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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Air Force **Date:** February 2020

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 4: Advanced Component Development & Prototypes (ACD&P)</i>	R-1 Program Element (Number/Name) PE 0604002F / <i>Air Force Weather Services Research</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	0.000	0.772	0.869	0.000	0.869	1.000	0.803	0.831	0.846	0.000	5.121
643560: <i>AF Weather Services Research</i>	-	0.000	0.772	0.869	0.000	0.869	1.000	0.803	0.831	0.846	0.000	5.121
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

Note
In FY2020, a portion of PE 0305111F, Weather Services, Project 672738 efforts were transferred to PE 0604002F, Air Force Weather Services Research, Project 643560 in order to properly align Advanced Component Development and Prototype activities with the correct funding source.

A. Mission Description and Budget Item Justification

This budget activity funds development necessary to evaluate integrated technologies and models for future operationalization into segments of the Air Force Weather Services (AFWS) in support of the 2018 National Defense Strategy (NDS) lines of effort. To improve readiness for a more lethal force, AFWS provides timely, accurate, resilient and relevant environmental information, to include space and terrestrial weather, for global battlespace situational awareness for Air Force (AF), Army, Special Operations Forces (SOF), combatant commands, and other government agencies. AFWS capabilities at home station and deployed provide critical support to the full spectrum of air and space combat operations. AFWS development enhances the lethality, effectiveness, and survivability of AF weapon systems and precision munitions by modernizing capability and seeking the military advantage to accurately predict friendly and foe environmental impacts to optimize mission execution and planning, targeting, weaponeering, battle damage assessment and space systems operations. To strengthen alliances and partnerships, AFWS development efforts integrate DoD, government agency, and commercial and international partner environmental data with AFWS information system equipment for processing, storing, exploiting and disseminating multi-domain weather information for analysis, forecasting, mission integration and greater interoperability. Funding for AFWS development also ensures greater performance and affordability through improvements to architecture and system efficiency, cybersecurity, joint all-domain command and control (JADC2)/advanced battle management system (ABMS)/sensing grid integration, migration to cloud computing, and expanding agile software development practices.

AFWS aligns activities under four capability areas: Weather Data Collection, Weather Data Analysis and Dissemination, Weather Forecasting, and Product Tailoring/Warfighter Applications. This alignment ensures an integrated and systems-oriented approach to program management decisions. A portion of the Weather Forecasting capability is addressed by APPN 3600, BA 04, PE 0604002F, Project 643560- Air Force Weather Services Research.

1. Weather Forecasting provides advanced scientific numerical weather prediction capabilities for automated, high resolution forecast products for mission planning, rehearsal, and execution. Space weather modeling assists in characterizing and forecasting the near-Earth environment to the sun, and enables space weather anomaly and space weather impact assessments. Weather Forecasting includes activities for Numerical Weather Modeling (NWM); Weather Services - Live, Virtual, Constructive (WS-LVC), and Space Weather Analysis and Forecast System (SWAFS). SWAFS is a software suite of 47 models and applications to ingest, process, and store space environmental data, run space environmental models to specify and forecast the near-earth environment, and run space effects characterization applications.

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This effort is in Budget Activity 4, Advanced Component Development and Prototypes (ACD&P), because efforts are necessary to evaluate integrated technologies, representative modes or prototype systems in a high fidelity and realistic operating environment.

B. Program Change Summary (\$ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	0.000	0.772	0.870	0.000	0.870
Current President's Budget	0.000	0.772	0.869	0.000	0.869
Total Adjustments	0.000	0.000	-0.001	0.000	-0.001
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	0.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	0.000	0.000			
• Other Adjustments	0.000	0.000	-0.001	0.000	-0.001

C. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
Title: Space Weather Analysis and Forecast Radiation Exposure Model (SWAFS-RadEx)	-	0.181	0.000
Description: SWAFS-RadEx (Radiation Exposure) AFRL Analysis of Alternatives (AoA) and modeling to assess high-flyer radiation exposure.			
FY 2020 Plans: In FY2020, a portion of PE 0305111F, Weather Services, Project 672738 efforts were transferred to PE 0604002F, Air Force Weather Services Research, Project 643560 in order to properly align Advanced Component Development and Prototype activities with the correct funding source. -Continue AFRL Analysis of Alternatives (AoA) started under PE0305111F in FY19 for existing RADEX models and begin technology maturation efforts. -Perform and exploit new data ingest of space weather observations. -Rapidly respond to implement system resiliency and situational awareness necessary to operate in the contested space domain. Activities may include, but are not limited to program office support, studies, technical analysis, prototyping, etc.			
FY 2021 Plans: N/A			
FY 2020 to FY 2021 Increase/Decrease Statement:			

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C. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
Funding decreased to \$0 due to the decision to fund higher priority capabilities. Further work on RadEx is expected to be completed through NASA and NOAA. No further funding from PE 0604002F is scheduled at this time.				
<p>Title: Space Weather Analysis and Forecast System (SWAFS) Magnetospheric Energetic Charged Particle Hazard Assessment (SWAFS- ECP HAS)</p> <p>Description: SWAFS-ECP HAS AFRL Analysis of Alternatives (AoA) and modeling to assess Energetic Charged Particle (ECP) conditions throughout the global space environment to enable decision makers to determine cause of satellite anomaly.</p> <p>FY 2020 Plans: In FY2020, a portion of PE 0305111F, Weather Services, Project 672738 efforts were transferred to PE 0604002F, Air Force Weather Services Research, Project 643560 in order to properly align Advanced Component Development and Prototype activities with the correct funding source. -Continue AFRL Analysis of Alternatives (AoA) started under PE0305111F in FY19 for existing ECP HAS models and begin technology maturation efforts. -Continue Magnetic Field Measuring (Magnetometer) AoA. -Perform and exploit new data ingest of space weather observations. -Rapidly respond to implement system resiliency and situational awareness necessary to operate in the contested space domain. Activities may include, but are not limited to program office support, studies, technical analysis, prototyping, etc.</p> <p>FY 2021 Plans: -Continue AFRL AoA for existing ECP HAS models with the Space Environment Anomaly Resolution (SpEAR) tool to support Combined Space Operations Center (CSpOC) and Satellite Operations Squadrons (SOPS). - Collect and exploit new data ingest of space weather observations. - Rapidly respond to implement system resiliency and situational awareness necessary to operate in the contested space domain. Activities may include, but are not limited to, program office support, studies, technical analysis, and prototyping.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding decreased due to allocation of funds to the Scintillation Nowcast Forecast study effort.</p>		-	0.591	0.288
<p>Title: Space Weather Analysis and Forecast System (SWAFS) Scintillation Nowcast and Forecast Technology (SNFT) software upgrade</p> <p>Description: SWAFS SNFT AFRL Analysis of Alternatives (AoA) to upgrade software allowing use of model algorithms that utilize sensor packages on the Constellation Observing System to monitor Meteorology, Ionosphere, and Climate (COSMIC II) to understand space environment conditions affecting satellites and communications.</p> <p>FY 2021 Plans:</p>		-	-	0.581

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C. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
- Begin AFRL AoA for SNFT software. - Collect and exploit new data ingest of space weather observations. - Rapidly respond to implement system resiliency and situational awareness necessary to operate in the contested space domain. Activities may include, but are not limited to, program office support, studies, technical analysis, and prototyping. FY 2020 to FY 2021 Increase/Decrease Statement: Funding increased due to the beginning of SNFT AoA through the AFRL.			
Accomplishments/Planned Programs Subtotals	-	0.772	0.869

D. Other Program Funding Summary (\$ in Millions)											
<u>Line Item</u>	<u>FY 2019</u>	<u>FY 2020</u>	<u>FY 2021</u> <u>Base</u>	<u>FY 2021</u> <u>OCO</u>	<u>FY 2021</u> <u>Total</u>	<u>FY 2022</u>	<u>FY 2023</u>	<u>FY 2024</u>	<u>FY 2025</u>	<u>Cost To Complete</u>	<u>Total Cost</u>
• RDTE 07 0305111F: <i>WEATHER SERVICE</i>	3.621	2.357	2.185	-	2.185	3.035	3.051	3.816	3.022	0.000	21.087

Remarks
0305111F BPAC 672738 3600 funds on Air Force PE located in IDECS.

E. Acquisition Strategy
SWAFS will use individual FAR-based and rapid acquisition contracting methods, as well as AFRL for development works (Technology Readiness Level (TRL) 6 and below) to develop AoA, design solutions, and prototype code.

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Exhibit R-4, RDT&E Schedule Profile: PB 2021 Air Force		Date: February 2020
Appropriation/Budget Activity 3600 / 4	R-1 Program Element (Number/Name) PE 0604002F / Air Force Weather Services Research	Project (Number/Name) 643560 / AF Weather Services Research

FY 2019				FY 2020				FY 2021				FY 2022				FY 2023				FY 2024				FY 2025			
1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4

SWAFS-RadEx	
SWAFS-RadEx Analysis of Alternatives	██████████
SWAFS-ECP HAS	
SWAFS-ECP HAS Analysis of Alternatives	██████████
Scintillation Nowcast	
Forecast Model Update Analysis of Alternatives	██
Solar Wind	
Solar Wind Model Analysis of Alternatives	██

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Exhibit R-4A, RDT&E Schedule Details: PB 2021 Air Force		Date: February 2020
Appropriation/Budget Activity 3600 / 4	R-1 Program Element (Number/Name) PE 0604002F / <i>Air Force Weather Services Research</i>	Project (Number/Name) 643560 / <i>AF Weather Services Research</i>

Schedule Details

Events by Sub Project	Start		End	
	Quarter	Year	Quarter	Year
SWAFS-RadEx				
SWAFS-RadEx Analysis of Alternatives	1	2020	4	2020
SWAFS-ECP HAS				
SWAFS-ECP HAS Analysis of Alternatives	1	2020	4	2020
Scintillation Nowcast				
Forecast Model Update Analysis of Alternatives	1	2021	4	2022
Solar Wind				
Solar Wind Model Analysis of Alternatives	1	2022	4	2024