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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Air Force **Date:** May 2021

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 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	-	0.747	2.234	0.986	0.000	0.986	-	-	-	-	-	-
643560: <i>AF Weather Services Research</i>	-	0.747	2.234	0.986	0.000	0.986	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This budget activity funds the 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's (NDS) three 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), Space Force (USSF), combatant commands, the Intelligence Community (IC), and other government agencies. AFWS capabilities at home station and deployed provide critical environmental intelligence in support of decision makers to gain the asymmetric advantage during 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, weaponing, battle damage assessment, and space systems operations. To strengthen alliances and partnerships, AFWS development efforts integrate Department of Defense (DoD), government agency, 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. To ensure greater performance and affordability for the AF, AFWS systems are being modernized through improvements to architecture and system efficiency, cybersecurity, joint all-domain command and control (JADC2) and 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 (PTWA). This alignment ensures an integrated and systems-oriented approach to program management decisions. A portion of the Weather Forecasting capability is addressed by RDT&E, BA 04, PE 0604002F, Project 643560 - Air Force Weather Services Research. By FY 2023, a portion of the APPN 3600 funding and activities from AF PE 0604002F, Project 643560, Air Force Weather Services Research, will be transferred to the USSF PE 1206402SF, Space Force Weather Services Research, in order to align current AF ground-based space sensing projects within the USSF portfolio.

1. Weather Forecasting provides global and regional advanced scientific numerical weather prediction capabilities for automated, high-resolution forecast products for mission planning 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) 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 program element may include necessary civilian pay expenses required to manage, execute, and deliver weapon system capability. The use of such programs funds would be in addition to the civilian pay expenses budgeted in program element 0605831F. In FY20 \$0M was expended for civilian pay expenses in this program element, and in FY21 \$0M is forecasted for civilian pay expenses in this program element.

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 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Previous President's Budget	0.772	0.869	1.000	0.000	1.000
Current President's Budget	0.747	2.234	0.986	0.000	0.986
Total Adjustments	-0.025	1.365	-0.014	0.000	-0.014
• Congressional General Reductions	0.000	-0.004			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	1.369			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	-0.025	0.000			
• SBIR/STTR Transfer	0.000	0.000			
• Other Adjustments	0.000	0.000	-0.014	0.000	-0.014

Congressional Add Details (\$ in Millions, and Includes General Reductions)

Project: 643560: *AF Weather Services Research*

Congressional Add: *Drought Warning System*

	FY 2020	FY 2021
	0.000	1.369
Congressional Add Subtotals for Project: 643560	0.000	1.369
Congressional Add Totals for all Projects	0.000	1.369

Change Summary Explanation

FY20: \$0.025M reprogrammed at end of FY20 to account for actuals.

FY21: \$0.004M reduction due to undistributed congressional general reduction and \$1.369M program increase due to congressional add for Drought Warning System.

C. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
Title: Space Weather Analysis and Forecast (SWAFS) Radiation Exposure (Rad-Ex) Model	0.181	0.000	0.000

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C. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>Description: SWAFS-RadEx Air Force Research Lab (AFRL) Analysis of Alternatives (AoA) and modeling to assess high-flyer radiation exposure.</p> <p>FY 2021 Plans: N/A</p> <p>FY 2022 Plans: N/A</p>				
<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 AoA and modeling to assess ECP conditions throughout the global space environment to enable decision makers to determine cause of satellite anomaly.</p> <p>FY 2021 Plans:</p> <ul style="list-style-type: none"> - 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). - Continue the AFRL AoA upgraded scintillation 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. - Continue program office and other related support activities that may include, but are not limited to, studies, technical analysis, and prototyping, etc. <p>FY 2022 Plans: N/A</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: FY 2022 decreased compared to FY 2021. Funding decreased due to the completion of the BA 04 RDT&E portion of this effort, RDT&E for this effort will continue with BA 07 Research, Development, Test, and Evaluation (RDT&E) funding from PE 0305111F.</p>		0.566	0.288	0.000
<p>Title: Space Weather Analysis and Forecast System (SWAFS) Scintillation Nowcast and Forecast Technology (SNFT) software upgrade</p> <p>Description: SWAFS SNFT AFRL 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>		-	0.577	0.986

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C. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p>FY 2021 Plans:</p> <ul style="list-style-type: none"> - Begin AFRL AoA for SNFT software. - Collect and exploit new data ingest of space weather observations. - Continue program office and other related support activities that may include, but are not limited to: studies, technical analysis, risk reduction experiments and prototyping, integration and test of command and control (C2) resiliency measures and mission partner interfaces, space test/combat range events, office support, etc. <p>FY 2022 Plans:</p> <ul style="list-style-type: none"> - Continue the AFRL AoA upgraded scintillation software. - Assess the maturity and readiness of scintillation software for integration into the SWAFS cloud environment. - Develop software prototypes based on the previous development of physics-based algorithms to rapidly respond to implement system resiliency and situational awareness necessary to operate in the contested space domain. <p>FY 2021 to FY 2022 Increase/Decrease Statement: FY 2022 increased compared to FY 2021. Funding increased due to increased priority of SNFT work for BA 04 RDT&E funding and increased software development prototyping effort, which is largely focused on the development of the foundational physics algorithms.</p>			
Accomplishments/Planned Programs Subtotals	0.747	0.865	0.986

	FY 2020	FY 2021
<p>Congressional Add: Drought Warning System</p> <p>FY 2020 Accomplishments: N/A</p> <p>FY 2021 Plans: - Review all new Broad Agency Announcement (BAA) white papers and request proposals. - Award 1 to 2 new contracts from new BAA, subject to change based on number of white paper submissions - and will look for efforts that will help to build upon previous AF Weather Service drought research efforts. - Research & prototype development will center on global drought research warning and mitigation, with emphasis/applications on extreme weather event forecasting, drought climate studies and regional destabilization analysis, effects to strategic basing and DoD installation environmental resiliency, and possible efforts for flood mitigation.</p>	0.000	1.369
Congressional Adds Subtotals	0.000	1.369

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D. Other Program Funding Summary (\$ in Millions)

<u>Line Item</u>	<u>FY 2020</u>	<u>FY 2021</u>	<u>FY 2022</u> <u>Base</u>	<u>FY 2022</u> <u>OCO</u>	<u>FY 2022</u> <u>Total</u>	<u>FY 2023</u>	<u>FY 2024</u>	<u>FY 2025</u>	<u>FY 2026</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>
• RDTE 07 0305111F: <i>WEATHER SERVICE</i>	2.357	4.099	4.362	-	4.362	-	-	-	-	-	-

Remarks

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

E. Acquisition Strategy

SWAFS will use individual Federal Acquisition Regulation (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 2022 Air Force		Date: May 2021
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 2020				FY 2021				FY 2022				FY 2023				FY 2024				FY 2025				FY 2026			
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 2022 Air Force		Date: May 2021
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

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	2	2021
Scintillation Nowcast				
Forecast Model Update Analysis of Alternatives	1	2021	4	2022
Solar Wind				
Solar Wind Model Analysis of Alternatives	1	2023	4	2026