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:
WPO Program Manager: Lingyan Xin (lingyan.xin@noaa.gov)

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