Information Sheet
FY25 NOAA/OAR/WPO/Social, Behavioral, and Economic Sciences Competition

The WPO Social Science Program (SSP) will support research in the FY25 social, behavioral, and economic sciences (SBES) competition in the following three primary research priorities: community responses to weather, behavioral responses to hazardous weather events, as well as data, forecasts, and societal outcomes. Each of these priorities is further described in the NOFO program priorities. The SSP is committed to supporting an inclusive research portfolio that addresses a diversity of hazards impacting communities across the full geographic extent of the United States and its territories. While studies from all regions are welcome, those that support research in the U.S. territories as well as in the western (including Alaska and Hawaii) and mid-western states of the US are strongly encouraged.

The social, behavioral, and economic sciences or SBES, are critical components for meeting NOAA's mission. By finding, funding, and fostering high-quality and innovative SBES research, the Weather Program Office (WPO) Social Science Program (SSP) supports NOAA's Research and Development (R&D) Vision Areas (2020–2026) to investigate critical research questions and integrate SBES into products, tools, and services that improve weather and air quality forecasting and societal outcomes. This program strongly encourages and supports SBES-led interdisciplinary work, applied research, and SBES research that advances theoretical findings into applications for the operational forecast community.

Elaboration of Science Emphases:

While there is growing interest in SBES research to improve forecast communication and develop specific products, there has been less focus on research-related infrastructure to collectively advance the needs of the research community and support SBES integration at the organizational level (See NASEM, 2018).

The FY25 SBES funding call intends to nurture SBES integration by focusing on methods, constructs, and the transfer of knowledge through research-guided recommendations. The range of disciplines covered by SBES provide a diversity of methodologies through which data may be collected and analyzed to understand the SBES program priorities presented in this NOFO. These methods include both qualitative and quantitative data collection techniques such as network analyses, computational modeling, surveys, case studies, ethnographies, and more.

Additional Information on Proposal Evaluation and Submission:

Project Outputs

WPO's SSP recognizes projects have many possible applications and research outputs, such as providing research-guided recommendations, transferring methodologies, informing and/or creating a tool or technology, and using newfound knowledge to enhance a product or service. These applications may be relevant across the Weather Enterprise. However, Principal

Investigators (PIs) should be aware that reviewers will examine the applicability and relevance of their proposed research to NOAA. Therefore, SSP encourages proposals to identify *all* possible research applications (e.g., for NWS, private weather industry, and/or other researchers), while focusing on primary research output(s) that may benefit NOAA.

Readiness Levels

Information about project Readiness Levels, often referred to as "RLs" can be found on the NOAA Office for Research, Transition, and Application webpage and are also described in the General Information Sheet. Research projects appropriate for this funding call range from early applied research (lower RLs) to mature stages of demonstration (higher RLs), and the same proposal may span multiple RLs if multiple methodologies are being proposed. The extent to which research results can be extrapolated to the relevant population(s) in real-world settings informs the project's RL. The SSP uses RLs to evaluate project maturity, *not* to judge the "correctness" of a PI's RL assessment. The SSP recognizes research and development takes time, and as such, does not expect projects to progress through all readiness levels in a two-year project period. Please use the following links for more information on NOAA's Policy on Research and Development Transitions (NAO 216-105B) and this handbook for definitions.

Note. SSP-funded projects are not required to use a NOAA testbed unless its use is appropriate within the scope of the proposed research methods.

Co-production and Transition Plans

For this NOFO, co-production refers to a process by which researchers work with key individuals who are engaged in the research process to help ensure the research outputs are useful, usable, and eventually put into practice. These individuals may include broadcast meteorologists, emergency managers, community leaders, NWS forecasters, or NWS Headquarters personnel. To enhance the relevance and feasibility of the proposed research, PIs are strongly encouraged to identify opportunities for meaningful engagement with collaborators such as those identified above as part of their research work plan. While not required, partnering with NWS Weather Forecast Offices and/or NWS Headquarters personnel (i.e., operational collaborators) can provide particularly valuable insights, as these entities are often among the primary users of WPO's research outputs. This collaboration ensures that research outputs are not only theoretically sound but also practically applicable and beneficial to practitioners.

If a project is selected for an award, a tangible outcome of the collaboration between researchers and operational collaborators is a transition plan. These plans serve as living documents that describe and facilitate the transition of research and development to practical applications. Per the NAO 216-105B, if a project has potential to progress beyond readiness level (RL) 4, the PI is expected to work alongside their operational collaborators and any additional designated NOAA/NWS Point of Contact to co-develop a transition plan within the first six months of the project period. Therefore, for projects beginning at RL > 4, PIs are strongly encouraged, but not required, to have an NOAA/NWS Operational Collaborator. For projects RL < 4, PIs are still encouraged to have an NOAA/NWS Operational Collaborator to consider the value and feasibility of their R&D to operations.

All identified funded and unfunded collaborators should be included in the project narrative of your LOI and full proposal. Before adding their name(s) to your LOI and proposal materials, please reach out to them ahead of time to verify their interest and availability. While no official collaboration form is required, unless you plan to work with a NOAA testbed (see Section IV.D.3 of the WPO FY25 NOFO for more information), any federal collaborator(s) named in a proposal requesting *allowable* funding **will** need to provide a Request for NOAA Federal Support to accompany the proposal submission documentation (see Section IV.D.3 of the WPO FY25 NOFO for more information).

SBES Data and Data Management

As stated in the Data Sharing Plan in the WPO FY25 NOFO (section IV.F.j. and VI.B.), all data collected must be accessible to the general public, typically within two years. PIs can satisfy data sharing requirements by submitting socio-economic data to a publicly accessible data archiving platform or repository approved by the funding program. Two examples of repositories used by SBES researchers include, but are not limited, to Converge/DesignSafe-CI and Harvard Dataverse; please review SSP guidance on data repositories for identifying additional appropriate platforms. SSP highly recommends publishing *both* data and associated instruments, if appropriate.

SSP suggests proposals include the following information in their Data Management Plan:

- Type of data to be collected and shared;
- Procedures for managing, storing, and maintaining the confidentiality of the data to be collected and shared;
- Roles and responsibilities of project or institutional staff in the management and retention of research data;
- Expected schedule for data sharing such that data is publicly accessible, in a timely fashion (typically within 2 years);
- Format of the final electronic dataset (i.e., metadata schema);
- Documentation to be provided;
- Location of data sharing (i.e.,, the intended data archive/repository); and
- Any circumstances that prevent either all or some of the data from being shared. This includes data that may fall under multiple statutes and hence must meet confidentiality requirements for each applicable statute (e.g., data covered by Common Rule for Protection of Human Subjects, FERPA, and HIPAA).

Additional information on Project Budgets and Timelines:

Project duration may not exceed two years; however, projects may have shorter timelines. For example, projects analyzing previously collected data may only require six months to a year, while research encompassing survey development, deployment, and analysis may require the full two year period. PIs need to be aware that reviewers will closely examine the proposed budgets in relation to the proposed scope of work.

Office of Management and Budget (OMB) / Paperwork Reduction Act (PRA) Process

If an award recipient uses agency sponsorship in any collection of information from the public, the recipient must obtain Office of Management and Budget (OMB) clearance as required by The Paperwork Reduction Act (PRA) of 1995. For example, sponsorship may include NOAA disseminating surveys on behalf of award recipients, either directly or through a NOAA social media account. If a PI is unsure whether their project requires OMB clearance, the PI should budget ample time for clearance in their proposal and if awarded, NOAA staff can help determine whether OMB clearance is necessary. If a funded project is determined by NOAA to require OMB clearance, the award recipient will work with their operational collaborator/NWS point of contact (POC) and the NWS OMB PRA liaison (nws.pra@noaa.gov). The award recipient must obtain OMB clearance before collecting information. Because OMB clearance can take anywhere from one week to nine months, the process for obtaining OMB clearance should begin as soon as possible. For additional information on the OMB/PRA process, please see the following resources guide to the Paperwork Reduction Act and Frequently Asked Questions.

Differences from other WPO Funding Opportunities:

Social science transcends all NOAA scientific missions and thus may have application to all WPO funding opportunities. However, not all research is suitable for the funding associated with the FY25 SBES competition as described in this NOFO. Please note, the program priorities for this SBES competition (see Section I.A.1. of the WPO FY25 NOFO) differ from those of the other WPO competitions detailed in this NOFO.

Letters of intent (LOI) are strongly encouraged for proposals submitted to this competition (see Section IV.E. of the WPO FY25 NOFO).

Competition Contact Information
WPO Social Science Program Manager: Alison Krepp (oar.wpo.nofocompetition@noaa.gov)

INFORMATION SHEET FOR THE FY2025 NOAA/OAR/WPO TESTBEDS COMPETITION

To accelerate transition of research to operations and to enhance the public benefits derived from these research activities, NOAA collaborates with the external science community on cooperative research activities and provides financial support for research-to-operations (R2O) transition projects through the United States Weather Research Program (USWRP) managed by NOAA's Office of Oceanic and Atmospheric Research (OAR) Weather Program Office (WPO). WPO collaborates with a portfolio of five USWRP-supported NOAA testbeds, including the Climate Testbed (CTB), Fire Weather Testbed (FWT), Hazardous Weather Testbed (HWT), Hurricane and Ocean Testbed (HOT), and Hydrometeorology Testbed (HMT). Areas of collaboration include: coordinating with testbed managers and staff, funding R2O projects to be demonstrated, tested, and evaluated within testbeds, and providing funding support for testbed infrastructure needs. These testbeds are jointly managed by both National Weather Service (NWS) and OAR staff. WPO's USWRP Testbeds and Joint Technology Transfer Initiative Programs support advanced projects seeking to transition into operations where testbed interactions and demonstrations in a quasi-operational environment are appropriate.

The objective of NOAA's testbeds is to foster iterative and interactive information exchanges between the research and operational communities, including R2O transitions and operations-to-research communications, that are enabled through organized experimentation in a simulated operational environment. This will involve close collaboration, facilitated by the testbed staff, between funded researchers and operational forecasters. For example, NOAA operational forecasters may actually run or utilize output from experimental techniques during their operational shifts or during episodic experimental periods. Following this, they provide direct feedback to the researchers for possible improvement.

Science projects focusing on relevant hazard focus areas that are relatively mature (i.e., not in the early or middle stages of development or proof-of-concept) are appropriate for these testbeds and this funding opportunity. This includes projects that propose practical outcomes that could be transitioned operationally to NOAA in the next two to five years. Given this expectation, projects selected for funding from this announcement should be ready to test and demonstrate their new capabilities in one of the testbeds during the project period. In the parlance of NOAA and other federal agencies, this requirement translates to the higher "readiness levels". Readiness levels (RLs), as adopted by NOAA per NAO 216-105B, have been described in the associated NOFO for this competition and announcement in Section I.A "Program Objectives". Please refer to that section for additional information.

Projects that are most appropriate for the five testbeds generally fall in or near the "demonstration" level of technical maturity, i.e., RLs of about 5 through 8 during the duration of

the project. Projects starting at RL 4 are also appropriate for the Fire Weather Testbed. Transitioning a mature demonstrated capability from RL 8 to 9 is beyond the scope of WPO and this funding opportunity. However, transition to operations could occur after the projects end if they are successful and approved for operational implementation.

Testing in the testbed facilities during the project performance period and working with the appropriate testbed staff to plan this testing and demonstration is a key requirement of the project. Applicants are encouraged to review each testbed's website for background on the testbed facility and its concept of operations, which varies from testbed to testbed. Given the relatively short project period, this requires mid to high RLs at project start. Ideally, the transition of a funded project from RL 5 or 6 at start to RL 8 at completion is desired. As a result, projects in early stages of development or proof-of-concept that are not ready for testbed demonstration during the project period (i.e. those with starting RLs at or below 4) are not the focus of this testbed funding opportunity.

Upon NOAA's selection of a proposal for funding, the testbed staff will coordinate with the principal investigator(s) (PIs) regarding project administration and planning, experimental schedules, and engagement with its test facility. The testbed staff will provide access to the NOAA-funded testbed facility and infrastructure (e.g. staff, computer hardware, software, and data) to facilitate the testing and evaluation in an environment that closely matches that of the operational entity. In preparation for the testing and evaluation, the PI(s) and testbed point(s) of contact will collaboratively develop a test plan within six months of the project start date describing what will be tested, what the schedule milestones are, and how each group will be involved in the evaluation process, including development and review of documentation, training, instructions, and success metrics. PIs must be involved directly in developing the test plan to make any necessary system adjustments when preparing their project for evaluation in the testbed. Performance progress will be monitored throughout the project by the testbed staff and WPO through communications and semiannual progress reports led by the PIs. Completed projects satisfying NWS metrics for success and operational constraints (e.g. added value, ease of use, computational efficiency, etc.) may be selected later for operational implementation by appropriate NWS operational offices.

In addition to test plans, PIs will also collaboratively develop R2O transition plans in coordination with designated NWS staff within six months of the project start date. This plan will outline how the project outcomes are envisioned to be transitioned to NWS operations. It will also explicitly state the timelines and basic approach for how suggested product improvements might be implemented. NOAA guidance will be provided for the development of test plans and R2O transition plans.

The science focus of a specific proposed project will determine which testbed is most appropriate for a given proposal. The overarching themes of each testbed are described below. Collaboration across testbeds is also possible. If proposing to work with multiple testbeds, letters

of intent and proposals should clearly identify the testbeds, and explain collaborative properties of the proposed work.

a) Climate Testbed

The CTB mission is to accelerate improvements in high-priority operational sub-seasonal to seasonal (S2S) monitoring and prediction products. CTB is managed by the NWS Climate Prediction Center (CPC) and the NWS Environmental Modeling Center (EMC) both located in College Park, Maryland. The CTB seeks to leverage research innovations in order to improve the S2S models, products, and services at CPC and EMC. CPC's priority areas include: outlooks (including temperature, precipitation, and hazards (e.g. extreme events including drought, terrestrial and marine excessive heat/cold, coastal flooding, and excessive precipitation)) on timescales from two weeks to seasons; drought monitoring products; improvements to the S2S skill of the Global Ensemble Forecast System (GEFS) and the Seasonal Forecast System (SFS); and suite of value-added climate re-analysis products for monitoring the slowly evolving climate state and for initial conditions for reforecasts for the GEFS and SFS systems. EMC's priority is improving the UFS-based SFS and GEFS, including physical parameterizations and data assimilation, through collaborative development efforts with the numerical weather prediction (NWP) enterprise. For additional details about CTB, go to: https://www.cpc.ncep.noaa.gov/products/CTB/.

b) Fire Weather Testbed

The FWT mission is to transition advanced technologies and new applications to operational platforms as quickly as possible. The FWT is managed by the OAR Global Systems Laboratory in Boulder, Colorado, in collaboration with NWS and NESDIS. The FWT focuses on evaluating capabilities that support National Weather Service products intended to provide situational awareness; provide services to fire partners across various agencies to safely mitigate dangerous wildland fires; assist in the implementation of prescribed fire and wildfire management to optimize resource utilization, minimize negative impacts on life and property, and mitigate future fire risk; and help communities prepare for hazards before, during, and after wildland fire. For additional details about the FWT, go to: https://gsl.noaa.gov/fire-wx/fire-weather-testbed.

c) Hazardous Weather Testbed

The HWT is a facility jointly-managed by the OAR National Severe Storms Laboratory, the NWS Storm Prediction Center (SPC), and the NWS Norman Weather Forecast Office, all located at the National Weather Center in Norman, Oklahoma. The HWT serves as a critical step in the process of bringing new hazardous weather science to NWS operations by examining ways to increase the lead-time and accuracy for weather and water forecasts and warnings for severe convective weather. The HWT consists of two primary programs, which include the

Experimental Forecast Program (EFP) and the Experimental Warning Program (EWP). The EFP focuses on testing and evaluating new forecast models, techniques, and products to support SPC forecast operations. The EWP focuses on testing and evaluating new applications, techniques, and products to support NWS Weather Forecast Office severe convective weather warning operations. Projects selected for funding may be part of several experiments that are conducted throughout the year. For additional details about HWT, go to: https://hwt.nssl.noaa.gov/.

d) Hurricane and Ocean Testbed

The HOT mission is to accelerate the transfer of promising products and services, focused on tropical weather and marine phenomena, into operational forecast centers. HOT is managed by the NWS National Hurricane Center (NHC) and the OAR Atlantic Oceanographic and Meteorological Laboratory, both located in Miami, Florida. HOT's focus areas include: new analyses of observations/new observing systems for real-time assessment of hazards (i.e. wind, rain, storm surge, severe weather, waves, dangerous ocean conditions); new model guidance for forecasts of hazards (i.e. wind, rain, storm surge, severe weather, waves, dangerous ocean conditions); improvement of analysis products/forecast guidance from a social, behavioral, and economic science perspective; and product enhancements to improve the collaboration and efficiency to produce forecasts and warnings, and/or messaging and communication of forecasts (i.e. impact-based decision support services) to end users. The HOT is housed at NHC, within the William Lapenta Laboratory (the "HOT Lab"), and includes both the dedicated physical space and an isolated cloud-based virtual infrastructure for testing and evaluation. For additional details about HOT, go to: https://www.nhc.noaa.gov/hot/.

e) Hydrometeorology Testbed

The HMT sits at the NWS Weather Prediction Center in College Park, MD, partnered with OAR Physical Sciences Laboratory in Boulder, Colorado, with goals of improving forecasts of extreme precipitation (e.g. convection) that leads to flash flooding and precipitation that leads to winter weather and its impacts (i.e. snow, sleet, freezing rain, atmospheric rivers). The HMT is a naturalistic decision making environment for both a virtual and in-person experience, and seeks to generate insight via collaborative research. The HMT is people-centered, building techniques and tools for forecasters and users of meteorological forecasts and observations and seeks to facilitate both research to operations and operations to research activities.

To support forecasters and forecasts alike, how humans discover, explore, and make use of new and novel technologies is an ever present challenge. Building tools and techniques for people requires testing and evaluation. As such, the HMT hosts immersive forecast and evaluation experiments, in either real-time or retrospective formats, to evaluate new techniques, tools, and models that assist in improving forecast processes and the forecasts of precipitation. These activities include both verification and evaluation of model forecasts (i.e. AI, NWP, statistical) and of data visualization strategies that may assist forecasters in interpreting both deterministic and ensemble systems. Focus groups have been held to gather feedback on

proposed research that would assist forecasters in current or future duties, or on data sets that are under development. The HMT assists researchers in gathering useful feedback for product enhancements or improvements. HMT does this through the Flash Flood and Intense Rainfall Experiment, the Winter Weather Experiment, and the new Atmospheric River Experiment. For additional details about HMT, go to: http://hmt.noaa.gov/ and https://www.wpc.ncep.noaa.gov/hmt/.

Competition Contact Information:

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CTB Testbed Manager: Matt Rosencrans (matthew.rosencrans@noaa.gov)
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Fiscal Year 2025 Competition Information Sheet
NOAA OAR Weather Program Office
Observations Program

This information summarizes key content for the Observations Competition from the FY25 NOAA OAR Weather Program Office (WPO) Notice of Funding Opportunity (NOFO).

Program Name

NOAA/OAR/WPO Observations Program

Observations Program: https://wpo.noaa.gov/Programs/Observations

Program Manager

Mark Vincent (mark.vincent@noaa.gov)

Funding for FY2025

Pending the availability of funds in FY2025, the Observations program anticipates a funding allocation of up to **$2,100,000.00 per year** for this competition. Projects may be for up to two years, with up to **$300,000/year**. A total of approximately **7 projects** may be funded.

Timeline for FY2025

Letters of Intent (LOI) due date: September 18, 2024

Expected NOAA response date on LOIs: October 4, 2024

Full application package due date: November 15, 2024

Funding recommendations: April 2025

Anticipated Start Date: August 1, 2025

Program Objectives for FY2025

The aim of this competition is to develop, demonstrate, and/or analyze innovative sensor and observing technologies and strategies that have high potential for advancing an observation systems portfolio that is mission-effective, integrated, adaptable, and affordable. Proposed projects should document clear relevance and support to the weather enterprise.

Observations from the surface through the troposphere serve as critical inputs for the analysis and forecasts of the operational weather enterprise for the protection of life and property and enhancement of the national economy. High resolution surface and planetary boundary layer/tropospheric observations in both the vertical and horizontal dimensions are limited, which impedes progress in skillful predictions of high-impact and disruptive weather. Proposals should focus on technologies and strategies with the potential to improve the accuracy, reliability, spatial coverage, cost effectiveness, deployability, safety, and sustainability of observations for eventual use by the operational weather enterprise such as NOAA, including the National Mesonet Program, the private sector, and other government sectors.

The scope includes weather-related observations and observing strategies targeting the surface through the planetary boundary layer/troposphere.. Satellite-based sensors are not included in this scope except to calibrate, validate, or integrate with in-situ observations as a secondary objective.

Engagement with, and participation by the operational weather commercial sector is also encouraged.

The strongest proposals should:

1. include **substantial collaboration with one or more operational weather stakeholder(s)** with the potential to benefit from the work
2. include **collaboration with other relevant R&D partners** to help accelerate results
3. clearly **document linkage to operational weather needs**
4. demonstrate **potential to transition to operations, applications, commercialization, or a final product**, and, if applicable (e.g., the path to operations is *not* commercialization), explain how **NOAA can sustain the observational capabilities** and outcomes of the proposed work in an operational capacity.

Projects appropriate for this competition range from Readiness Level (RL) 4 to RL 7 and have potential to transition to operations, application, commercialization, final product, or knowledge at either NOAA or the weather enterprise within the next 3 to 6 years. The NOAA Readiness Levels are defined in the FY23 WPO General Information Sheet.

For additional information on this WPO Observations Program funding opportunity, including complete, detailed descriptions for each priority, please review the FY24 Observations Program funding information sheet for the Observations competition in the grant package associated with this announcement at https://www.grants.gov.

Program Priorities for FY2025

The WPO Observations Program, in collaboration with the NWS and other NOAA stakeholders, developed the following four priorities.

OBS-1: **Weather Buoy Mitigation Vehicle** - Develop and demonstrate a high endurance, modular construction and portable Uncrewed Surface Vehicle (USV) that is combined with an Artificial Intelligence (AI) User Interface (UI) and easy payload integration capability. The vehicle will be used to quickly mitigate weather buoy outages to reduce observational data gaps until a long-term moored buoy solution is available. Using AI, automated station keeping will provide more consistent maritime weather observations.

OBS-2: **Rainfall Estimate Improvement** - Specific Differential Phase (KDP) is a critical dual polarization weather radar parameter used to estimate rainfall rates in the presence of hail, identify regions of ice crystal growth within the Dendritic Growth Layer, and determine the location of thunderstorm downdrafts. This priority seeks research aiming to develop and demonstrate an improved derived KDP product by separating the contributions of propagation from backscattered components of the total differential phase, filtering measurement variance to rid of unwanted signals but retain resolution, and identifying return data corrupted by artifacts to ultimately improve rainfall, particularly heavy rainfall, estimates

OBS-3: **SFMR Improvement** - The Stepped Frequency Microwave Radiometer (SFMR) delivers surface wind speed and rain rate estimates along the track of the reconnaissance aircraft around and within a tropical cyclone. There is a critical need to further improve the understanding and processing of SFMR retrievals to ultimately provide trustworthy data to forecasters and decision makers. This priority targets activities aiming to develop and demonstrate software to process SFMR brightness temperature measurements and deliver more reliable rain rates and surface wind speeds from all SFMR instruments on reconnaissance aircraft. Additionally, projects may seek to leverage other in-situ and remotely sensed tropical cyclone observations for SFMR validation.

OBS-4 Tropical Cyclone Reconnaissance Data Advancements: Use NOAA Unified Forecast Systems, including the Global Forecast System (GFS) and Hurricane Analysis and Forecast System (HAFS) to develop and demonstrate:

- Improved use of airborne reconnaissance observations of tropical cyclones already in the operational data stream, through methods such as super-obbing of high-resolution reconnaissance data
- Assimilation of existing experimental tropical cyclone reconnaissance data that

is not already in the operational data stream
- Assimilation of other new or experimental data, in-situ and remotely sensed, from poorly sampled regions that pertain to improving tropical cyclone forecasts; in particular, examine how new or experimental data can be coordinated with tropical cyclone airborne reconnaissance data
- QA/QC procedures for tropical cyclone airborne reconnaissance data

INFORMATION SHEET FOR THE FY25 NOAA/OAR/WPO SUBSEASONAL-TO-SEASONAL (S2S) COMPETITION

The Weather Research and Forecasting Innovation Act of 2017 calls for NOAA to improve its Subseasonal to Seasonal (S2S) capabilities, and defines subseasonal to seasonal as the range between two weeks and two years. NOAA's Office of Oceanic and Atmospheric Research (OAR) is aligning its subseasonal to seasonal research with other observational and weather research within the Weather Program Office to efficiently support the Weather Act goals. Through this effort, NOAA and OAR will address a spectrum of issues on the subseasonal to seasonal time frame ranging from foundational research to the transition of research to operations.

NOAA is moving toward a unified modeling approach to support prediction of extreme weather and its associated drivers at extended time ranges. A key aim is to harness predictability sources across scales present in the Earth system relevant to the subseasonal to seasonal prediction problem, from the synoptic range out to two years. Such predictability sources include cyclical modes of variability (i.e. MJO, ENSO, NAO, QBO, etc.) as well as their interactions and impacts on extremes and high-impact weather.

The WPO S2S program will support the progression of NOAA's ability to address these challenges. In particular, the program will place a strong emphasis on projects designed to increase capabilities related to precipitation, its excess, shortfalls, duration, and precision of spatial and temporal placement on the subseasonal to seasonal scale. A myriad of factors known and unknown contribute to accurate prediction of precipitation or drought beyond two weeks. Additional factors such as vegetation or fuel development exacerbating fire weather precursors are of interest. While projects investigating any of these factors will be considered, preference will be given to proposals that utilize models and components participating in NOAA's Unified Forecast System (UFS), particularly the development of the Seasonal Forecast System (SFS), and ongoing multi-model ensemble efforts on the subseasonal to seasonal timescale within the North American Multi-Model Ensemble (NMME) or related subseasonal ensemble efforts, and which leverage existing NOAA, WMO, and other agency datasets. If applicable, proposers are encouraged to articulate how they can collaborate with the Earth Prediction Innovation Center (EPIC). Projects should address improvements in the three areas of immediate need detailed below - data assimilation, numerical model processes and component interaction via the community-based UFS, and multi-model ensemble methods and postprocessing.

Priority S2S-1: Improved data assimilation (DA) for individual Earth system components such as the cryosphere, ocean, waves, land surface, and atmospheric composition, and the incorporation of new observation types is critical to better monitoring Earth system variability across all time scales. Coupled DA, where observations in one component of the Earth system are allowed to directly impact the state estimation in other components, is crucial to advance subseasonal-to-seasonal prediction through improved model initialization, in particular within the community-based Joint Effort for DA Integration (JEDI) project. JEDI is central to the UFS DA strategy, including the NCEP Environmental Modeling Center (EMC) DA strategy. Prospective proposals are encouraged to articulate how they can leverage and collaborate with the Joint Center for Satellite Data Assimilation JEDI project. The optimum approach(es) to coupled DA

(including innovative AI/ML techniques) in the context of Earth system modeling and prediction is an open research question, and thus represents a major research need for NOAA. Projects supporting improved DA will:

● develop a new methodology, or significantly advance an existing methodology, for coupled DA with demonstrable relevance to the Earth system prediction and/or monitoring needs on the subseasonal to seasonal scale of one or more NOAA Line Offices;

● develop new or experimental DA-based approaches to monitoring products for the cryosphere, ocean, land surface, or atmospheric composition on the subseasonal to seasonal scale;

● emphasize the implications and application of these technologies on prediction of precipitation on the subseasonal to seasonal scale while utilizing existing NOAA, WMO, and other agency datasets.

Priority S2S-2: The WPO S2S effort is interested in supporting community-based approaches to improve Earth system models via development and evaluation of individual sub-elements within model components (e.g. the surface drag parameterization in a surface-layer turbulence scheme or ocean mixed layer thermohaline processes), single column modeling, limited area modeling, and more. Development and evaluation may extend to or focus on processes occurring within one component of the Earth system models or on characterizing the component-to-component interactions, i.e., land-atmosphere, ocean-atmosphere, ocean-ice flux exchanges. Proposed projects to identify and address sources of model bias within the UFS modeling suite, especially the SFS are welcomed. This involves understanding the source of the biases such as issues in models' physical process representation, model component interaction, numerical approach, or the interactions between these issues, via a systematic process-oriented evaluation of the biases. Efforts towards building tools for process oriented diagnostics to assess earth system model component performance or inter-model interactions are invited. Fundamental research may also address attribution, implicit model bias, and progression of models participating in community ensembles that contribute to the predictive capability. This predictive capability focus can emphasize a range of phenomena related to precipitation/drought, processes influencing precipitation/drought, and implications of modeled precipitation or its lack for forecast utility. The portfolio will only consider models and components designed to improve or supplement the community-based NOAA UFS development.

Priority S2S-3: To improve ensemble prediction capabilities, including multi-model ensembles, the WPO S2S program is interested in proposals improving existing ensembles, via techniques to determine the optimal number of models vs. number of members for each Earth System model, leading to improved prediction skill and assessments of uncertainty for various phenomena (e.g., temperature, precipitation, snowpack, sea ice conditions, extreme and high-impact weather to include conditions contributing to droughts, fires, tornadoes, hurricanes, floods, heat waves, coastal inundation, and winter storms) with a specific emphasis on subseasonal to seasonal precipitation and extreme precipitation events. Sophisticated ensemble methodologies might utilize various statistical regression, error reduction, and bias correction schema

(including innovative and emerging Artificial Intelligence/Machine Learning/Deep Learning methods), while incorporating other advanced, modern reanalysis and postprocessing techniques within the NMME or subseasonal ensemble efforts.

Selected projects will be expected to participate in an annual workshop for the duration of the project, and share results with other researchers via webinars. Projects are expected to initially fall within Readiness Levels (RLs) 2 and 4. Transition plans will be required for projects within this program call for any project that is expected to reach RL 4 or greater by the end of the period of performance; however, investigators should describe the general transition process intended for their work to the UFS community model to be incorporated into the NOAA predictive capability. If the project has potential to progress beyond an RL of 4 at any point, per NAO 216-105B, the PI will receive more information from the program manager and is required to submit a research-to-operations transition plan with the first progress report.

These funding opportunities are only open to non-Federal principal investigators; however, principal investigators are encouraged to consult with and include NOAA and/or other Federal employees as co-investigators.

INFORMATION SHEET FOR THE FY2025 NOAA/OAR/WPO AIR QUALITY RESEARCH AND FORECASTING COMPETITION

NOAA collaborates with the external science community to improve NOAA's air quality forecasting capabilities through applied research and it provides financial support for research-to-operations (R2O) transition projects through the United States Weather Research Program (USWRP) to accelerate transitions to operations and to enhance the public benefits derived from these projects.

The National Air Quality Forecasting Capability (NAQFC) generates numerical guidance for predictions of ozone (O_3), particulate matter with diameter equal to or less than 2.5 micrometers ($PM_{2.5}$), wildfire smoke, and airborne dust over the contiguous United States (CONUS), Alaska, and Hawaii. The guidance products are produced with hourly outputs at 12 km resolutions out to 72 hours and are distributed in numerical and graphical format at https://airquality.weather.gov/. Ozone and $PM_{2.5}$ products are generated by the NOAA National Centers for Environmental Prediction (NCEP) Unified Forecast System (UFS) and an online-coupled air quality component that simulates atmospheric chemistry using the U.S. Environmental Protection Agency (EPA) Community Multiscale Air Quality (CMAQ) model. The system also ingests inventory-based emissions estimates from the EPA, natural source emissions from wildfire smoke and dust. Satellite-derived fire products, high-resolution Regional Hourly Advanced Baseline Imager (ABI) and Visible Infrared Imaging Radiometer Suite (VIIRS) Emissions (RAVE) are utilized to calculate fire emissions. The UFS-AQM online prediction system (i.e., AQMv7) is scheduled to replace the current regional air quality prediction system (i.e., AQMv6), which is based on the GFS-CMAQ offline system, in May 2024.

The Global Ensemble Forecast System-Aerosols (GEFS-Aerosols version 12) was implemented into operations in September 2020 with updates to scavenging and deposition processes. GEFS-Aerosols is a global atmospheric composition model that integrates weather and air quality using the FV3 dynamic core. GEFS-Aerosols currently produces five-day forecasts of the global distribution of smoke, soot, organic carbon, sulfate, and large and small particles of dust and sea salt. The aerosol modules are based on the NASA Goddard Chemistry Aerosol Radiation and Transport model (GOCART). Global anthropogenic emission inventories are derived from the Department of Energy's Community Emissions Data System. GEFS-Aerosols also includes a new dust emissions algorithm and biomass burning plume rise module. Work is underway to transition the unified NASA-NOAA GOCART system to the coupled Unified Forecast System (UFS). Possible upgrades for GEFS (version 13) include adding more ensemble members to produce a probabilistic aerosol forecast while including aerosol-radiation feedbacks and extending the forecast to the sub-seasonal time scale.

Emissions used for regional O_3 and $PM_{2.5}$ predictions are updated regularly with

improvements including projected changes in emissions from point and mobile sources (reducing NOx emissions especially in the eastern US), and inclusion of smoke and dust sources in CMAQ with updates to CMAQ chemistry. The CMAQ model that provides operational ozone predictions was upgraded to use a newer CB06 chemical mechanism and includes the AERO7 module and real-time smoke and dust emissions to provide operational $PM_{2.5}$ predictions from the same system.

Projects focusing on air quality research and forecasting that are relatively mature and not in the early stages of development or proof-of-concept are appropriate for this funding opportunity. This includes those projects that propose practical outcomes that could be transitioned operationally to NOAA in the next 3 to 5 years. In the parlance of NOAA and other federal agencies, this requirement translates to the higher "readiness levels". Readiness levels, as adopted by NOAA per NAO 216-105B, have been described in the associated NOFO for this competition and announcement in Section I.A "Program Objectives". Please refer to that section for additional information.

Projects that are most appropriate for this competition generally fall in or near the "demonstration" level of technical maturity, i.e., readiness levels of about 5 through 8 during the duration of the project. Ideally, the transition of a funded project from readiness level 5 or 6 at start-up to 8 at completion is OAR's driving goal in funding these projects. On the other hand, projects in early stages of development or proof-of-concept during the project period (i.e. those with start-up readiness levels of 4 or below) are not the focus of this funding opportunity. Transitioning a mature demonstrated capability from level 8 to 9 is beyond the scope of this funding opportunity but could occur after the project's end if they are successful and approved for operational implementation by NOAA's National Weather Service (NWS). Completed projects satisfying NWS metrics for success and operational constraints (e.g. added value, ease of use, computational efficiency, etc.) may be selected later for operational implementation by appropriate NWS operational offices.

PIs selected for funding will collaboratively develop R2O Transition Plans in coordination with designated NWS staff within six months of the project start date. This plan will outline how the project outcomes are envisioned to be transitioned to NWS operations. NOAA guidance will be provided for the development of R2O Transition Plans.

Competition Contact Information:
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INFORMATION SHEET FOR THE
FY2025 NOAA/OAR/WPO *VORTEX-USA* COMPETITION

General program priorities for interdisciplinary studies and transition to the Weather Enterprise

VORTEX-USA is a research program intended to improve the effectiveness of tornado forecasts and warnings in the U.S. This program represents an evolution from the VORTEX-SE program of 2015-2020. VORTEX-USA will extend the approaches and findings from that program to other regions of the U.S., while maintaining a strong emphasis on Southeast issues. New meteorological knowledge will be gained through examination of historical data, special datasets collected in the field through earlier VORTEX-SE campaigns, and the application of state-of-the-art numerical weather prediction and data assimilation systems. VORTEX-USA will also explore avenues for more effectively communicating tornado forecasts to the public, and evaluate aspects of public vulnerability, risk perception and response to these forecasts in order to more effectively mitigate damage, injuries, and loss of life from tornadoes.

Investigators should understand that VORTEX-USA is a program that is intended to have the *maximum possible near-term societal benefit* by reducing the impacts of tornadoes. In preparing and reviewing proposals, investigators and reviewers should assess the viability of moving results expeditiously toward application. This perspective should serve to inform investigators of the applicability of their proposal to a NOAA grant competition, in contrast with funding programs of other agencies such as the National Science Foundation. Basic research is not excluded in VORTEX-USA, but proposals for basic research carry a certain burden of convincing reviewers of a likely path toward application. The Notice of Funding Opportunity gives an example of Readiness Levels, and these should serve to give investigators a sense of how new knowledge can advance toward application in NOAA. VORTEX-USA knowledge may follow other paths leading to societal benefit through education of participants in the Weather Enterprise, insights into urban planning or codes, and a variety of diverse routes. Regardless of the exact route for transition, investigators should always consider how to advance their findings to application and positive societal impact beyond publishing and hoping that the new knowledge is "somehow" implemented.

In the past, VORTEX-SE has used several mechanisms to encourage interdisciplinary studies. The spectrum of approaches that are appropriate for VORTEX-USA-supported projects range from very narrow single-discipline efforts, to efforts that can only effectively proceed when they involve more than one discipline. The latter typically are more costly, often involving two or more principal investigators. Investigators need to be aware that reviewers will scrutinize the proposed budgets. Single-discipline proposals are not expected to generally cost near the annual grant limit ($500,000/project), while necessary inter-discipline collaboration may more easily justify budgets near the grant limit. In past

competitions, VORTEX-SE has limited single-discipline proposals to $300,000/project, and many worthy proposals have been received that fit within that constraint.

In this competition, we do not specify any required discipline areas for individual proposals. The mix of disciplines should be that which best facilitates the research goals.

Collaboration with elements of the Weather Enterprise

Past competitions have encouraged investigators to form collaborations with the Weather Enterprise, especially the NWS. Indeed, the first proposal review criterion (30 points weight) continues to be an assessment of the relevance to the Weather Enterprise, including NOAA. The general result from the past has been the inclusion of letters of support in proposals, but often only weak collaborative efforts have ensued. In this competition, we *discourage the practice of including letters of support*, with the exception of projects using datasets from the PERiLS field campaign (see more information below). On the other hand, we wish to encourage actual collaborations with the Weather Enterprise where possible and useful. **Hence, it will be a strength if proposals include an investigator(s) engaged in the operational aspects of the Weather Enterprise, and show a *substantive role* for that investigator(s) in the conduct of the project.**

PERiLS

VORTEX-USA, in collaboration with the National Science Foundation, supported a major field program in the Southeast U.S. in the 2022 and 2023 Spring seasons called Propagation, Evolution, and Rotation in Linear Storms (PERiLS). Data from the 2022 and 2023 campaigns is publicly available, and proposals utilizing PERiLS data sets *will be accepted* in the FY2025 NOFO competition. However, because the funding mechanisms for PERiLS datasets vary, and with them the requirements for data sharing, any proposals utilizing PERiLS data will require either (1) a letter of support from the principal investigator responsible for the dataset explicitly stating that the proposal investigator(s) will have access to that data set for their proposed work; or (2) that data set's principal investigator being an investigator on the proposed grant. *Investigators already funded to conduct research using PERiLS data sets cannot propose work already detailed in their funded grants if the ongoing research grant timeline extends into the FY2025 funding period.* Proposals to deploy new instrumentation or conduct new field campaigns will not be considered; investigators interested in collecting data should contact the VORTEX-USA Program Manager for more information.

Elaboration of Science Emphases

This section supplements the brief descriptions of program priorities from the funding opportunity announcement.

VORTEX-USA seeks to encourage new research proposals related to understanding and reducing societal vulnerability to tornadoes. Interdisciplinary research investigating the extent to which the physical, social and economic factors contribute to harm is needed and should draw from the following three main emphases:

- Investigating how physical, social, and economic factors interact to contribute to harm, and which intersections in particular contribute to severity of impact in different regional, local and household circumstances. Prior VORTEX-Southeast research has identified specific socioeconomic factors that contribute to vulnerability in the Southeast, e.g., the prevalence of manufactured housing. Further research in the Southeast and in other regions to identify and refine our understanding of these factors are key to reducing vulnerability.
- Understanding different populations' capacities to respond to forecasts and warnings for tornadoes, and current practices that can be utilized and leveraged to alleviate vulnerabilities and reduce harm from tornadoes in the Southeast and other regions.
- Understanding the factors and decisions that enhance individual survival of tornadoes under different circumstances. Given the vulnerabilities associated with mobile and manufactured housing that previous research has identified, studies and projects further examining the vulnerabilities and decision-making of residents in this type of housing are particularly encouraged.

Physical and/or social science studies focused on improving actionable information to the public and end users in the critical time period from 30 minutes to 4 hours prior to a tornadic event. This topic area has two main emphases:

- Improving probabilistic hazard and warning information in support of NWS strategic efforts to develop capacity to provide Probabilistic Integrated Decision Support Services.
- Researching products and messaging techniques that will provide consistent information that the public can utilize to support better decision making and outcomes, particularly in light of rapidly evolving technology (e.g., AI, improved communication technology such as ATSC 3.0, etc.).

Data management and availability

VORTEX-USA researchers are strongly encouraged to use existing VORTEX-USA data which are available in the catalogs maintained by UCAR's Earth Observing Laboratory

(http://data.eol.ucar.edu/, search for “VORTEX”). As mentioned above, extensive data was collected during the PERiLS field campaigns, and proposals leveraging this significant dataset are particularly encouraged.