FY 2017 Verification of the Origins of Rotation in Tornadoes Experiment in the Southeast U.S. (VORTEX-SE), and Infrasound Detection of Tornadoes

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ANNOUNCEMENT OF FEDERAL FUNDING OPPORTUNITY

EXECUTIVE SUMMARY

Federal Agency Name(s): Office of Oceanic and Atmospheric Research (OAR), National Oceanic and Atmospheric Administration (NOAA), Department of Commerce

Funding Opportunity Title: FY 2017 Verification of the Origins of Rotation in Tornadoes Experiment in the Southeast U.S. (VORTEX-SE), and Infrasound Detection of Tornadoes

Announcement Type: Initial

Funding Opportunity Number: NOAA-OAR-OWAQ-2017-2005153

Catalog of Federal Domestic Assistance (CFDA) Number: 11.459, Weather and Air Quality Research

Dates: Full application packages must be submitted through Grants.gov no later than 5:00 p.m. Eastern Time (ET) on Wednesday March 15, 2017. Expected project start date is September 1, 2017.

Funding Opportunity Description: This research funding opportunity is being jointly issued by the NOAA OAR Office and Weather and Air Quality (OWAQ) and the National Severe Storms Laboratory (NSSL). It seeks to obtain new knowledge of the meteorological and infrasound aspects of tornadoes in the southeastern United States (U.S.) and the social and behavioral aspects of the public response to tornado forecasts and tornado events. This new knowledge will improve our ability to understand, forecast and warn the public of tornadoes and elicit appropriate responses to mitigate damage, injuries, and loss of life.

FULL ANNOUNCEMENT TEXT

I. Funding Opportunity Description

A. Program Objective

Verification of the Origins of Rotation in Tornadoes Experiment in the Southeast United States (VORTEX-SE) is a research program intended to improve tornado forecasts and warnings in the United States, particularly the southeastern United States (U.S.), by obtaining new knowledge of atmospheric processes that are conducive to tornadoes, and of special importance, in the Southeast. This will be achieved through examination of historical data and the application of state-of-the-art numerical weather prediction and data assimilation systems. Further, VORTEX-SE will explore avenues for more effectively communicating tornado forecasts to the public, and evaluate aspects of public risk perception and response to these forecasts in order to more effectively mitigate damage, injuries, and loss of life from tornadoes.

When examining measures of the threat posed by tornadoes to life and property, the southeastern U.S. has six of the eight most vulnerable states. Some of the vulnerability is due to issues such as a relatively large proportion of the population residing in mobile homes, which are known to be unsafe even in moderate strength tornadoes. Another above-normal risk in the Southeast is that many tornadoes occur during nighttime hours, associated with over half the deaths and injuries. Further, tornado casualties are disproportionately in the late fall and winter months, which are not typically associated with tornadoes according to conventional understanding or public perception, and they often occur under conditions of marginal thermodynamic instability but very strong vertical wind shear. Hence, there are many issues in the continuum spanning meteorological understanding to public awareness and perception that must be addressed in order to reduce the high tornado vulnerability in the Southeast.

TWO CATEGORIES OF SUPPORTED PROJECTS

The projects that NOAA will support through this Federal Funding Opportunity (FFO) fall into two categories. Principal investigators must identify which one of these categories their project predominantly falls in since the proposals will be separated, ranked, and selected from the separate proposal pools in two separate competitions:

1) VORTEX-SE: The VORTEX-SE topics pertain to research in the physical, social, behavioral, and economic sciences to improve the ability to forecast, detect, communicate threat information, and reduce vulnerability to tornadoes in the Southeast U.S.

2) Infrasound understanding, detection, and warning of tornadoes: Although broadly similar to the above priority area, this second topic focuses more narrowly on infrasound data collection and applications to the understanding, detection, and warning for severe thunderstorms and tornadoes (including tornadoes generated by land-falling hurricanes) using infrasound techniques.

Details of each of these two competitions are described below.

1. VORTEX-SE COMPETITION

a) Planning and Objectives

Science planning in VORTEX-SE is carried out by a Scientific Steering Committee. The latest VORTEX-SE Science Plan can be found at http://www.nssl.noaa.gov/projects/vortexse/science2017.pdf. The NOAA VLab (https://vlab.ncep.noaa.gov) is the primary site for information regarding the science objectives of VORTEX-SE. All interested parties are encouraged to join the VORTEX-SE community in the virtual workshop and participate in the development of the science agenda.

In the broadest terms, the FY2017 VORTEX-SE funding opportunity: 1) emphasizes the analysis of existing data sets; 2) emphasizes addressing specific issues that must be resolved prior to future research and field campaigns; 3) emphasizes the assessment of current shortcomings of numerical models and the observations required to validate and improve these models; 4) continues to emphasize research in vulnerability, forecast and communication processes, and risk perception; and 5) emphasizes interdisciplinary approaches. These emphases are described in detail below in Sec. I.B.1.

By June of 2017, VORTEX-SE likely will have obtained meteorological data sets in the Southeast from the past two years that can be utilized in a variety of studies to support the research priorities of these projects. In order to improve the utilization of data already collected, VORTEX-SE will not be conducting a field observing campaign in 2018. Thus this FFO will not support the collection of any new meteorological field observations. However, collection of new social and behavioral science-related data is appropriate as is the collection of new infrasound data (see Sec. I.B.2 for the latter). Proposals that include any meteorological field observation collection activities not related to infrasound or social/behavioral science projects during the project period will be rejected from consideration and returned without review. However, for projects utilizing existing meteorological data, the use of data collected in 2016 or 2017 VORTEX-SE field campaigns

or other historical data is encouraged. The 2016 data sets can be examined at the VORTEX-SE data archive at http://catalog.eol.ucar.edu/vortex-se_2016. The 2017 VORTEX-SE Operations Plan (http://www.nssl.noaa.gov/projects/vortexse/operations2017.pdf) lists the data sets that are expected to be obtained in March and April 2017. Please note that the researchers who collected VORTEX-SE field campaign data sets are not obligated to share them until two years after collection. Hence, investigators who are proposing to do analysis work that will utilize these data collected by other institutions are required to obtain the permission of (or form collaborations with) the data owners prior to submitting a proposal in response to this solicitation. The proposal must clearly assert that the needed permissions have been obtained if that data access is essential to the outcomes of the project.

Another motivation for the 2018 hiatus in field observations is to allow researchers to use Numerical Weather Prediction (NWP) and other approaches to identify important local and mesoscale processes, in the Planetary Boundary Layer (PBL) and the free atmosphere, that influence the tornadic storm potential. Of special current concern are those processes that modify Convective Available Potential Energy (CAPE) on these scales. The VORTEX-SE Scientific Steering Committee has determined that a large focused field campaign focused on these issues would be appropriate in about 2020, and so the initial research described above is especially important at this time. Ideally, these studies will make use of data collected in the 2016 and 2017 campaigns.

Researchers should be aware of another difference between this funding opportunity and those of the last two years. The ultimate goal of research in VORTEX-SE is to improve the forecasting, warning, and detection of tornadoes, the communication of tornado threats, and the mitigation of those threats. Researchers should be able to convey how their proposed work will advance us in the direction of that ultimate goal. Proposal evaluation criteria assess the degree to which the proposed work is likely to coordinate and/or transfer new knowledge, technology, and research approaches across disciplines and into operations or applications (components of the weather enterprise engaged in identifying, detecting, communicating, and mitigating tornado hazards). Thus researchers are required to propose direct collaborations and/or interactions either across disciplines and/or with operations/applications. This change is intended to motivate research that will have the greatest, and most immediate, benefit to the public.

Proposals to this program are restricted to the topics listed below in Sec. I.B.1. The topic descriptions are intentionally broad in order to allow prospective investigators as much freedom as possible to pose novel and innovative approaches. To allow prospective investigators to see the ideas and priorities identified by the Scientific Steering Committee, which are broadly encapsulated in the topics in Sec. I. B.1, the on-line VORTEX-SE Science

Plan should be consulted. The Science Plan provides additional insights regarding the science topics, including working group reports that were used to inform the generation of the science topics.

Using guidance from the VORTEX-SE Scientific Steering Committee, the topics were selected by NOAA based upon the maturity of the ideas developed by the community, their timeliness with respect to other research objectives within a multi-year context, and their relevance to the NOAA mission.

b) Prioritization

VORTEX-SE scientific prioritization began with the advice of the VORTEX-SE Scientific Steering Committee. This committee has assessed which research topics are sufficiently well understood and executable that it is likely that proposals can be created that have the potential of producing the desired new knowledge. The committee also determined the optimal sequencing of related groups of topics to advance the science as efficiently as possible. Considering this advice, NOAA then established which foci are of greatest potential to advance the NOAA mission. This forms the basis for the specific research objectives listed below in Section I.B.1.

Further prioritization will involve synergism between funded activities and maximizing the amount of scientific findings in operations, given the funding constraints, that will lead to improved operational forecasts, warnings, and societal response. Thus, all investigators responding to this FFO should consider how the significant findings from their proposed activities can be shared and communicated with, and eventually transferred, to National Weather Service (NWS) operations, to other organizations and individuals responsible for communicating weather hazard information to the public, and to the public in general. NOAA encourages submission of proposals for projects that engage NOAA scientists in studies addressing the NOAA FFO priorities listed below.

VORTEX-SE is a program that is being conducted with a single one-year allocation of funds to NOAA. Because there is no certainty of additional future funds, the highest priority will be those projects that can produce significant new knowledge through a single one or two year grant with no assumptions regarding follow-on support or special observations beyond those already obtained in 2016 and 2017.

2. INFRASOUND UNDERSTANDING, DETECTION, AND WARNING OF TORNADOES COMPETITION

The second category of supported projects in this FFO is focused on infrasound applications to tornado understanding, detection, and warning. A separate competition from the above VORTEX-SE competition with separate funding will be used.

Innovative research over the past 40+ years has demonstrated the potential of infrasonic technology for the detection of a variety of geophysical phenomena, including tornadoes. Infrasound (specifically near-infrasound) is the range of acoustic frequencies just below the audible and approximately in the 0.5 to 10 Hz frequency range. Infrasound can travel great distances with little atmospheric absorption (sometimes over 1000 km) but can take many minutes to an hour to travel these distances. It can take about five minutes for infrasound waves to travel only about 100 km.

Limited studies using Doppler radars and visual observations for verification have shown correspondence between the occurrence of tornadoes and the generation of infrasound from the same region as detected by specially-designed ground-based infrasonic observation networks deployed in the United States, mostly on the Colorado plains. Also there have been very limited studies addressing the potential of improved understanding of hurricanes, tornadoes associated with land-falling hurricanes, and related phenomena (e.g., land spouts) through infrasound data collection. There are many uncertainties due to the limited amount of data that has been collected to study the phenomena.

NOAA plans to support several studies under this program to improve our understanding of infrasound as it relates to the detection of tornadoes in the U.S., particularly the Southeast U.S., the potential operational forecasting and warning benefits, and the limits of temporal and spatial detectability with various infrasound observing network configurations (e.g., how precise can source locations be determined, measures of detectability and warning such as false alarm rate and probability of detection, etc.).

NOAA will not support studies under this FFO related to the engineering development of infrasonic observing sensor hardware. Infrasonic sensors in the desired frequency range have been developed and are available commercially. NOAA would support the deployment of sensor networks and collection of such data in the approximate 0.5-10 Hz near-infrasound range from existing sensors. We are most interested in the follow up analysis of that data, through comparison with historic archived infrasonic data and other available coincident observational data, that could produce meaningful practical results and improved understanding with limited funding over a two year time span.

B. Program Priorities

The program priorities for each of the two project categories are described in detail below. Highest rated proposals from this FFO are expected to be those that clearly address one or more of these focused priorities.

1. VORTEX-SE COMPETITION

Proposals that address the topics below must not include field observing activities (excluding social/behavioral data collection, which is appropriate). Also note that all topics in this section, including topics a-e which emphasize physical science research, also carry the program-wide requirement for collaboration and/or consultation across disciplines and/or with others in the weather enterprise (e.g. NWS, emergency management, media, etc.). See Sec. V.A.1 and V.A.2 below.

a. Improving numerical forecasts and simulations of potentially tornadic storms and their environments in the Southeast U.S.

There are two major needs for improved numerical models in VORTEX-SE. First, forecast models and ensembles must continue to be improved and validated, especially with respect to PBL processes and representation, but also the free-atmosphere processes relevant to storm initiation, modulation, interaction, and evolution must be validated. Second, numerical models will increasingly be relied upon for process studies where small scales, terrain, and land use make observationally based approaches difficult. Hence the model representation of key aspects of these processes must be validated, and studies must be conducted to assess the best observing strategies and practices (what, when, where to observe; what would be the impact of gap-filling radars and other observing systems, etc.) to improve the models. The latter interest applies equally at the mesoscale as well as storm scales.

Investigators should be cognizant of the Steering Committee recommendation to conduct a major field campaign broadly related to mesoscale aspects of low-CAPE environments in ~ 2020. Hence research that can be used to inform the observing strategies of that experiment are strongly encouraged. Studies that assimilate, or use for validation, data collected in the 2016 and 2017 spring observing campaigns are strongly encouraged. Observing System Simulation Experiments, Observing System Experiments, physics sensitivity, and Ensemble Sensitivity Analysis approaches are especially encouraged.

This topic does not include process studies per se, but instead is intended to benefit the planning and effectiveness of future process studies. Topic I.B.1.d describes process study objectives.

b. Analysis of 4-dimensional (4D) flow and state in complex terrain

Future VORTEX-SE studies, including processes related to tornado formation as well as electrification, will require reliable quantification of the 4D flow. This topic supports studies and validation of methods and approaches to the problem. Because direct validation would be beneficial, investigators are encouraged to work with 2017 Spring Campaign observing platform operators to acquire sufficient necessary direct validation observations (e.g. vertically-pointing, Velocity-Azimuth Display [VAD], or Range-Height Indicator [RHI] radar data). Investigators are encouraged to incorporate data collected in the 2016 and 2017 spring in their research approach.

c. Observations of boundary layer heterogeneity

The 2016 and 2017 field campaigns of VORTEX-SE will likely produce data sets suitable for studies of boundary layer evolution and heterogeneity, especially at the 10-100 km scales. Studies that provide insights into the evolution of CAPE and shear in low-CAPE environments are especially needed in anticipation of a larger field campaign around 2019-2020 focused on issues surrounding low-CAPE environments in the Southeast.

d. Preliminary studies of vertical drafts, cold pools, and electrification in potentially tornadic storms

The roles of downdrafts and cold pools in potentially tornadic storms in the Southeast are poorly understood, as is the role of updraft size, intensity, and evolution in lightning characteristics This topic seeks additional preliminary information about the character of downdrafts and cold pools in Southeast U.S. storms, and possibly their relationship to microphysical processes, as well as studies of draft structure in relation to lightning These studies are likely to be somewhat preliminary and foundational, and should establish ideas for fruitful routes for further new knowledge in subsequent investigations. In particular, investigators should be aware that future field campaigns focusing on storm processes will depend on improving our ability to diagnose and observe those processes.

e. Studies of the role of terrain in modulating tornado potential

A primary focus of the 2017 VORTEX-SE Spring Campaign will be on the role of the Sand Mountain plateau in northeast Alabama in altering the flow and state of the local environment, with possible implications for modulating tornado potential. Proposals are encouraged for investigation of these special data sets, possibly including an emphasis on

how these local effects are depicted in NWP.

f. Understanding and reducing societal vulnerability to tornadoes

This topic has three main emphases that are of a strongly interdisciplinary nature: 1) investigating how physical, social, and economic factors interact to contribute to harm from tornadoes in the Southeast, and which intersections of factors are the most important contributors in different local and household circumstances; 2) understanding different populations' capacities and current practices that can be utilized and leveraged to alleviate vulnerabilities and reduce harm from tornadoes in the Southeast; and 3) understanding the factors and decisions that enhance individual survival of tornadoes under different circumstances. Building improved understanding in the first area is especially critical, to help clarify the "southeast tornado problem" and which types of events, circumstances, populations, etc. are most important to focus on in subsequent years of research.

g. Research on operational forecasting, NWS partners, and the warning and response system

The two main emphases in this topic are 1) investigating forecasters' interpretations and use of different types of information in decisions about whether, when, and how to issue warnings and other products; and 2) understanding how uncertainty affects the forecast and warning process (for forecasters and partners) and information gaps that contribute to uncertainty, and how increased use of probabilistic hazard and warning information could help reduce gaps in the system. This work will provide improved understanding of the interplay between probability of detection, false alarms, and warning lead time, as defined by the NWS, for Southeast tornadoes, while helping establish foundational knowledge about uncertainty that will facilitate a future transition to a more probabilistic approach to warnings. It will also provide important knowledge for prioritizing physical science research and observations, and for developing and testing recommendations for operational improvements in subsequent years of the program.

Investigators are encouraged to consider contemporary activities such as Warn-on-Forecast (http://www.nssl.noaa.gov/projects/wof/) and FACETs (http://www.nssl.noaa.gov/projects/facets/) when developing proposal ideas. FACETs (Forecasting a Continuum of Environmental Threats) is a program that was borne out of NOAA's Weather Ready Nation (WRN) initiatives. FACETs provides a framework to integrate physical, social, and behavioral science insights for effective creation, delivery and application of user-specific decision support information. This is simultaneously a proposed reinvention of the NWS hazard forecasting paradigm; a comprehensive framework to

organize the science, technology and practices needed to achieve that reinvention; and a potential delivery mechanism for high-resolution, probabilistic guidance from numerical weather prediction ensembles. Also, as appropriate, investigators are encouraged to connect their research to NOAA's Warn-on-Forecast research program, which seeks to dramatically increase tornado, severe thunderstorm, and flash flood warning lead times using probabilistic hazard guidance that is provided by an ensemble of forecasts from convection-resolving numerical weather prediction models

h. Risk communication, risk perception, and information use in protective decision making (with a focus on members of the public and other end-users)

This topic has two primary emphases: 1) understanding the interpretations and uses of probabilistic hazard information, warnings and other information (including the roles of actual and perceived false alarms and near misses, experience, structure type and sheltering options, cultural factors, and so on) among different members of the public in different circumstances; and 2) investigating intersections among information, vulnerabilities and capacities, and protective decision making. This work will provide an important foundation for investigating more specific research questions and developing and testing recommendations for improving risk communication and protective decision making in subsequent years of the program. Interdisciplinary proposals could, for example, possibly involve operational meteorologists, fluid dynamics theoreticians and modelers, structural engineers, and social/behavioral researchers. Investigators are encouraged to consider Warn-on-Forecast and FACETs when developing proposal ideas.

2. INFRASOUND UNDERSTANDING, DETECTION, AND WARNING OF TORNADOES COMPETITION

The following program priorities are among the most important activities that NOAA would support to help demonstrate the potential value of infrasound technology for tornado understanding, detection, and warning, especially when applied to the southeast U.S. Collection and analysis of new infrasonic data in the Southeast U.S. during the project period are highly encouraged.

a. Demonstrate how infrasound information can enhance tornado threat predictive capability of the NWS (e.g., size, strength, lead time, location, etc.)

The operational benefits to the NWS of infrasound for the detection and warning of tornadoes to improve warning lead time have been evaluated in the early 2000's in

coordination with NWS forecast offices in Colorado and Kansas but have not been fully studied.

b. Measure infrasound from tornadic storms also scanned with Doppler and polarimetric radars and observed by storm chasers and compare the data to relate the infrasound characteristic to the physical attributes of tornadoes deduced by the radar or visual observations and to identify the radiating mechanisms responsible for infrasound

The physical mechanisms in tornadic thunderstorms that might generate these acoustic waves is uncertain but has been postulated to be caused by various sources, including radial vibration processes of the vortex core, flow instabilities, and corotating multiple vortices. Past studies suggest some ability to determine vortex size and strength based on the frequency of the infrasound. How might infrasound data fill gaps in areas where radar data is unavailable or unreliable due to terrain blockages or at far ranges?

c. Study infrasound propagation in complex atmospheric environments associated with severe weather (e.g., with outflow boundaries, mesocyclones, high shear) and in regions of complex terrain to determine detectability efficiency by ground networks

Past studies have focused on the high plains of Colorado and not in other diverse regions of the U.S. such as in the Southeast U.S where complex terrain and potentially complex ducting environments may have important effects on infrasound propagation and detection by ground-based observing networks.

d. Collect infrasonic data during IOPs and other times and determine detectability limits of tornadoes and associated errors of detectability in space and time

e. Define the infrasound observing network geometries optimum for regional detection and warning and limits of detection with various configurations, number of required sensors, and spacing

f. Develop improved algorithms for real time processing of infrasonic data and subsequent display that present infrasonic data in quickly-accessible forms that can be easily interpreted by operational meteorologist forecasters, for example by overlaying with radar, storm reports, or other ancillary data sources for verification.

C. Program Authority

49 U.S.C. 44720(b)

II. Award Information

A. Funding Availability

It is expected that in Fiscal Year (FY) 2017 NOAA will fund 10-20 VORTEX-SE projects and about two infrasound projects. Total two-year funding amounts per project are limited to no more than $300,000 for the VORTEX-SE competition and no more than $250,000 for the infrasound competition. For the case of multi-institution projects, these amounts are total per-project amounts, not per-institution amounts. Funding of any proposals is contingent upon availability of these funds.

B. Project/Award Period

The period of awards is up to two years. Release of the funding for the second year is contingent upon a favorable review near the end of the first year.

C. Type of Funding Instrument

The funding instrument for the top selected projects will be a grant, or, if there is proposed substantial involvement of NOAA scientists in projects funded by this notice, a cooperative agreement. Examples of substantial involvement may include, but are not limited to, applications for collaboration between NOAA scientists and a recipient scientist or contemplation by NOAA of detailing Federal employee personnel to work on proposed projects. NOAA will make decisions regarding the use of a grant or a cooperative agreement on a case-by-case basis. For projects involving investigators from multiple institutions, separate grants or cooperative agreements will be issued to each institution that submits a winning proposal.

If the applicant is a university that has a NOAA Joint or Cooperative Institute (CI), the institution is encouraged to submit a proposal on behalf of the CI. The proposal must specify the name of the CI, its award number, and the NOAA-approved research theme applicable to the work to be performed in the proposal's project narrative. The proposal will use the facilities and administrative rate (F&A or Indirect cost rate) associated with the main CI award.

If the CI proposal is selected for funding, NOAA will notify the university that a separate competitive award will be issued with its own award number. However, the competitive award will include a Special Award Condition (SAC) that evidences the link between it and the CI award. The SAC would provide (1) that the university has submitted the proposal on behalf of the CI; (2) that the existing University/NOAA MOA will be incorporated by

reference into the terms of the competitive award, and (3) that any progress report(s) for the competitive award must follow the timetable of and be submitted by the CI directly to the funding program. Copies of these progress reports will be attached to the CI's performance report as an appendix.

III. Eligibility Information

A. Eligible Applicants

Eligible applicants are institutions of higher education; other nonprofits; commercial organizations; or state, local, and Indian tribal governments. Federal government employees are ineligible but may serve as unfunded co-I's on applications where substantial federal involvement is proposed.

B. Cost Sharing or Matching Requirement

No cost sharing is required under this program.

C. Other Criteria that Affect Eligibility

None.

IV. Application and Submission Information

A. Address to Request Application Package

Application packages for full proposals are available at: www.grants.gov/web/grants/applicants/apply-for-grants.html.

B. Content and Form of Application

The instructions for preparation of full proposals provided below are mandatory. Failure to adhere to these requirements will result in proposals being rejected and returned without review. Please carefully review and apply this application information.

1. Full Proposal

(a) The full application (proposal) must be dated and display page numbers. It must include a title page that identifies each Principal Investigator (PI) and co-PI and the respective institutional representative by full name, title, organization, telephone number, mailing address, e-mail address. Identify the NOAA FFO competition number and the most appropriate category from section I (either VORTEX-SE or Infrasound).

The title page must include a brief table at the bottom showing the total requested funds for each annual period for each institution that is contributing to the project. If there are several institutions submitting separate applications for the same joint project, the names of all institutions along with their lead PI information and total requested funding for each annual period for each institution must appear on the title page of each of the applications.

(b) A one-page abstract must be included and must contain a concise summary of the proposed work to be completed and the identification of the most appropriate category from section I. The abstract must appear on a separate page, headed with the proposal title and the name(s) of the PI(s) and their home institution(s).

(c) All proposals must provide a Statement of Work that includes:

(1) The proposed duration of the project from one to two years;

(2) The proposed work must be completely described, including: identification of the problem to be addressed and its relevance to the specific science priorities identified in Section I.B; the conceptual framework; scientific hypotheses and objectives; results from prior research; proposed methodology and work plan; and any operational applicability. Include a reference list at the end with the most important references;

(3) Project deliverables (expected analyses, results, etc., that would be described in the research performance progress reports);

(4) A timeline with key milestones for conducting the research and delivering the scientific and technical results over the course of the project;

(5) A description of travel associated with data collection, project meetings, and the presentation of results at scientific conferences.

(6) A description of the interdisciplinary aspects of the project, and/or the proposed collaborations with other individuals/groups in the weather enterprise (e.g. the National Weather Service, emergency managers, the private sector) involved in identifying, detecting, communicating, and/or mitigating tornado hazards and risks.

(7) If data sets are utilized that are not yet publicly available, a description of the data access arrangements that have been made with the persons or institutions managing that data.

The above Statement of Work items in IV.B.1.(c).1-7 must be fully contained within no more than TEN PAGES (not including reference list) using a 12-point font and one-inch margins. For applications from multiple institutions for the same joint project, identical SOWs are typically submitted in each separate institution's application, but they must clearly describe the work contributions of each PI and institution.

(d) An abbreviated Curriculum Vitae (CV) for the PIs, co-PIs, and co-Is with a reference list of all publications within at least the last three years must be included. CV's are not needed for collaborator partners.

(e) Current and pending financial assistance support: Each investigator must submit a list that includes project title, supporting agency, investigator months, total dollar value and duration. Requested amounts should be listed for pending support.

(f) Data Management Plan: See section VI.B.4 below for details and required submission of this information as a part of the full application.

(g) The full proposal package includes the information described in this section as well as the required federal forms: (1) Application for Federal Assistance (SF-424), (2) Budget Information - Non-Construction Programs (SF-424A), (3) Certifications (CD-511), (4) Assurances - Non-Construction Program (SF-424B), and (5) Disclosure of Lobbying Activities (Standard Form LLL). Applicants must use the Standard Form SF 424A Budget Information-Non Construction Programs that is contained in the standard NOAA Grants and Cooperative Agreement Package. Pay careful attention to show the yearly budget breakout on the SF 424A for multi-year proposals.

(h) All applicants must submit (in addition to the above SF-424A) a detailed itemized Budget Table within the Budget Narrative Attachment section broken out by year that includes the PI's scientific and technical support staff salaries and fringe benefits, facility requirements, computing and communications, supplies and travel. It must also include a detailed Budget Justification that describes and justifies each expense and demonstrates cost effectiveness (refer to the NOAA budget narrative guidance at http://www.ago.noaa.gov/grants/training.html). The information on the SF-424A and this separate budget table must be consistent and should include only the amount of funding that will be provided to the institution submitting the proposal. It should not include budget information for PIs or co-PIs at other institutions who are contributing to the joint project since that information should be included in their own separate application. However, in cases of multiple applications from separate institutions associated with the same project, the summary budget table is still required to be included at the bottom of the title page as

described above in Sec. IV.B.1.a.

If indirect charges are included in the budget, applicant must have an approved negotiated Indirect Cost Rate Agreement. If an applicant has not previously established an indirect cost rate with a Federal agency they may choose to negotiate a rate with the Department of Commerce or use the de minimis indirect cost rate of 10% of MTDC (as allowable under 2 C.F.R. §200.414). The negotiation and approval of a rate is subject to the procedures required by NOAA and the Department of Commerce Standard Terms and Conditions Section B.06. The NOAA contact for indirect or facilities and administrative costs is:

Lamar Revis, Grants Officer
NOAA Grants Management Division
1325 East West Highway
9th Floor
Silver Spring, Maryland 20910
lamar.revis@noaa.gov

(i) This announcement does not require any National Environmental Policy Act (NEPA) questions to be answered as part of the application. This will be done after project selection. For additional information on NEPA, see section VI.B.3.

C. Unique Entity Identifier and System for Award Management (SAM)

To enable the use of a universal identifier and to enhance the quality of information available to the public as required by the Federal Funding Accountability and Transparency Act of 2006, to the extent applicable, any proposal awarded in response to this announcement will be required to use the System for Award Management (SAM), which may be accessed online at https://www.sam.gov/portal/public/SAM/. Applicants are also required to use the Dun and Bradstreet Universal Numbering System and will be subject to reporting requirements, as identified in OMB guidance published at 2 CFR Parts 25, 170 (2013), which may be accessed at http://www.ecfr.gov/cgi-bin/text-idx?SID=1ccffb4c1d4de03addd6a041113460f9&mc=true&node=se2.1.200_1300&rgn=div8
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D. Submission Dates and Times

Complete application packages must be submitted no later than 05:00 p.m. Eastern Time (ET) on Wednesday March 15, 2017. The date and time receipt indication from Grants.gov will be the basis of determining timeliness. Applications received after that time will be rejected and will not be reviewed.

E. Intergovernmental Review

Applications under this program are not subject to Executive Order 12372, "Intergovernmental Review of Federal Programs."

F. Funding Restrictions

NOAA will not accept proposals for projects related to the engineering development of new or improved infrasonic, radar, or other meteorological observational sensor hardware. Existing or off-the-shelf hardware or field experiment equipment is expected to be used where appropriate.

NOAA will not accept more than one proposal for joint projects with identical (or nearly identical) statements of work that are submitted from the same institution (i.e., an institution cannot be considered for more than one funded grant for the same project and must abide by the project funding limits specified in Sect. II.A).

Funding beyond the first year will be dependent upon satisfactory performance and the continued availability of funds.

G. Other Submission Requirements

Complete application packages must be submitted electronically through the http://grants.gov website by the due date. Applicants should note that it can take between 3-5 business days or as long as 3 weeks to register with Grants.gov if all steps are not completed in a timely manner, and registration is required only once. Users of Grants.gov will be able to download a copy of the application package, complete it offline, and then upload and submit the application via the Grants.gov site. If an applicant has problems downloading the application forms from Grants.gov, contact Grants.gov Customer Support at 1-800-518-4726 or support@Grants.gov. To use Grants.gov, applicants must have a Dun and Bradstreet Universal Numbering System (DUNS) number and current registration in the System for Award Management (SAM) system. Applicants should allow a minimum of five days to complete the SAM registration. Registration is required only once, but must be renewed periodically. In all, there are approximately five steps needed to set up your organization's Grants.gov account (see http://www.grants.gov/applicants/get_registered.jsp).

V. Application Review Information

A. Evaluation Criteria

Applicants are required to address in their proposal the criterion described in this section

which are the fundamental basis for reviewing, scoring, and ranking of the proposals. The evaluation criteria and weighting of the criteria are as follows for both competitions (for a total of 100 points):

1. Importance/Relevance and Applicability of Proposed Project to Program Goals (30 points)

This criterion ascertains whether there is relevance to NOAA, federal, regional, state, or local activities, and whether the proposed activity is aligned with project objectives. The reviewers will consider the following questions in their assessment of this criterion:

How well does the proposal address one or more of the NOAA science priorities listed in Section I.B?
How does the proposed activity enhance NOAA's strategic plan and mission goals? Does the study address an important problem?
How will scientific knowledge be advanced?
Does this activity serve to identify gaps in current understanding and provide a foundation for future focused investigations consistent with the VORTEX-SE Science Plan and infrasonic objectives and priorities?
Will this activity improve concepts or methods that drive the field of study?
Does the project employ novel concepts, approaches or methods?
Does the project expect to provide significant new knowledge through a single award with no assumptions regarding follow-on support?
To what extent can it be shown that the proposed activity will lead to improved operational forecasts, warnings, and societal response?
Does the proposed activity involve interdisciplinary research, such as between the physical and behavioral and social sciences?
Does the proposed activity involve direct collaboration with elements of the weather enterprise involved in identifying, detecting, and communicating tornado hazard information, and mitigating tornado risk? Such elements might, for example, be the National Weather Service, emergency managers, or private forecasting entities. Does the proposed activity specify the means by which the research will be coordinated, shared, communicated and managed between the various communities?

2. Technical merit (35 points)

This criterion assesses whether the approach is technically sound and/or innovative, if the methods are appropriate, and whether there are clear project goals and objectives. The reviewers will consider the following questions in their assessment of this criterion:

Is the conceptual framework, design, methodology, and proposed analysis adequately developed, well-integrated, and appropriate for the goal of the project?
Is the scope of the proposal appropriate for a short-duration grant and limited new observations?
Does the applicant acknowledge potential problem areas and consider alternatives to mitigate risks?
Does the proposal include metrics that evaluate the success or failure of the project?
Does the proposal include appropriate milestones for this project?

3. Overall qualifications of applicants (20 points)

This ascertains whether the applicant possesses the necessary education, experience, training, facilities, and administrative resources to accomplish the project. The reviewers will consider the following questions in their assessment of this criterion:

Does the environment in which the work will be done and the project management plan contribute to the probability of success?
Do the proposed activities take advantage of unique features of the intended environment or employ useful collaborative arrangements?

4. Project costs (10 points)

The project's budget is evaluated to determine if it is realistic and commensurate with the project needs and time-frame. The reviewers will consider the following questions in their assessment of this criterion:

Are the requested costs realistic, reasonable, allowable, allocable, necessary and commensurate with the project needs and time period?
Has the applicant proposed cost-efficient ways of accomplishing the project and collaborating with other project participants?

5. Outreach and education (5 points)

This criterion assesses whether the project provides a focused and effective education and outreach strategy regarding NOAA's mission to protect the Nation's natural resources. The reviewers will consider the following questions in their assessment of this criterion:

Does the proposal include a plan for sharing project progress and results with the general public through a web site?

Does the proposal include the publication of the results in a peer-reviewed publication and presenting results at a national conference or workshop?
Does the proposal promote the education and field experience of undergraduate and graduate students, and/or are opportunities developed to share with K-12 educators?

B. Review and Selection Process

Once a full application has been received, an administrative review will first be conducted to determine compliance with all submission requirements, completeness of the application, and responsiveness to the NOAA priorities in Section I.B. If all requirements are satisfied and the application is responsive to the NOAA priorities, the application will move to the next stage of review. If not, the application will be rejected and the PIs will be notified.

All compliant proposals will then receive an objective review in two stages. In Stage 1, independent peer mail reviews consisting of at least three subject matter experts who may be Federal and non-Federal Government employees will evaluate applications using the last four evaluation criteria specified in section V.A.2-5: technical merit, overall qualifications of applications, project costs, and outreach. The independent reviewers' scores will be averaged to obtain Stage 1 average score for each application. Applications that received a Stage 1 average score of 40 or higher (out of 70) will advance to the Stage 2 review process.

In the Stage 2 review process, a separate panel of at least three Federal and/or non-Federal Government subject matter experts will evaluate each remaining application for the evaluation criteria V.A.1: importance/relevance and applicability of proposal to the program goals. Each panelist will provide a score ranging between 0-30 for each application. They will have access to Stage 1 scores and comments for each application. All Stage 2 panelist’s scores for each application will be averaged to obtain Stage 2 average score for each application.

To determine the final score for each application, the Stage 1 average score will be added to the Stage 2 average score. These final scores for each application will be used to determine the rank order of the proposals for the competition. The NSSL Director will assess the rankings and evaluations and make a fund or do-not-fund recommendation to the OWAQ Director, who is the selecting official and will then make selection recommendations to the NOAA Grants Officer. Any application considered for funding may be required to address the issues raised in the evaluation of the application by the reviewers, program officer, selecting official, and/or grants officer before an award is issued.

C. Selection Factors

The merit review ratings shall provide a rank order to the Selecting Official for final funding recommendations. The OWAQ Director shall recommend awards in the rank order unless the applications are justified to be selected out of rank order based upon one or more of the following factors:

1. Availability of funding

2. Balance/distribution of funds:
   a. Geographically
   b. By type of institutions
   c. By type of partners
   d. By research areas
   e. By project types

3. Whether this project duplicates other projects funded or considered for funding by NOAA or other federal agencies.

4. Program priorities and policy factors.

5. Applicant's prior award performance.

6. Partnerships and/or participation of targeted groups.

7. Adequacy of information necessary for NOAA staff to make a NEPA determination and draft necessary documentation before recommendations for funding are made to the Grants Officer.

D. Anticipated Announcement and Award Dates

Funding for approved projects is anticipated to begin September 1, 2017. Applicants should use this date as their proposed project start date.

VI. Award Administration Information

A. Award Notices

Applicants will receive notification from NOAA that their application has either been recommended or not recommended for funding to the NOAA Grants Management Division after completion of the review process. All applicants will receive their average scores for their application and overarching reviewer comments. Notices of recommendation for

funding are not an authorization to initiate the project. Official notification of funding, signed by a NOAA Grants Officer, will come later if approved and is the only authorizing document that allows the project to begin.

B. Administrative and National Policy Requirements

1) Department of Commerce Pre-Award Notification Requirements

The Department of Commerce Pre-Award Notification Requirements for Grants and Cooperative Agreements contained in the Federal Register notice of December 30, 2014 (79 FR 78390) are applicable to this solicitation and may be accessed online at http://www.gpo.gov/fdsys/pkg/FR-2014-12-30/pdf/2014-30297.pdf

2) Limitation of Liability

Funding for programs listed in this notice is contingent upon the availability of continuing Congressional appropriations. Applicants are hereby given notice that funds have not yet been appropriated for the programs listed in this notice. In no event will NOAA or the Department of Commerce be responsible for proposal preparation costs. Publication of this announcement does not oblige NOAA to award any specific project or to obligate any available funds.

3) National Environmental Policy Act (NEPA)

NOAA must analyze the potential environmental impacts, as required by the National Environmental Policy Act (NEPA), for applicant projects or proposals which are seeking NOAA federal funding opportunities. Detailed information on NOAA compliance with NEPA can be found at the following NOAA NEPA website: http://www.nepa.noaa.gov/, including our NOAA Administrative Order 216-6 for NEPA, http://www.nepa.noaa.gov/NAO216_6.pdf, and the Council on Environmental Quality implementation regulations, http://energy.gov/sites/prod/files/NEPA-40CFR1500_1508.pdf. Consequently, as part of an applicant's package, and under their description of their program activities, applicants are required to provide detailed information on the activities to be conducted, locations, sites, species and habitat to be affected, possible construction activities, and any environmental concerns that may exist (e.g., the use and disposal of hazardous or toxic chemicals, introduction of non- indigenous species, impacts to endangered and threatened species, aquaculture projects, and impacts to coral reef systems). In addition to providing specific information that will serve as the basis for any required impact analyses, applicants may also be requested to assist NOAA in drafting an environmental assessment, if NOAA determines an assessment is required. Applicants will also be required to cooperate

with NOAA in identifying feasible measures to reduce or avoid any identified adverse environmental impacts of their proposal. Failure to do so shall be grounds for not selecting an application. In some cases if additional information is required after an application is selected, funds can be withheld by the Grants Officer under a special award condition requiring the recipient to submit additional environmental compliance information sufficient to enable NOAA to make an assessment on any impacts that a project may have on the environment.

4) Data Management Plan

a. Environmental data and information collected or created under NOAA grants or cooperative agreements must be made discoverable by and accessible to the general public, in a timely fashion (typically within two years), free of charge or at no more than the cost of reproduction, unless an exemption is granted by the NOAA Program. Data should be available in at least one machine-readable format, preferably a widely-used or open-standard format, and should also be accompanied by machine-readable documentation (metadata), preferably based on widely used or international standards.

b. Proposals submitted in response to this Announcement must include a Data Management Plan of up to two pages describing how these requirements will be satisfied. The Data Management Plan should be aligned with the Data Management Guidance provided by NOAA in the Announcement. The contents of the Data Management Plan (or absence thereof), and past performance regarding such plans, will be considered as part of proposal review. A typical plan should include descriptions of the types of environmental data and information expected to be created during the course of the project; the tentative date by which data will be shared; the standards to be used for data/metadata format and content; methods for providing data access; approximate total volume of data to be collected; and prior experience in making such data accessible. The costs of data preparation, accessibility, or archiving may be included in the proposal budget unless otherwise stated in the Guidance. Accepted submission of data to the NOAA National Centers for Environmental Information (NCEI) is one way to satisfy data sharing requirements; however, NCEI is not obligated to accept all submissions and may charge a fee, particularly for large or unusual datasets.

c. NOAA may, at its own discretion, make publicly visible the Data Management Plan from funded proposals, or use information from the Data Management Plan to produce a formal metadata record and include that metadata in a Catalog to indicate the pending availability of new data.

d. Proposal submitters are hereby advised that the final pre-publication manuscripts of scholarly articles produced entirely or primarily with NOAA funding will be required to be submitted to NOAA Institutional Repository after acceptance, and no later than upon publication. Such manuscripts shall be made publicly available by NOAA one year after publication by the journal.

5) Unpaid or delinquent tax liability

In accordance with Section 523 of Division B and Sections 744 and 745 of Division E of the Consolidated and Further Continuing Appropriations Act, 2015 (Pub. L. 113-235) or a future public law, an authorized representative of the selected applicant(s) will be required to provide certain pre-award representations regarding federal felony and federal criminal tax convictions, unpaid federal tax assessments, and delinquent federal tax returns.

The form must be completed and submitted with grant applications for: (a) all for-profit and non-profit organization applicants (Part I, and if required, Part II); and (b) all non-Federal entity applicants anticipating receipt of $5 million or more in the current Federal Fiscal Year appropriated funding (Part II only). The form can be found at http://www.ago.noaa.gov/grants/forms.html.

6) Review of Risk

After applications are proposed for funding by the selecting official, the Grants Office will perform administration reviews. These may include assessments of the financial stability of an applicant and the quality of the applicant’s management systems, history of performance, and the applicant’s ability to effectively implement statutory, regulatory, or other requirements imposed on non-Federal entities. Special conditions that address any risks determined to exist may be applied. Applicants may submit comments to the Federal Awardee Performance and Integrity Information System (FAPIIS) about any information included in the system about their organization for consideration by the awarding agency.

7) Freedom of Information Act (FOIA)

U.S. Department of Commerce regulations implementing FOIA are found at 15 C.F.R. Part 4, “Public Information.” These regulations set forth rules for the Department regarding making requested materials, information, and records publicly available under the FOIA. Applications submitted in response to this Federal Funding Opportunity may be subject to requests for release under the Act. In the event that an application contains information or data that the applicant deems to be confidential commercial information which is exempt

from disclosure under FOIA, that information should be identified, bracketed, and marked as "Privileged, Confidential, Commercial or Financial Information." Based on these markings, the confidentiality of the contents of those pages will be protected to the extent permitted by law.

C. Reporting

Award recipients will be required to submit performance (technical) and financial reports via NOAA's Grants Online system. Performance reports must follow a content template provided by NOAA/OAR. Collaborative project PIs should provide an identical report from each of the separate collaborating institutions that clearly identifies what work each institution did. All reports will be submitted on a semi-annual schedule and must be submitted no later than 30 days following the end of each 6-month period from the start date of the award. The comprehensive final report is due 90 days after the award expiration. Copies of all submitted reports will become the property of the U.S. Government.

The Federal Funding Accountability and Transparency Act of 2006 includes a requirement for awardees of applicable Federal grants to report information about first-tier sub-awards and executive compensation under Federal assistance awards issued in FY 2011 or later. All awardees of applicable grants and cooperative agreements are required to report to the Federal Sub-award Reporting System (FSRS) available at www.FSRS.gov on all sub-awards over $25,000.

VII. Agency Contacts

For questions about this announcement contact Richard Fulton at NOAA-OAR-OWAQ at Richard.Fulton@noaa.gov.

VIII. Other Information

To use grants.gov, applicants must have a Dun and Bradstreet Data Universal Numbering System (DUNS) number and be registered in the System for Award Management (SAM). [Note: Your organization's Employer Identification Number (EIN) will be needed on the application form.] Applicants are strongly encouraged not to wait until the application deadline data to begin the application process through grants.gov.