dissemination Project to develop, demonstrate and validate products and decision aids to provide environmentally based recommendations to commanders at the Strategic, Operational, and Tactical levels of military operations.

E. Performance Metrics

Goal: Develop techniques and tools to provide tactially relevant METOC based advice to military commanders. Focus areas include, but are not limited to, electromagnetic maneuver warfare, electro-optical impacts (of environment on sensors and weapons systems), and anstisubmarine warfare. Metric -- Tasks will address no less than 75% of applicable capability gaps and requirements.

Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy			Date: March 2019
Appropriation/Budget Activity 1319 / 4	R-1 Program Element (Number/Name) PE 0603207N / *Air/Ocean Tactical Applications*	Project (Number/Name) 3405 / *Decision Support Products & Dissemination*	

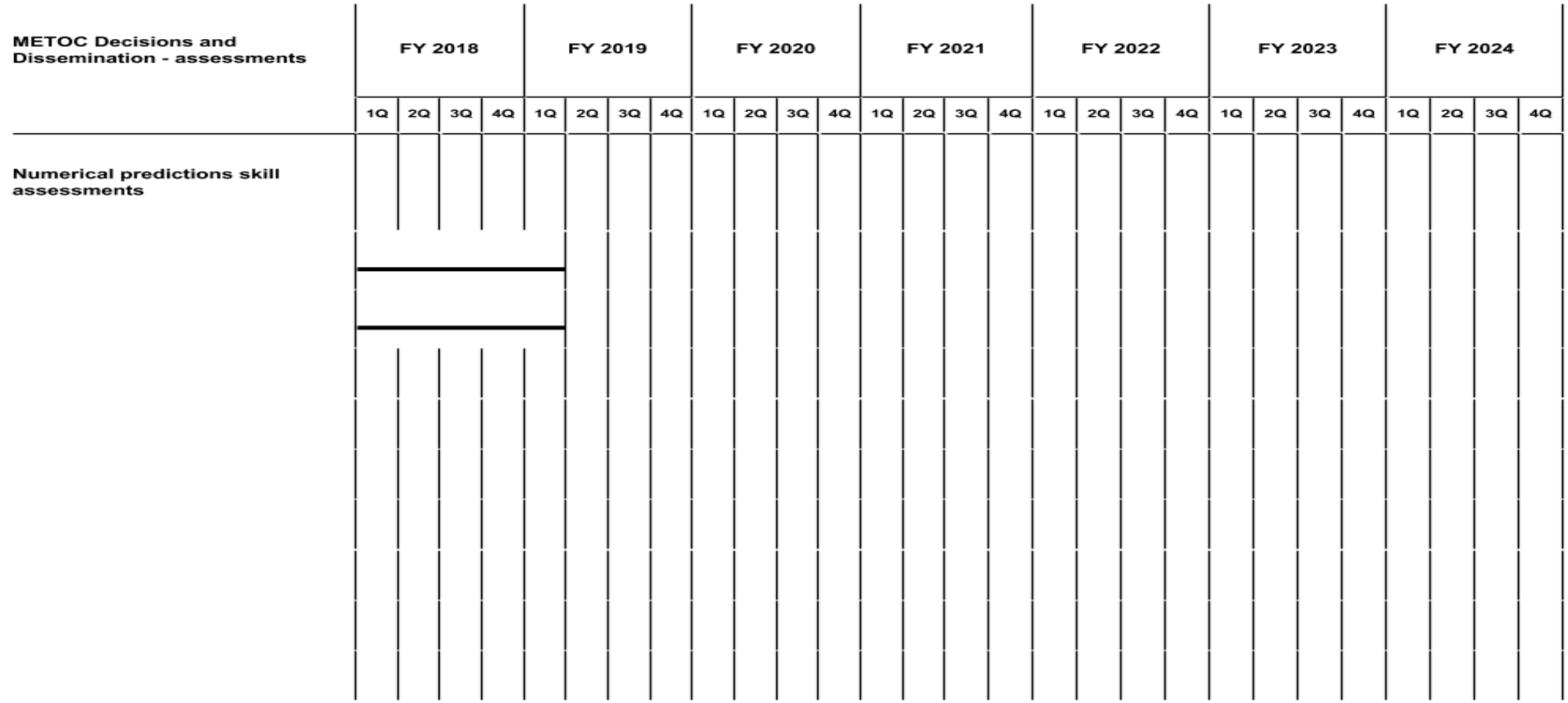
Support ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
METOC Tactical Environmental Support	WR	NRL : Washington DC	0.000	0.111	Nov 2017	0.232	Nov 2018	0.500	Nov 2019	-		0.500	0.000	0.843	-
METOC Tactical Environmental Support	WR	NRL : Monterey, CA; Dtennis Space Center, MS	0.000	0.100	Nov 2017	0.100	Nov 2018	0.117	Nov 2019	-		0.117	Continuing	Continuing	Continuing
METOC Tactical Environmental Support	C/FFP	Various : Various	0.000	0.104	Nov 2017	0.762	Nov 2018	0.500	Nov 2019	-		0.500	0.000	1.366	-
		Subtotal	0.000	0.315		1.094		1.117		-		1.117	Continuing	Continuing	N/A

	Prior Years	FY 2018		FY 2019		FY 2020 Base		FY 2020 OCO		FY 2020 Total	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals	0.000	0.315		1.094		1.117		-		1.117	Continuing	Continuing	N/A

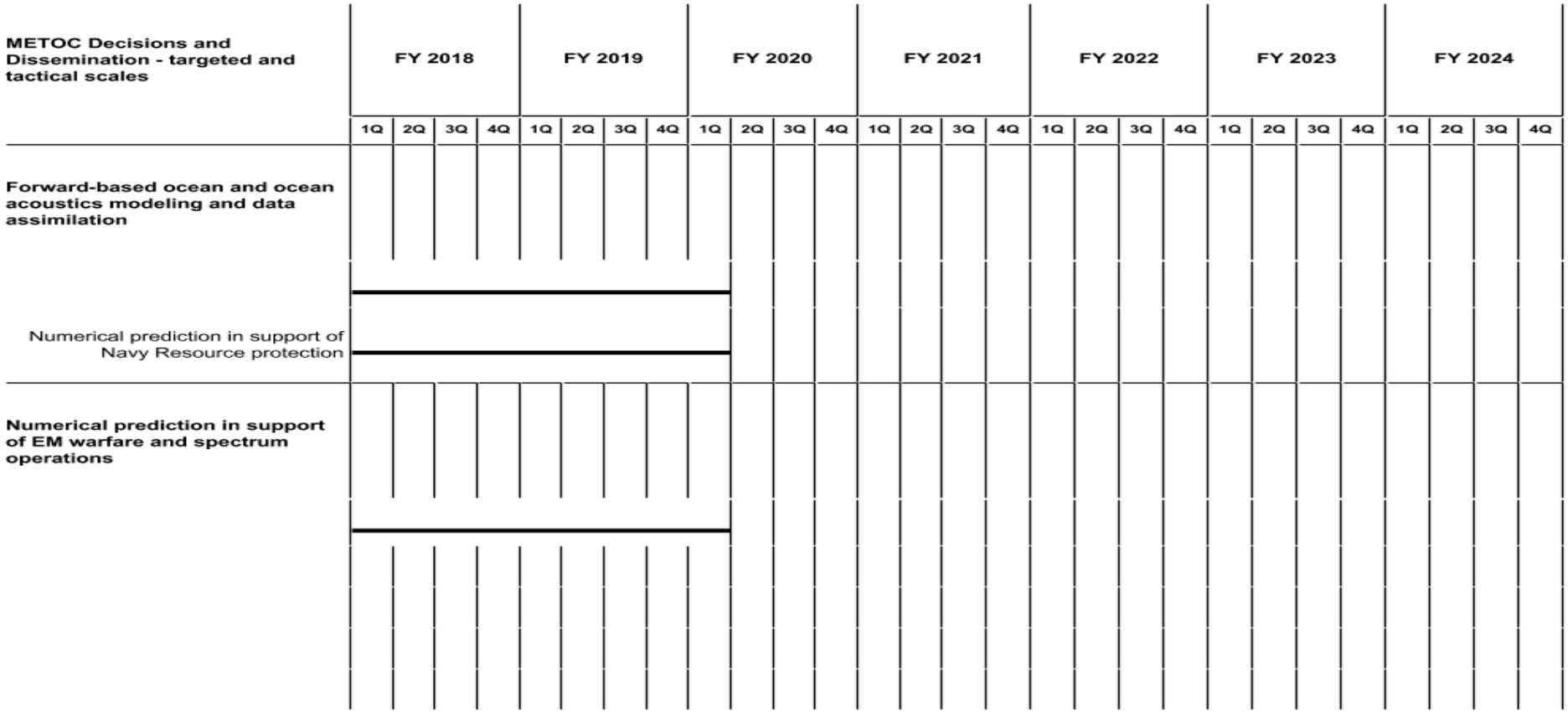
Remarks

Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 3405 / *Decision Support Products & Dissemination*



2020DON - 0603207N - 3405

Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 3405 / *Decision Support Products & Dissemination*



2020DON - 0603207N - 3405

Exhibit R-4A, RDT&E Schedule Details: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603207N / *Air/Ocean Tactical Applications*	**Project (Number/Name)** 3405 / *Decision Support Products & Dissemination*

Schedule Details

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
METOC Decisions and Dissemination - assessments				
Numerical predictions skill assessments: Global Ocean Multi-Model Comparison -- NRL-SSC	1	2018	1	2019
Numerical predictions skill assessments: Ocean model performance indicators for operational Navy ocean and acoustic model assessment -- NRL-SSC	1	2018	1	2019
METOC Decisions and Dissemination - targeted and tactical scales				
Forward-based ocean and ocean acoustics modeling and data assimilation: Adaptive Air ASW Planning and Evaluation Tool	1	2018	1	2020
Forward-based ocean and ocean acoustics modeling and data assimilation: Numerical prediction in support of Navy Resource protection: ship routing and base preparedness algorithms	1	2018	1	2020
Numerical prediction in support of EM warfare and spectrum operations: Environmental Performance Surfaces for OTH Radars and HF Communications (AKA, Pearman OTH RADAR Exploitation) -- NRL-SSC	1	2018	1	2020