FY2021 Weather Program Office Research Programs

TABLE OF CONTENTS

NOTICE OF FUNDING OPPORTUNITY

EXECUTIVE SUMMARY

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

Funding Opportunity Title: FY2021 Weather Program Office Research Programs

Announcement Type: Initial

Funding Opportunity Number: NOAA-OAR-WPO-2021-2006592

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

Dates: For each of the three competitions within this Fiscal Year 2021 funding opportunity, full applications must be received by 5:00 pm Eastern Time (ET) on November 18, 2020. Applications received after this deadline will not be considered. Pre-proposal Letters of Intent (LOIs) are strongly encouraged for potential applicants to all competitions and must be received by 5:00 pm ET on September 22, 2020, in order to receive a pre-proposal review. Award decisions are expected in April 2021. Grants for all competitions will be up to two years in length and are recommended to begin August 1, 2021, as described in Section II.B "Project/Award Period".

Funding Opportunity Description: NOAA's Weather Program Office (WPO; formerly OWAQ, the Office of Weather and Air Quality) is soliciting proposals for weather, air quality, and earth-system modeling and observations research reflecting multiple science objectives spanning time scales from hours to seasons, and from weather and water observations and earth system modeling to social, and behavioral, and economic science. There will be three grant competitions from this notification valued at approximately $7,750,000 as follows: 1) Joint Technology Transfer Initiative (JTTI), 2) Observations, and 3) Social, Behavioral, and Economic Sciences (SBES).

In alignment with the Weather Forecasting and Innovation Act of 2017 (Public Law 115-25), the funded projects should improve the weather community's understanding and ultimately its services of weather and water forecasting through engagement with the external scientific community on key science gaps of mutual interest. Through this funding opportunity, NOAA will support new weather, water, climate, earth system, and air quality observing and forecasting applications, including improved analysis techniques, better statistical or dynamic forecast models and techniques, and communication of that information to better inform the public.

To achieve success with these objectives, selected projects should focus on advancing science and technology from the research stage to transitionable outputs or prototype products that NOAA or external partners could further develop into practical applications and operations. For the purposes of NOAA-funded projects, the maturity of projects is broadly classified using Readiness Levels (RLs), as adopted by NOAA and other federal agencies. The numerical RL scale from 1 to 9 is designed to track project maturity across the progressive spectrum from research to development to demonstration to deployment. RLs are defined in the context of NOAA's overall process for transitioning funded research into operations, commercialization, or other applications in NOAA's Policy on Research and Development Transitions described in NOAA Administrative Order 216-105B and in Section VIII. Additional information can be found in the Procedural Handbook for NOAA's Policy on Research & Development Transitions at https://www.noaa.gov/organization/administration/nao-216-105b-policy-on-research-and-development-transitions.

Depending on the program objectives, the individual competitions within this notice of funding opportunity may favor projects at specific stages of maturity as signified by their estimated current RL. Program-specific project maturity considerations for funding are included in Section I.A "Program Objective." While all programs in this funding opportunity encourage an acceleration of research toward operationalization and/or other application, no program directly supports an actual research-to-NOAA operations transition (i.e., the RL 8-to-9 transition) itself; the funded projects are, however, expected to work with NOAA operational center representatives to develop strategies if future transitions to NOAA are anticipated.

NOAA, OAR, and WPO encourage applicants and awardees to support the principles of diversity and inclusion when writing their proposals and performing their work. Diversity is defined as a collection of individual attributes that together help organizations achieve objectives. Inclusion is defined as a culture that connects each employee to the organization. Promoting diversity and inclusion improves creativity, productivity, and the vitality of the weather and water research community in which WPO engages.

FULL ANNOUNCEMENT TEXT

I. Funding Opportunity Description

A. Program Objective

1. JTTI

The U.S. faces a spectrum of high impact environmental hazards that cause havoc on people's lives and the nation's economy. Through improved forecasting of the events, better communication and preparedness, loss of lives and property damage can be reduced. While NOAA is the sole U.S. government authority for issuing official weather forecasts and warnings for life threatening events, the broader weather enterprise plays an important role in communication and dissemination of weather information tailored to specific customers.

Through this JTTI announcement, WPO/OAR/NOAA is seeking proposals to support further development, testing and evaluation of mature weather research that has potential for improving NOAA's NWS operational capabilities, with particular emphasis on (i) In collaboration with the Unified Forecast System (UFS) community, further develop, test and enhance data assimilation techniques, develop and evaluate physics, improve model component coupling techniques and capabilities, and utilizing Artificial Intelligence/Machine Learning (AI/ML) for improving forecasts, (ii) Further development and enhancement of physics suite tuning and evaluations, post-processing techniques and tools, and (iii) Improve forecasts and messaging of extreme weather and high impact weather events (e.g., severe convection, winter storms, extreme rainfall). Applicants are encouraged to visit the UFS website (https://www.ufscommunity.org/) and the NWS website (http://www.weather.gov/) to learn more about the NWS current capabilities, as well as the NOSC website (https://nosc.noaa.gov/), the DTC website (http://www.dtcenter.org/testing-evaluation/data-assimilation), and future plans (https://www.weather.gov/news/192203-strategic-plan).

In order to successfully transition new technology to NOAA operations shortly after the completion of selected projects, the JTTI program will focus on projects associated with Readiness Levels 4 to 8. As such, projects that are best suited to submit to JTTI are at a stage where the concept has already been proven to work successfully in the local environment and has potential for further prototype development and testing in a pseudo-operational environment. The potential investigators are highly encouraged to contact one of the NOAA testbed managers if they plan to test their products in a NOAA testbed, website (https://www.testbeds.noaa.gov/). In order for NOAA to successfully transition the new technologies developed as a result of this funding opportunity into NOAA operations,

applicants must identify a NOAA/NWS operational office (receiving party) that will be responsible for testing and evaluation for feasibility to implement the research into operations. Ultimately, the implementation decision lies with the NWS. Applicants are highly encouraged to collaborate (and demonstrate collaboration using the NOAA Collaborator Acknowledgment described in Section IV.B.2.h) with the NOAA/NWS scientists throughout the project (see Section V.A.1.(6) and (7)).

For additional program information on JTTI and this competition, please review the supplemental Information Sheet for the JTTI competition in the grant package associated with this announcement at https://www.grants.gov.

2. Observations

The aim of this competition is to develop and demonstrate innovative sensor and observing technologies that have high potential for advancing an observation systems portfolio that is mission-effective, integrated, adaptable, and affordable.

Surface-based and boundary layer observations serve as critical inputs for the analysis and forecasts of the operational weather and water enterprise for the protection of life and property and enhancement of the national economy. Given that the relative absence of high-resolution surface and planetary boundary layer observations impedes progress in skillful predictions of high-impact and disruptive weather, proposals should focus on technologies 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 and water enterprise including NOAA, the National Mesonet Program, the private sector, and other government sectors.

The scope includes weather and water related observations from the surface through the planetary boundary layer including in-situ surface, profiling, balloon-borne, radar, and airborne and/or unmanned systems (UxS) based technologies. Satellite-based sensors are not included in this scope except to calibrate, validate, or integrate with in-situ observations as a secondary objective.

Realizing that boundary layer and surface-based observations are unevenly distributed in space, time and purpose, proposals of particular interest should leverage in-situ surface, profiling, balloon-borne, radar, airborne, and/or UxS based observing technologies for use in sensing adverse weather phenomena beyond just severe thunderstorms and tornadoes, such as extreme precipitation, extreme temperatures, winter storms, flash floods, tropical

cyclones, and fire weather, and that are cost-effective, widely available, and/or affordably available for purchase, independent of investment beyond the grant award period.

The strongest proposals should:

-include substantial collaboration with one or more operational weather stakeholders with the potential to benefit from the work and deliver sample data to the stakeholders for evaluation during the practical portion of the award period

-clearly document linkage to operational weather needs and demonstrate or allocate effort to understand how new observations may be used in the operational weather enterprise and tailor aspects of the observation collection and instrument design accordingly

-demonstrate potential to transition to operations, applications, or commercialization sometime after the award period.

Opportunities for collaboration with operational stakeholders: As stated above, strong proposals should have substantial collaboration with one or more operational stakeholders. One source of collaboration is with the NOAA/National Weather Service that has 122 Weather Forecast Offices around the country as well as National Centers, National Water Center, River Forecast Centers, and Center Weather Service Units (https://www.nws.noaa.gov/organization.php). Proposers are encouraged to report their planned interactions with NWS offices to Jordan Gerth, Jordan.Gerth@noaa.gov, at the National Weather Service Office of Observations. Other collaborative opportunities include work toward developing innovative observations to improve airborne surveillance and numerical weather models. Observations that will improve the predictive skill of the Unified Forecast System are encouraged (see ufscommunity.org). Other examples of potential collaboration with operational stakeholders include the National Mesonet Program (https://nationalmesonet.us/nmp-partners/) and State Climatologist Programs (https://stateclimate.org/). Engagement with, and participation by the operational weather commercial sector is also encouraged.

Projects appropriate for this competition range from Readiness Level (RL) 5 to RL 7 and have potential to transition to operations, application, or commercialization at either NOAA or the weather and water enterprise within the next 3 to 6 years.

3. SBES

Recent societal impacts from hurricanes, floods, snow storms, and wildfires demonstrate that although there have been considerable advances in weather prediction and forecasting, there is a need to understand the intersection of people and meteorology. A variety of social,

behavioral, and environmental factors “affect how we prepare for, observe, predict, respond to, and are impacted by weather hazards” (NASEM, 2018. doi:10.17226/24865). Thus, social, behavioral, and economic science (SBES) research plays a critical role in connecting NOAA's weather forecast information and improvements to the public’s growing forecast needs. The Weather Research and Forecasting Innovation Act of 2017 further recognizes the importance of SBES integration within the larger weather enterprise by emphasizing the need to improve our understanding of how people (e.g., NWS stakeholders/core partners, forecasters, the public(s) receive, interpret, and respond to warnings and forecasts of weather events that endanger life and property, as well as how to best communicate weather events to various stakeholders.

The WPO Social Science Program (SSP) is dedicated to finding, funding, and fostering collaborative SBES weather research and helps translate findings into potential weather applications. Through this funding announcement, WPO SSP solicits SBES research proposals that benefit the overall weather community. The WPO SSP seeks to involve SBES researchers and social science led, interdisciplinary teams to integrate SBES into meteorological research, forecasting, information displays, and communication of uncertainty. These disciplines include (but are not limited to) anthropology, communication, economics, geography, political science, psychology, and sociology. This program also helps support the underlying SBES components of the Forecasting a Continuum of Environmental Threats (FACETs) framework by prioritizing the communication of uncertainty and probabilistic information. Specifically, this funding call supports interdisciplinary work, applied research, and more broadly, social science research that will advance theoretical findings into applications for the operational forecast community.

Projects appropriate for this competition range from Readiness Level (RL) 2 to RL 7 and have potential to transition to operations at either NOAA or the weather and water enterprise within the next 3 to 7 years. Social science projects aimed at theory and methodological development with respect to a particular application area would fall between RL2–3. Projects advancing existing products or enhancing a well-established methodology would likely fall between RL4–7. NOAA Readiness Levels are defined in Section VIII.

NWS collaborations are strongly encouraged. While transition and implementation decisions lie with the NWS, collaborative efforts help convey the potential value of the project output, especially with NOAA/NWS. These applications could impact the people, processes, and products surrounding the 24/7 operational forecasting process. Applicants are highly encouraged to collaborate with NOAA/NWS throughout the project, especially for projects falling between RL4-7. If the collaborator(s) will contribute a significant amount of time to research and development, a NOAA Collaborator Acknowledgment Form is required

(see Section IV.B.2.d.9).

All projects that involve the use of human test subjects must clearly state so in their application (see Section IV.B.2.d.2 and d.6). If the project includes using secondary data sources and/or analysis of previously collected data, please state so clearly in the proposal.

For additional program information on this competition, please review the supplemental Information Sheet for the SBES competition in the grant package associated with this announcement at https://www.grants.gov.

B. Program Priorities

1. JTTI

WPO, in collaboration with the NWS, developed the following three priorities (each with sub-priorities) for the JTTI Program.

JTTI-1: In collaboration with the UFS community (https://ufscommunity.org/) and/or the UFS/R2O Project (https://www.weather.gov/media/sti/UFS-R2O-Project-Proposal-Public.pdf), further develop, test and enhance data assimilation techniques, develop and evaluate physics, improve model component coupling techniques and capabilities, and utilize Artificial Intelligence/Machine Learning (AI/ML) for improving forecasts:

JTTI-1(a): Test and improve methods for coupled data assimilation strategies for GFSv17/GEFSv13 or other applications within the UFS. This includes (i) developing and testing multi-scale hybrid EnVar (with Joint Effort for Data assimilation Integration (JEDI) if available) for UFS (particularly multi-scale covariance localization), (ii) developing and testing initialization and ensemble strategies for the Rapid Refresh Forecast System (RRFS) (e.g., multi-physics, stochastic physics etc.), (iii) initializing regional nested, coupled domains for the Hurricane Analysis and Forecast System (HAFS), or (iv) further develop and/or improve quality control and bias corrections (utilizing machine learning) for high frequency remote sensing observations (radar, satellite radiance, lightning etc.).

JTTI-1(b): Develop hierarchical testing approaches for land model evaluation and coupling in the context of the UFS. The land models of interest include but are not limited to the current land component in the UFS, but should be ready to run with the UFS by the end of the project. Projects on developing and implementing land-only reanalysis and reforecast datasets and metrics for evaluating the fidelity of UFS in capturing key land processes and land-atmospheric coupling, isolating and quantifying the impacts of the land component on

coupled system particularly in terms of surface temperature and precipitation forecasts from weather to subseasonal timescales, and assimilating land-relevant observations to improve land initiate states, are strongly encouraged.

JTTI-1(c): Accelerate the use of AI in product generation in operations, particularly for better use of existing ensembles, and creation of auto-tuning and auto-calibration capabilities for machine learning techniques to reduce operations and maintenance costs.

JTTI-2: Work with the UFS community (https://ufscommunity.org) and/or the UFS R2O Project (https://www.weather.gov/media/sti/UFS-R2O-Project-Proposal-Public.pdf)to further development and enhancement of physics suite tuning and evaluations, post-processing techniques and tools, to include:

JTTI-2(a): Develop post-processing software for the UFS, including novel algorithms and methods for model bias correction and calibration such as machine learning and artificial intelligence, software optimization and compression techniques, visualization techniques, and probabilistic data sets and statistics derived from ensemble systems.

JTTI-2(b): Physics improvements for the UFS, including: (i) Improve and enhance existing Common Community Physics Package (CCPP) physics parameterizations including addressing known biases. This includes tuning of coefficients or physics parameters, adding new (or unaccounted) processes/forcing terms to existing packages. Test and evaluate these schemes at weather to subseasonal scales, or (ii) Work with the UFS community to develop a systematic evaluation of physics suites (not individual schemes) and tuning of physics configurations (optimization of physics configurations), with a focus on scale-aware physics. For example, should we turn the cumulus scheme on or off for Convection-Allowing Models (CAM)? Or turn on shallow convection only?

JTTI-2(c): Develop novel verification metrics, methods, algorithms, and graphical displays for all UFS applications using METplus, METExpress, and METViewer using existing and emerging data sets to help diagnose systematic errors, test and improve new UFS applications, and provide real-time model performance characteristics.

JTTI-3: Improve forecasts and messaging of extreme weather and high impact weather events (e.g., severe convection, winter storms, extreme rainfall), to include:

JTTI-3(a): Further develop, test and evaluate tools and models that convey probabilistic hazard information to assist forecasters in diagnosing the magnitude and evolution of high impact and extreme weather events.

JTTI-3(b): Further develop, test and evaluate new or improved ways of enhancing forecaster use of probabilistic information, including quantifying impacts, in short-range and medium-range weather forecasts.

JTTI-3(c): Utilize social and behavioral science during the development, testing, and evaluation of forecast tools that can be used to diagnose forecast uncertainty of high impact and extreme events. This includes projects focused on usability, human factors, and co-creation of software development.

2. Observations

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

Obs-1: Extreme temperatures. Extreme temperatures are a public health concern, particularly in urban and suburban areas. High density observations that quantify how extreme temperatures, combined with dew point and wind speed, impact outdoor activities are particularly sought (such as the conditions that children walking to school in the winter, or attending outdoor summertime events would experience) to improve how the public receives messages of apparent temperature and temperature-related hazards.

Obs-2: Aircraft and radiosonde data analysis. Analysis of aircraft data relative to radiosondes, both in time and space, could inform future NWS decisions about allocating resources for one or both observation types. The NWS seeks studies that explore the relative value of in-situ observations providing complementary or duplicative information, evaluating both where there is redundancy in the weather observation network and where there are unfilled gaps, or where there are new types of observations that provide cost-value benefit if adopted more broadly.

Obs-3: Unmanned Aircraft Systems (UAS) data analysis. An analysis or observing system experiment of the quality, consistency, and value of temperature, moisture, and wind observations collected from UAS for assimilation into numerical weather prediction models could enhance NWS operations, investments, and modeling efforts. A proposal of this nature should consider the importance of atmospheric properties with increasing height because UAS would not provide information in the upper troposphere and stratosphere as a radiosonde does. The NWS is also interested if there are certain sites and scenarios where UAS observations are not possible or representative due to local weather conditions or flight

restrictions, and an observational strategy for deciding whether collecting an UAS-based observation is safe.

Obs-4: UxS and expendables. UxS and expendables, including systems deployable from operational hurricane and weather surveillance aircraft, that have high potential for improving operational data such as wind speed and direction, temperature, air pressure, and moisture that forecasters and scientists need to better understand, model, and forecast rapidly intensifying storms.

Obs-5: UAS mapping. Georeferenced observations of floodwater extent from UAS platforms enable collection of data sets for validation of flood inundation mapping approaches. Technologies considered viable include optical imagery showing flooding extent, oblique imagery post-processed to estimate water surface elevation, post-event low-altitude high-resolution imagery showing debris lines. Also of interest is high altitude, high resolution Synthetic Aperture Radar data that offers the potential for near-real time assessment of flooded areas, and rapid estimation of water depth.

Obs-6: Gap filling radars. Small, self-contained radars that provide meteorological insights into deep convection and associated impacts where there is poor or nonexistent radar coverage in the United States, including territories, are of interest. For example, Weather Surveillance Radar (WSR-88D) and terminal doppler weather radar (TDWR) coverage of the U.S. varies. In addition, the United States territory of American Samoa does not have a weather radar despite frequent flash flooding. Proposals involving any radar technology of this nature must explain the anticipated, added benefit of the project for NWS operations and/or societal impact in addition to enhancing a technical or scientific understanding of the equipment or atmosphere, and arrange to deliver the data to NWS operations for use in near real-time at no additional cost to the Government during the grant award period in which it is deployed. Of interest are proposals that leverage a single new radar with low maintenance costs and high data quality, to complement other observations, including existing radar, in-situ, and satellite observations.

Obs-7: Snow observations. Affordable, automated surface-based observations, potentially supported by data analysis, interpretation, and/or processing algorithms, that can provide meteorologists and hydrologists with frequent (hourly or better) surface snowfall information, including new snow accumulation, snowfall rate, snow depth, and snow-water equivalent (SWE), consistent with reporting standards. Automated observations in remote areas that require only seasonal maintenance and do not require external power or communications, and those upstream with or adjacent to transportation corridors and densely populated areas, would be of added benefit. Other potential projects of value include:

-combining winter precipitation datasets, particularly of different observation types (e.g., merging aircraft, UAS, and/or satellite with ground-based observations), toward the goal of a unified, consistent snow dataset spanning multiple decades.

-developing algorithms for snow to SWE.

-analyzing hydrometeor type and density of accumulated winter precipitation.

-airborne and in-situ technologies to collect accurately calibrated and validated SWE estimates throughout the western United States, Alaska, and upper tier to evaluate and support water resource management.

Obs-8: Harnessing data sets of opportunity. Observations that are being collected by commercial industry, states, local authorities, and private citizens, but are not presently part of an operational weather observing network, are of interest. These nonconventional observations include data collected in densely populated urban areas and gaps in the United States and territories observing networks, and surrounding oceans. Examples include but are not limited to networks of personal weather stations, data from smartphones, citizen scientist reports, mesonets, and aircraft data.

Obs-9: Other areas of interest. Including:

-studies that improve the algorithms of existing observing equipment, such as part of the Automated Surface Observing System (ASOS), to provide more accurate or complete observational information for weather services.

-improving the quality of observations through algorithms associated with observing equipment.

-observational studies involving the evolution of the planetary boundary layer in marine environments and coastal areas.

-understanding where there may be complementary or duplicative observations, and where deploying new, affordable observations could enhance the NWS mission with little or no recurring cost for maintenance or development after the award period.

-other innovative observing technologies with high potential for improving weather and water forecasts and services and have strong linkage to operational needs and potential for transition.

-innovative observations needed to improve and validate specific physics packages or processes in component models (e.g., atmosphere, ocean, land, sea ice, wave, atmospheric composition) of the Unified Forecast System (UFScommunity.org).

3. SBES

The WPO Social Science Program (SSP), in collaboration with NWS, developed the

following two priorities:

SSP-1: Develop and test methodologies that systematically collect data on end users. End-users include (but are not limited to) emergency managers, operational forecasters, broadcast meteorologists, public(s), and other weather and water decision makers. Project outputs may include methods or processes that the operational forecast community can use to understand their respective audiences. Methods developed should be accessible to those with no social science training and/or who work within the operational forecasting community. These topics include:

SSP-1(a): Identify, develop, and test methods that lead to understanding the forecaster operational decision environment. This could include uncertainty information needs as it relates to high impact weather events; spatial and temporal resolution needs; and/or information relating to ensembles within the unified, community-based numerical weather prediction modeling suite, as well as observations, tools, technologies, and post-processing needs. This could also include collecting data on inter-office collaboration or community efforts as it relates to operational modeling in the weather enterprise.

SSP-1(b): Identify, develop, and test methods that measure the effectiveness of Impact-Based Decision Support Services (IDSS). This could include collecting needs about physical science information (e.g., information related to timing, uncertainty, severity, and/or lead times for certain types of weather events), technology (e.g., formats, interactivity), and tools (e.g., graphics, interactive, apps). This may also include ways to measure emergency managers' risk/decision thresholds and/or other factors that could influence the effectiveness of IDSS (e.g., geographic differences, strength of relationships, local demographics).

SSP-1(c): Identify, develop, and test methods that measure how the public receives, interprets, perceives, and responds to weather information, especially warnings, with respect to protective action decision-making. This may also include ways to measure factors that influence protective action decision making, such as social and/or physical context(s), prior experiences, and geographical and/or cultural environments.

SSP-2: Improving visual and verbal communication of forecast risk and uncertainty, including probabilistic forecast information, for different hazards at various spatial and temporal time-scales and lead times (e.g., ranging from minutes to subseasonal) including:

SSP-2(a): Activities to improve the visual display of confidence, uncertainty, and/or probabilistic information for forecasters, emergency managers, and/or the public. Visual displays may include the use of static or interactive maps, graphics, virtual reality, or other

creative visualizations. Visual displays may explicitly or implicitly convey probabilistic information. Project outputs may include visuals or research guided recommendations for use by the operational forecast community.

SSP-2(b): Activities leading to improved verbal communication of confidence, uncertainty, and/or probabilistic information for forecasters, emergency managers, and/or the public. Project outputs may include research guided recommendations for the operational forecast community.

SSP-2(c): Activities that increase understanding of how public(s) perceive two or more types of uncertainty as it relates to the communication of a particular weather event. This may include uncertainty of more than one hazard, such as hurricane winds vs. inland flooding, or between more than one variable, such as the temporal vs. spatial uncertainty of a tornado. This may also include examining probability reference classes and/or numeracy scales.

SSP-2(d): Activities leading to the theoretical advancement of how scales, indices, categories, and risk and/or severity levels impact public perceptions of weather risk and uncertainty. This could include the evaluation of design cues, such as the use of colors or numbers, and/or words or phrases to help convey hazard levels.

C. Program Authority

Public Law 115-25 Weather Research and Forecasting Innovation Act of 2017, 15 U.S.C. 8512(c).

II. Award Information

A. Funding Availability

The total available funding and total per-project or per-project-per-year funding limits for each project for each competition are identified below and vary by competition. These estimates are based on anticipated or actual NOAA funding availability. For the case of collaborative multi-institution projects, the amounts identified below are per-project (or annual project total) amounts and not per-institution amounts. Please confirm that the requested funding amounts in your application’s budget satisfy these stated maximum limits before submitting your application to a particular competition. Any proposal that exceeds the stated per-project or per-project-per-year funding limit below for the competition to which it

is submitted will be rejected and not reviewed. For information on the maximum project time period for each competition, please see Section II.B “Project/Award Period” below.

Funds allocated for each competition may be altered depending on the number and quality of proposals submitted within each competition, and federal funding appropriations. Funding of any proposal is contingent upon the availability of these NOAA funds. “M” refers to millions of U.S. dollars. “K” refers to thousands of U.S. dollars.

1. JTTI
   Approximate total grant funding per year: $3.5M
   Expected number of funded projects: 12
   Maximum funding limit per project per year: $300K

2. Observations
   Approximate total grant funding per year: $3.0M
   Expected number of funded projects: 10-15
   Maximum funding limit per project per year: $300K

3. SBES
   Approximate total grant funding per year: $1.25M
   Expected number of funded projects: 8
   Maximum funding limit per project per year: $250K

B. Project/Award Period

The maximum time period of awards and award start date are the same for all selected projects in all three competitions in this announcement (JTTI, Observations, and SBES) and are identified below. Any proposal that exceeds the stated duration will be rejected and not reviewed. The recommended project start date is also defined below for each competition. Applicants are advised to use this date as the project start date in their proposal.

Maximum Award Length: 2 years
Start Date: August 1, 2021

The formal grant award is subject to the availability of funds. It is possible that NOAA may delay the start of some grant awards due to delays in Congressional budget appropriations or other circumstances that would prevent formal grant award by the start date defined by the Principal Investigator (PI) in the proposal package. In these instances, the PI will be informed of any schedule revisions. In the event of a lapse in government

appropriations, assume that there is no change to the regularly scheduled start date unless a revised schedule has been announced.

C. Type of Funding Instrument

The funding instrument for these awards will be either a grant or a cooperative agreement. If it is proposed or anticipated that NOAA employees will be substantially involved in the research or implementation of the project, the funding instrument will be 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 personnel to work on proposed projects. NOAA will make decisions regarding the use of a cooperative agreement or grant on a case-by-case basis based on the nature of the work proposed in the application package. All awards funding projects intending to utilize one of NOAA's testbeds are expected to be awarded as a cooperative agreement due to the planned involvement of NOAA staff in the testbed demonstration testing.

Approved funding allocated for federal NOAA institutions shall be awarded by an intra-agency fund transfer. Inter-Agency Agreement (IAA) fund transfers to non-NOAA federal agencies are not permitted under the funding opportunities in this notice.

For collaborative projects involving investigators from multiple, separate institutions, separate awards will be issued to each institution that submits an approved proposal for those projects.

III. Eligibility Information

A. Eligible Applicants

Applicants are responsible for ensuring that they are eligible for the competition for which they are applying. If any applicants requesting funding are ineligible, the application(s) will be rejected without review.

Eligible applicants are U.S. institutions of higher education; other nonprofits; Cooperative Institutes; U.S.-based commercial organizations; state, local and Indian tribal governments in the U.S.; and other U.S. non-profit organizations. No foreign (based outside of the U.S.) applicants may request funding. NOAA federal employees and contractors proposing to perform work directly for NOAA may serve as co-PIs or co-Investigators (co-

Is) but are ineligible for their salary costs and are required to partner with one or more eligible non-federal institution(s) who would submit the application for the competition through Grants.gov per instructions in Section IV.G “Other Submission Requirements”. Restrictions on requesting federal employee salary and other costs are described in Section IV.F “Funding Restrictions”. Eligibility also depends on the statutory authority that permits NOAA to fund the proposed activity.

Any NOAA federal employee listed as a co-PI, co-I, or collaborator on the title page of a proposal (if eligible) must have provided explicit pre-approval to the PI to be identified as a contributor to the proposed project prior to submission of the application. Do not add a NOAA federal employee to the application without their explicit agreement to participate in your project. Each collaborating NOAA federal institution (including NOAA centers, laboratories, and testbeds) should complete a NOAA Collaborator Acknowledgment Form (attached to this announcement; see Section IV.B.2.h) and attach it to the proposal upon submission.

All funded investigators must assure and verify if requested that they will not be allocated for greater than 100% of their annual employment time should their proposal be selected for funding. NOAA will verify this requirement if the proposal is recommended for funding.

B. Cost Sharing or Matching Requirement

No cost sharing is required under this announcement.

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: https://www.grants.gov/web/grants/applicants/apply-for-grants.html. There is no similar official application package for Letters of Intent (LOIs) other than the requirements identified below in Section IV.B.1.

B. Content and Form of Application

Applicants to all competitions are required to submit a full proposal and are strongly encouraged (but not required) to submit an LOI. The requirements for preparation of full applications provided below are mandatory. Failure to adhere to these instructions will result in LOIs and/or full proposals being rejected and returned without review. Some helpful resources for applicants can be found here: wpo.noaa.gov/nofo.

MULTI-INSTITUTION PROPOSALS. For joint projects spanning multiple applications and institutions, all applications for that project must have the same title and identify the same Lead PI, co-PIs and co-Is on the applications' title page. The designated Lead PI and their associated institution will be responsible for additional documents in the event of multi-organization applications, as described in Section IV.B.2.

For multi-institution collaborative proposals with no subaward agreements, separate proposal packages with identical project titles, title pages, project narratives, and project start dates must be submitted to Grants.gov by each collaborative partner or PI institution who wishes to receive funds directly from NOAA. If any non-federal institution proposed to receive funding directly from NOAA as part of a multi-institution collaborative project fails to submit a full proposal, then all partner proposals may be rejected without review, unless a subaward agreement has been arranged. Federal institutions may not submit a full proposal.

All external proposal package components must be identical among all separate proposal submissions to Grants.gov for a multi-institution collaborative project, with two exceptions: 1) each institution's separate budget information tables and budget justification (which will apply only to their own institution's portion of the collaborative project and not the budgets for any other funded institution), and 2) any other institution-specific documents. Each identical title page must list all funded and unfunded PIs and their institutional affiliation(s), even if from a separate funded institution, for a given joint project.

SUBAWARDS. If a subaward agreement has been arranged with their funded co-PIs such that the full award amount will be distributed directly from NOAA to one institution, then only one project proposal must be submitted (by the Lead-PI's institution) to Grants.gov. Any institutions receiving funding through a subaward by another institution and not directly from NOAA are not required to submit a full proposal. If a subaward agreement has been arranged with their funded co-PIs, only one project proposal must be submitted (by the Lead-PI's institution) to Grants.gov.

SUPPORT FOR NOAA FEDERAL COLLABORATORS. The proposal may request

funding to support the following costs for federal collaborators: project-related travel for federal co-PIs (including to field sites, but excluding travel for conferences, workshops, etc.); infrastructure funding required by a NOAA organization hosting a non-federal PI or co-PI at a NOAA federal facility (e.g., a NOAA Cooperative Institute employee; such as costs for federal office space or computer access); equipment necessary to complete the project; and travel for NWS forecasters in support of project-critical testbed activities. No other funding for federal institutions may be requested as part of this funding opportunity.

The need for federal NWS forecaster travel support must be coordinated with the relevant Testbed Manager(s). Requested support for federal NWS forecaster travel for testbeds may be renegotiated pending availability of NOAA Testbed resources following coordination with NOAA Testbed Managers.

If the proposal is requesting any funding to support NOAA federal collaborators, then the proposal must include a signed letter of commitment from that NOAA host organization's director requesting such funding. Applicants may budget up to, but not more than, 20% of the total proposed budget toward these NOAA organizations' costs. These costs should be clearly identified and justified in the letter but must not be included in the non-federal PI's SF-424 budget documents. These costs should also be included in the budget summary on each application's title page and be identified in the Lead-PI institution's budget summary and budget justification described in Section IV.B.2. This sum will count against the maximum project cost as specified for the competition. The request for these funds will be considered by the WPO Program Manager and, if approved, will be provided directly to the NOAA organization if the proposal is selected. If this proposed funding is not properly documented, the application may be rejected without review.

1. Letter of Intent (LOI)

Prior to submitting a full application package (proposal) for the competitions identified in this announcement, all PIs are strongly encouraged (but not required) to submit a pre-application to NOAA in the form of an LOI for each planned project. For joint projects from more than one institution, only one LOI should be submitted, by the Lead PI. The LOI should provide a concise description of the proposed work and a summary budget table.

The purpose of the LOI review process is to provide feedback to PIs regarding whether NOAA encourages them to submit a full application by assessing relevance and value of their proposed project to the Program's objectives in advance of preparing a more lengthy full application. Following a review, NOAA will respond to all PIs who submit an LOI

either encouraging or discouraging a full proposal. Full applications will be encouraged only for LOIs deemed most relevant to this announcement's priorities and potentially valuable to NOAA's mission. However, PIs who do not submit an LOI or who are not encouraged by NOAA to submit a proposal after review of their LOI will not be precluded from submitting a full proposal. PIs will be provided, upon request, a short synthesis of the factors from the review that led to the recommendation.

The LOI should be submitted via email to oar.wpo.competitions@noaa.gov no later than 5:00 p.m. Eastern Time (ET) on September 22, 2020. Refer to Section IV.D for LOI submission information.

(a) The LOI must be no more than two pages in length, using a 12-point font and one inch margins, and it must include a project header at the top with the following information: title, the name(s) of all PI(s) and co-PIs, their home institution(s), and the name of the specific funding competition identified in Section I to which they are applying.

(b) The LOI must contain a brief description of the intended project, methodology, timelines, and project outputs/outcomes, in addition to its relevance to one or more of the specified priorities identified in Section I.B. Identify the potential operational recipient(s) of the project outcomes/outputs. If a potential recipient is a NOAA organization, identify the specific local weather/river forecast office, national forecast service center, etc.

(c) Briefly describe the current RL (see Section I.A) of the proposed project at start-up and the expected RL at project completion. Also briefly describe any future steps recommended to advance the project output(s) to its ultimate application, operationalization (by NOAA), or commercialization. Clearly state whether the project intends to leverage resources from a NOAA Testbed.

(d) The LOI must include a simple budget table to summarize funding allocation (for example, salaries, computing and communications, indirect charges, and travel). If there are any unusual allocation requests, include a brief justification.

(e) For LOIs that include a request for NOAA high performance computing resources, PIs must include an estimate of needed processing and storage requirements. Due to NOAA’s shortage of high performance computing and storage for research, investigators are strongly encouraged to seek computing resources, including cloud computing resources, from other sources and should be aware that these NOAA resources may not be available for their project.

(f) LOIs will be reviewed by WPO following the criteria specified in Section V.A to assess the potential value of the proposed research to NOAA.

2. Full Proposal

FORMAT. All pages should be single-spaced and set in 12-point font with one-inch margins on 8 ½ x 11 inch paper. The proposal should be submitted as a PDF file. It must be dated and display page numbers. The final proposal must include a project narrative that must not exceed 14 pages, including Sections IV.B.2.(a-k) below (including the title page, abstract, figures, and data management plan), but excluding applicant Curricula Vitae (CVs), reference list, and supporting letters and forms). For separate applications from multiple institutions for the same joint project, an identical project narrative is required in each institution's application, but they must clearly describe the work contributions of each funded PI. The statement of work must contain the following elements:

a) TITLE PAGE (one-page): Provide the following information: each PI and the respective institutional representative by full name, title, organization, telephone number, email address; the mailing address for the institution's PI; the total requested funds for each annual period for the project as a whole, and for each individual institution (including each internal federal and external non-federal institution), including indirect costs; and the competition to which it is being submitted.

If there are several institutions submitting separate applications for the same joint project, the names of all institutions along with their PI information and total requested funding for each annual period for each institution must appear on the title page of each of the separate applications.

b) ABSTRACT (one-page): A one-page abstract that contains a brief, plain-language summary of the proposed work to be completed. It should address the primary project outputs/products, their relevance to NOAA or other operations, and intended research outcomes/benefits and/or long-term societal and be written for an intended audience of non-experts. The abstract must appear on a separate page, headed with the proposal title and the names of all PIs and their institution(s).

c) PROBLEM STATEMENT: Identify the problem to be addressed and/or the opportunity for scientific advancement, and its relevance to one or more of the specific NOAA science priorities identified in Section I.B. If appropriate, please concisely cite results from prior relevant research and/or previously-funded NOAA projects (provide the NOAA project grant

award number, title, and period of performance.)

d) PROJECT OUTPUTS/ PRODUCTS: Identify the planned outputs/products (e.g. instruments, sensors or observing platforms; model codes, software, or algorithms; published data sets or databases; inventions, patent applications, and/or licenses; audio or video products; outreach, education, and training events; publications, conference papers, and presentations). Provide the current/starting and target/project-completion readiness level (RL) with an explanation of how each level was determined.
Per NOAA policy, development of a more comprehensive research-to-operations (R2O) transition plan will be required within 6 months after the project start date if the project is selected for an award and intends to develop beyond RL-4 and/or intends to transition into operations after the completion of the award. Transition plan guidance will be provided by NOAA for applicable projects once the project begins. While a project funded through this notice may not have the sole purpose of benefiting a federal entity (such as NWS), it may be eligible to transition into NOAA operations outside of this award if an operational center expresses interest.

e) OUTCOMES/IMPACT: Identify the planned impacts/outcomes/benefits for this project (e.g. improvements in detection, accuracy, lead time, skill, processing speed, efficiency, cost, knowledge). Identify which specific weather enterprise group or organization is expected to be the ultimate recipient(s) and beneficiary(ies) (end-users) of these project outcomes (e.g., local weather or river forecast offices, a national operational forecast center, a state mesonet, a commercial organization, etc.). Please also include a statement describing the ultimate societal benefits of the proposed project. Briefly describe, qualitatively or quantitatively, how the project’s outcomes contribute to the well-being of society and/or ecosystems. Provide any metrics or performance indicators if appropriate.

f) METHODS AND ACTIVITIES: Provide the key activities and methods that will be conducted to successfully complete the project. This may include information on data collection, analysis, collaborations needed (including needed operational collaborations for transition), and necessary travel (associated with data collection, project meetings, testbed planning meetings, testbed experiments, and the presentation of results at scientific conferences as appropriate). Applicants are encouraged to consider contingencies in the event of scenarios that restrict travel, such as those resulting from COVID-19.

g) TIMELINE with key milestones, products, and expected progression of RLs: Provide a table or chart with a schedule for completing key products, activities, and RLs. Proposals intending to use human test subjects should specify clearly in the timeline approximately when IRB approval will be obtained and when the testing is expected to occur.

h) ADDITIONAL REQUIRED INFORMATION, IF APPLICABLE:

i. Use of Human Subjects: Applicants submitting proposals that involve the use of human test subjects should state so clearly in their application. These proposed research activities require approval of the applicant's Institutional Review Board (IRB) before such research can proceed. Applicants are responsible for obtaining IRB approval from their institution and providing that documentation to NOAA once the approval is obtained and prior to any NOAA-funded human subject testing.

ii. Use of Testbeds: Clearly specify whether the proposed work will involve testing in one of the NOAA Testbeds or Proving Grounds. If yes, state which specific NOAA Testbed or Proving Ground will be used.

iii. High-Performance Computing Request: For applications requesting the use of NOAA's high-performance computing (HPC) platform, include the estimated processing and storage requirements, including expected core hours. It is strongly recommended that any proposal leveraging NOAA HPC include strong collaboration with a NOAA institution. Due to NOAA's shortage of high performance computing and storage for research, investigators are strongly encouraged to seek computing resources, including cloud computing resources, from other sources and should be aware that these NOAA resources may not be available for their project.

iv. NOAA Collaborators and/or Resources: If applicants intend to leverage NOAA resources or unfunded federal collaborators during research and development (beyond only writing a transition plan) through an unfunded collaboration with a NOAA laboratory, center, office, testbed, or proving ground, a NOAA Collaborator Acknowledgment Form (attached to this announcement) should be completed and signed by the lead federal Co-Investigator, relevant NOAA Testbed Manager, or other collaborator(s) and submitted by the Lead PI as part of the proposal package. The proposal package should include one form from each collaborating NOAA laboratory, center, office, testbed, or proving ground. Any federal NOAA collaborators requesting (non-salary) funding through an intra-agency transfer should provide a separate letter (in lieu of the NOAA Collaborator Acknowledgment Form) outlining the request and the commitment to the project. Any leveraged NOAA resources, including (but not limited to) ship or vessel time, aircraft time, HPC time, and observing system time, should be described in the proposal.

v. Reference List: Provide a list with the most important references (optional). This reference list does not count toward the application's page limit. While the full reference list is optional, applicants are still encouraged to include citations as appropriate throughout the

proposal.

vi. National Environmental Policy Act (NEPA): This announcement does not require any NEPA questions to be answered as part of the application. A NEPA evaluation will be completed after project selection. The applicant(s) may be required to answer additional NEPA-related questions if NOAA needs additional information beyond what is described in the proposal package. For additional information on NEPA, see section VI.B.

i) OUTREACH AND EDUCATION: Describe how the project team plans to share project progress and results with the general public(s) and/or scientific community, including but not limited to, a website, hosting workshops, developing training materials, or other engagement activities. Also describe any activities that promote the education and field experience of undergraduate and graduate students, and/or are opportunities developed to share with K–12 educators, as well as any educational scholarship or internship opportunities presented by this project.

j) DIVERSITY AND INCLUSION (D&I). This section should articulate how the proposed project furthers their institution's commitment to diversity and inclusion. A strong D&I statement communicates to the project team and stakeholders that creating and fostering a diverse and inclusive workforce is a priority for the applicant and their institution. Proposals should include, and will be evaluated on (among other criteria; see Section V.A.5), specifics on ongoing or planned project activities that encourage diversity and an inclusive research environment, including, but not limited to:

-a diverse project team;

-utilization of educational and research partnerships with institutions serving minority and underrepresented populations (such as Historically Black Colleges and Universities, Tribal Colleges and Universities, Minority Serving Institutions, NOAA Cooperative Science Centers, and institutions that work in underserved communities);

-utilization of active collaborative programs seeking diversity in science, technology, engineering, and mathematics (STEM);

-involvement with existing education and outreach programs (such as the NOAA Educational Partnership Program); and

-any other initiatives that build the capacity of and materially foster a diverse and inclusive research team and environment.

NOAA values the advancement of scientific knowledge and activities that contribute to the achievement of societally relevant outcomes. Such outcomes include, but are not limited to: full participation of women, persons with disabilities, and underrepresented minorities in STEM; increased public scientific literacy and public engagement with science and

technology; improved well-being of individuals in society; development of a diverse, globally-competitive STEM workforce; increased partnerships between academia, industry, and others; improved national security; increased economic competitiveness of the United States; and enhanced infrastructure for research and education.

k) DATA MANAGEMENT PLAN. Proposals submitted in response to this announcement must include a Data Management Plan. See Section VI.B., Administrative and National Policy Requirements, below for additional information on what the plan should contain. Also refer to your institution's data storing and sharing policies and regulations.

Additional required application content described below is not included in the page count defined above. The 14-page maximum only applies to Sections IV.B.2.(a-k).

l) CURRICULUM VITAE (CV). A CV of 3 pages or less for all PIs, co-PIs, and co-Is. The CV should include a reference list of all publications and conference presentations relevant to the proposed work within at least the last three years. CVs are not required for collaborator partners.

m) CURRENT AND PENDING SUPPORT. Each investigator requesting funding support must submit a list that includes project title, supporting agency, funding start and end months, investigator months, total dollar value and duration. Requested amounts should be listed for pending support.

n) BUDGET. Two budget summaries must be included in each institution's proposal, in addition to the SF-424A Budget Information form and title page budget table: a detailed itemized Budget Table organized by year and a Budget Justification that demonstrates cost effectiveness. This budget summary should include the PI's scientific and technical support staff salaries and fringe benefits, facility requirements, computing and communications, supplies and travel. The information on the SF-424A and this separate budget table must match exactly and should include only the amount of funding that will be provided to the institution submitting the proposal. The SF-424A should not include budget information for PIs or co-Is at other institutions who may be contributing to a joint project. If funding is requested by a NOAA organization to host a non-federal PI or co-I at a NOAA facility, the proposal must also include a signed letter of commitment from the NOAA host organization's director (see Section IV.G).

For collaborative joint projects involving multiple institutions, each institution should provide its own budget table, justification, and SF-424A in its application. The joint project's

Lead PI should additionally include a separate summary budget table in their institution's application that displays the total summary budget for all partners on a joint project in addition to the detailed budget for their own institution. Total funding requested by other institutions (including any federal institutions) must be included in the budget summary table on the title page (see Section IV.B.2). Failure to include all required budget information may be grounds for rejecting the proposal without review.

If indirect charges are included in the budget, the applicant must have an approved negotiated Indirect Cost Rate Agreement and must include it as a part of the application package. Federal or contractor salaries, materials, equipment, and travel expenses are not appropriate to classify as indirect costs. 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 Modified Total Direct Cost (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 Office
NOAA Grants Management Division
1325 East West Highway
9th Floor
Silver Spring, Maryland 20910
lamar.revis@noaa.gov

o) STANDARD FORMS. The full proposal package includes the information described above as well as the required federal forms:

(1) Standard Form 424 - Application for Federal Assistance
(2) Standard Form 424A - Budget Information - Non-Construction Programs
(3) Standard Form 424B - Assurances - Non-Construction Program
(4) Form CD-511 - Certifications Regarding Lobbying
(5) Standard Form LLL - Disclosure of Lobbying Activities

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 page 1A of the SF-424A for multi-year proposals.

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, 31 U.S.C. 6101 note, 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/SAM/. Applicants are also required to use the Dun and Bradstreet Universal Numbering System (DUNS), as identified in OMB guidance published at 2 CFR Parts 25, which may be accessed at https://www.govinfo.gov/content/pkg/CFR-2018-title2-vol1/xml/CFR-2018-title2-vol1-part25.xml.

Applicants should allow a minimum of five days to complete the SAM registration. Registration is required only once, but must be renewed periodically. Each applicant is required to:

(i) Register in SAM before submitting an application;

(ii) Provide a valid unique entity identifier in the application; and

(iii) Continue to maintain an active SAM registration with current information at all times during which it has an active federal award or an application or plan under consideration by NOAA (or any other federal agency).

NOAA may not make a federal award to an applicant until the applicant has complied with all applicable unique entity identifier and SAM requirements. It is recommended that these requirements are satisfied by the application deadline, and if an applicant has not fully complied with the requirements by the time NOAA is ready to make a federal award, NOAA may determine that the applicant is not qualified to receive a federal award and use that determination as a basis for making a federal award to another applicant.

In all, there are approximately eight steps needed to set up your organization's Grants.gov account. It can take between 3–5 business days or as long as 3 weeks to register with if all steps are not completed in a timely manner. Organizations already registered with Grants.gov are not required to re-register but should ensure their Grants.gov password is up-to-date. Additional information about the Grants.gov registration process can be found online at https://www.grants.gov/web/grants/applicants/registration.html.

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 Customer Support at 1-800-518-4726 or support@grants.gov.

D. Submission Dates and Times

LOIs must be received by NOAA via oar.wpo.competitions@noaa.gov no later than 5:00 p.m. Eastern Time (ET) on September 22, 2020 in order to receive feedback. NOAA determines whether an LOI has been submitted before the deadline by the date and time on the email. LOIs received after the deadline will not be reviewed, but in such cases PIs are still permitted to submit a full proposal. On or about 16 October 2020, applicants submitting an LOI will receive an email response from NOAA encouraging or discouraging a full submission proposal.

Full application packages for all competitions must be submitted via Grants.gov no later than 5:00 p.m. Eastern Time (ET) on November 18, 2020. Applications received after that time or via other means (including email) will be rejected and will not be reviewed. The date and time receipt indication from Grants.gov will be the basis of determining acceptance for review processing by NOAA.

In the event of a lapse in government appropriations or other extenuating circumstances precluding NOAA from executing the competitions in a timely manner, assume that there is no change to the regularly scheduled deadlines unless a revised deadline has been announced and published on Grants.gov.

LOI due date: September 22, 2020
Expected NOAA response date on LOIs: October 16, 2020
Full application package due date: November 18, 2020

Applicants are strongly encouraged to not wait until the application deadline date to begin the application process through Grants.gov. Please also consider the amount of time required by your institutional representative to process and submit your application. Plan your time accordingly to avoid being disqualified for a late submission.

E. Intergovernmental Review

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

F. Funding Restrictions

Funding beyond the first year will be dependent upon satisfactory performance and the continued availability of funds. NOAA is not responsible for proposal preparation costs.

NOAA cannot, by federal regulation (31 U.S.C 6303), fund any research work through a federal grant or cooperative agreement in which the grantee proposes to develop or deliver to NOAA any tangible product deliverable beyond research results as reported in standard semi-annual progress reports and final reports, including, for example, software modules that the recipient might wish that NOAA would use for its operational forecasting mission. NOAA cannot fund nor accept any such award deliverables that would be more appropriately funded through a procurement mechanism. However, NOAA may possibly pursue such follow-on contract mechanisms with the recipient after the award ends if the project is successful and follow-on contractual work is warranted. Do not propose to provide NOAA any deliverables other than semi-annual progress reports and final reports as that is prohibited by federal regulations.

NOAA will not fund federal salary costs for federal government employees (NOAA or otherwise) who may propose to serve as a PI, co-I, or collaborator. However, travel or other reasonable and justified costs for federal NOAA employee PIs, co-Is, or collaborators may be requested to be funded as eligible costs only if directly related to the funded project and if approved by NOAA (see Section IV.B). In these approved cases, funds will be transferred directly to the federal employee's organization through an intra-agency fund transfer within NOAA (see Section II.C). Any and all eligible costs associated with supporting a federal employee for a given project must be clearly identified in a separate federal budget table to be included with the application and be justified in an associated federal budget justification section but excluded from the non-federal applicant’s SF-424 budget forms.

Applicants may submit proposals to multiple competitions if the proposals are on different topics and the Lead PI is eligible for each competition. If submitting multiple proposals with the same PI, please acknowledge the other application(s) and, if they are similar, describe the differences between them. NOAA will not accept more than one proposal for any one or more of these NOAA competitions in Section I with identical (or effectively identical) statements of work (i.e., institutions or PIs cannot submit or be considered for more than one funded award among all three competitions for the same or predominantly similar project, as determined by the Program Manager, and must abide by the per-project total funding limits specified in Sect. II.A). If NOAA determines that identical or predominantly identical proposals have been submitted to one or more than one competition, the one that is submitted first to Grants.gov will be accepted by NOAA for consideration and all others will be rejected without review. Multiple proposals on different topics submitted to one or more competitions from the same PI or institution are permitted.

NOAA will not accept separate, related proposals for collaborative projects among multiple PIs and/or institutions that are critically dependent on successful funding of another separate proposal from the same or another PI at the same or different institution to accomplish the respective proposed project objectives. In other words, NOAA funding decisions for any given submitted proposal should not and will not be contingent upon funding decisions of any other separate submitted proposal unless it is a collaborative project with all contributing funded PIs identified on the title page and with funding requested in each respective institution's application that satisfies the maximum per-project (or per-project per-year) funding limits defined in Sect. II.A. For these collaborative projects, a coordinated project proposal must identify all funded PIs and co-PIs from all partnering funded institutions on the title page that will contribute toward a portion of that project proposal's collaborative objectives or outcomes (though each participating institution requesting funding must submit this application to Grants.gov separately from their own institution). WPO will group each of these separate applications together as a joint proposal based on the similar title pages.

Proposal packages that do not satisfy the above restrictions will be rejected without review.

G. Other Submission Requirements

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. If submitting on behalf of the CI, specify in the proposal 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 Specific 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 Memorandum of Agreement 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 the funding program 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.

V. Application Review Information

A. Evaluation Criteria

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

This criterion determines if there is intrinsic value in the proposed work and/or relevance to NOAA, federal, regional, state, or local activities. This criterion is not intended to evaluate technical or scientific merit. The reviewers will consider the following questions in their assessment of this criterion:

(1) How clearly defined is the problem and/or opportunity for scientific advancement targeted by the proposal?

(2) How relevant is the proposed project to the NOAA program objectives and priorities in Section I?

(3) How clearly does the proposal address the problem and/or opportunity for scientific advancement?

(4) How clearly does the proposal link to operational/application needs, gaps, and opportunities?

(5) How appropriate are the proposed end-users in relation to the Program Priorities?

(6) If the applicants intend to collaborate with NOAA (including NWS) or other operational units, how robust is the proposed collaboration (i.e. operational Co-PI, collaborator, letter of support)?

(7) If the applicants intend to collaborate with NOAA federal laboratories, centers, or testbeds, how robust is the information contained in the NOAA Collaborator Acknowledgment Form?

(8) In terms of RLs, how appropriate is the current (i.e., at project start) state for the competition to which it is applying?

(9) How realistic and achievable is the proposed preliminary path to operationalization, commercialization, or other application?

(10) If the project builds on a previous NOAA financial assistance award, did operational/application stakeholders recommend continuation of the project?

(11) If the proposed transition is to NWS operations, does the proposal consider leveraging existing NWS framework(s), infrastructure, and/or concept(s) of operations?

(12) If the project proposes to transition an output to NOAA or other weather/water enterprise operational service capability, how feasible is the proposed transition within 2-5 years of project completion?

(13) How specific and appropriate are the project outputs and products in supporting the program objectives and priorities?

(14) How compelling and impactful are the project benefits and outcomes in supporting the program objectives and priorities?

2. Technical/Scientific Merit (35 points)

This criterion assesses if the proposed approach is technically sound and/or innovative, if the methods are appropriate, and clarity of project schedule and outputs. The reviewers will consider the following questions in their assessment of this criterion:

(1) How technically sound are the proposed methods and solutions to the scientific problem?

(2) How achievable are the proposed methods and solutions to the scientific problem?

(3) How does the proposed project improve technology, concepts, or methods and advance the field of study?

(4) If applicable, how does the proposed project improve technology, concepts, or methods to eventually improve NOAA operations?

(5) How novel are the concepts, approaches, or methods employed?

(6) How clear and feasible is the schedule for milestones, outputs, and advancing Readiness Levels (RLs)?

(7) How clearly defined are metrics to evaluate project success and/or failure?

3. Overall Qualifications of Applicants (15 points)

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

(1) How will the applicant's education, experience, training, facilities, and/or resources help accomplish the project?

(2) How effective are the collaborative arrangements and partnerships needed to accomplish the project?

(3) How effectively has the applicant demonstrated the ability to conduct successful research?

(4) How effectively has the applicant demonstrated the ability to publish peer reviewed articles?

(5) How effectively have the applicant and co-investigators demonstrated experience in transitioning research to operations related to the NOAA priorities in Section I.B?

4. Project Costs (10 points)

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

(1) Are the requested costs realistic, reasonable, allowable, allocable, necessary, and commensurate with the project outputs/products and outcomes/benefits, and time period?

(2) How impactful are the potential benefits relative to the cost?

(3) Has the applicant proposed cost-efficient ways of accomplishing the project?

5. Outreach, Education, Diversity, and Inclusion (10 points)

This section will be scored out of a total of 10 points, with 5 points allocated for Education and Outreach and 5 points for Diversity and Inclusion.

a. Outreach and Education (5 points). This criterion assesses whether the project provides a focused and effective education and outreach strategy regarding NOAA's weather mission to provide weather, water, and climate data, forecasts and warnings for the protection of life and property and enhancement of the national economy. This section will be scored out of 5 points. The reviewers will consider the following questions in their assessment of this criterion:

(1) How well does the proposal include activities or outputs for sharing project progress and results with the general public(s) and/or scientific community through a website, hosting workshops, developing training materials, or other engagement activities?

(2) Does the proposal include the publication of the results in a peer-reviewed publication and presenting results at a national conference or workshop?

(3) 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?

(4) Does this proposal utilize educational scholarship or internship programs?

(5) How well does the proposal describe its Data Management Plan and intentions for sharing data generated during the project?

b. Diversity and Inclusion (5 points). This criterion also assesses the project’s compliance with NOAA’s policy on diversity and inclusion, as defined in Section IV.2.f, and its potential broader impact on D&I. This section will be scored out of 5 points. The reviewers will consider the following elements in their assessment of this criterion:

(1) How clearly does the proposal’s D&I statement describe how the project will address and promote diversity and inclusion?

(2) Does the proposal provide specifics on how the applicants have already implemented

D&I in their group, at their institution, or in the preparation of the proposal (e.g. diverse project team, utilizing new and existing partnerships and programs, etc.)?

(3) Does the proposal provide specifics on how the applicants will further advance D&I in the context of their project (e.g. diverse project team, utilizing new and existing partnerships and programs, etc.)?

B. Review and Selection Process

Once a full application package has been received, an administrative review will first be conducted to determine compliance with all submission requirements, completeness of the application, and general responsiveness to the NOAA priorities in Section I.B. If all requirements are satisfied and the application is responsive to at least one of 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 applications (proposals) will then receive an objective peer review within one of the three competition category pools to which it was submitted. All proposals within a given competition category pool will be competed and ranked against each other. Independent peer reviews consisting of at least three subject matter experts per proposal who may be Federal and non-Federal Government employees will evaluate applications using the evaluation criteria specified in Section V.A.

The JTTI competition will conduct one independent peer review panel of at least 3 reviewers per proposal for Evaluation Criterion #1 in Section V.A and a separate independent peer review panel of at least 3 other reviewers for Evaluation Criteria #2-5. For the Observations and SBES competitions, the same independent peer review panel of at least 3 reviewers will review all the evaluation criteria for a given proposal. In all cases, the independent reviewers' scores will be averaged for each evaluation criteria and summed to obtain the average total score for each application. These final scores for each application will be used to determine the rank order of the proposals for each of the competitions.

Any application considered for funding may be required to address the issues raised in the evaluation of the application by the reviewers, program officer, and/or selecting official before a selection recommendation decision is made, and/or a grants officer before an award is made.

The WPO Director is the designated Selection Official for all competitions in this announcement and will make the final selection recommendations to the NOAA Grants

Officer.

C. Selection Factors

The merit review ratings shall provide a rank order to the selecting official for final funding recommendations. He/she shall recommend awards in the rank order of the review 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

Applications should use the recommended date defined in Section II.B for a given competition as the start date for their proposed project. Review of applications will occur during the 2–3 months following the full application due date. WPO anticipates that funding recommendation decisions on applications will be made in April 2021. Such decisions are contingent upon the final FY 2021 appropriation to NOAA by Congress and the final allocation of funds to OAR by NOAA and actions by the NOAA Grants Officer. NOAA’s

Grants Management Division will normally make award offers approximately one month before the planned start date for each of the competitions (Section II.B). Significant Congressional funding delays after the fiscal year begins may result in delays in the dates of both award recommendation decisions and the awards themselves and could result in awards offers not being distributed until after the proposed project start dates.

VI. Award Administration Information

A. Award Notices

Applicants will receive notification from WPO 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 of the grant award, signed by a NOAA Grants Officer, will come typically two to three months later if approved and is the only official document that authorizes the project to begin.

B. Administrative and National Policy Requirements

DEPARTMENT OF COMMERCE PRE-AWARD NOTIFICATION REQUIREMENTS FOR GRANTS AND COOPERATIVE AGREEMENTS. 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

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.

REVIEW OF RISK. After applications are proposed for funding by the Selecting Official, the Grants Office will perform administrative reviews, including an assessment of risk posed by the applicant under 2 C.F.R. 200.205. 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.

NATIONAL ENVIRONMENTAL POLICY ACT (NEPA). If recommended for funding, applicants whose proposed projects may have an environmental impact will be asked to furnish sufficient information to assist NOAA in assessing the potential environmental consequences of supporting the project. NOAA must analyze the potential environmental impacts, as required by the National Environmental Policy Act (NEPA), for each project which seeks NOAA funding. Detailed information on NEPA can be found at the following NOAA NEPA website: http://www.nepa.noaa.gov/, including our NOAA Administrative order 216-6A for NEPA, http://www.corporateservices.noaa.gov/ames/administrative_orders/chapter_216/216-6A.html and the Council on Environmental Quality implementation regulations.

If needed by NOAA for NEPA assessment, applicants will be asked 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. The 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.

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.

UNIFORM ADMINISTRATIVE REQUIREMENTS, COST PRINCIPLES, AND AUDIT REQUIREMENTS. Through 2 C.F.R. § 1327.101, the Department of Commerce adopted Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards at 2 C.F.R. Part 200, which apply to awards in this program. Refer to http://go.usa.gov/SBYh and http://go.usa.gov/SBg4.

DOC TERMS AND CONDITIONS. Successful applicants who accept a NOAA award under this solicitation will be bound by Department of Commerce Financial Assistance Standard Terms and Conditions. This document will be provided in the award package in NOAA's Grants Online system at https://grantsonline.rdc.noaa.gov/flows/home/Login/LoginController.jpf and at http://go.usa.gov/hKbj.

MINORITY SERVING INSTITUTIONS. The Department of Commerce/National Oceanic and Atmospheric Administration (DOC/NOAA) is strongly committed to increasing the participation of Minority Serving Institutions, i.e., Historically Black Colleges and Universities, Hispanic-serving institutions, Tribal colleges and universities, Alaskan Native and Native Hawaiian institutions, and institutions that work in underserved communities.

DATA SHARING PLAN.

1. 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 must 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.

2. 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 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.

3. 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.

4. Applicants 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 the 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.

FREEDOM OF INFORMATION ACT (FOIA). In the event that an application contains information or data that you do not want disclosed prior to award for purposes other than the evaluation of the application, mark each page containing such information or data with the words "Privileged, Confidential, Commercial, or Financial Information - Limited Use" at the top of the page to assist NOAA in making disclosure determinations. DOC regulations implementing the Freedom of Information Act (FOIA), 5 U.S.C 552, are found at 15 C.F.R. Part 4, which sets forth rules for DOC to make requested materials, information, and records publicly available under FOIA. The contents of funded applications may be subject to requests for release under the FOIA. Based on the information provided by the applicant, the confidentiality of the content of funded applications will be maintained to the maximum extent permitted by law.

C. Reporting

Award recipients will be required to submit project performance (technical) and financial reports via NOAA’s Grants Online system. Performance reports must follow a content template and guidance provided by WPO. PIs of collaborative projects should provide an identical report from each of the separate collaborating institutions clearly identifying the work performed by each institution. 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.

As part of WPO's commitment to sharing research results and other accomplishments, it is anticipated that final project reports and interim summaries will be shared publicly. Grantees must mark personally/organizationally identifying information, confidential/proprietary technology, processes, and/or financial information in these reports. Performance reporting guidance will be provided for funded projects.

While not required, project teams are encouraged to increase project and program visibility by publicly sharing progress and results throughout the course of the project. For example, a locally-hosted website could be developed to display examples of product output. These visibility endeavours should be included in NOAA progress reports.

All dissemination of results, including publications and written or oral presentations, supported by this funding opportunity should acknowledge WPO and the specific program supporting the project.

The Federal Funding Accountability and Transparency Act, 31 U.S.C. 6101, includes a requirement for awardees of applicable federal grants to report information about first-tier subawards and executive compensation under federal assistance awards. All awardees of applicable grants and cooperative agreements are required to report to the Federal Subaward Reporting System (FSRS) available at https://www.fsrs.gov/ on all subawards over $25,000. Refer to 2 CFR Parts 170.

VII. Agency Contacts

For general questions about this announcement, please contact WPO at oar.wpo.competitions@noaa.gov. For specific questions about a specific competition, please contact the appropriate Federal Program Manager below:

JTTI: Dr. Chandra Kondragunta (chandra.kondragunta@noaa.gov; 301-734-1034)
Observations: Dr. Mark Vincent (mark.vincent@noaa.gov; 301-734-1026)
SBES: Dr. Gina Eosco (gina.eosco@noaa.gov; 301-734-1068)

VIII. Other Information

Readiness Level Definitions

RL 1 (Basic Research): Basic research, experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view. Basic research can be oriented or directed towards some broad fields of general interest, with the explicit goal of a range of future applications.

RL 2 (Applied Research): Applied research, original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific, practical aim or objective. Applied research is undertaken either to determine possible uses for the findings of basic research, or to determine new methods or ways of achieving specific and predetermined objectives.

RL 3 (Development): Proof-of-concept for system, process, product, service, or tool; this can be considered an early phase of experimental development; feasibility studies may be included.

RL 4 (Development): Successful evaluation of system, subsystem, process, product, service, or tool in a laboratory or other experimental environment; this can be considered an intermediate phase of development.

RL 5 (Development): Successful evaluation of system, subsystem process, product, service, or tool in relevant environment through testing and prototyping; this can be considered the final stage of development before demonstration begins.

RL 6 (Demonstration): Demonstration of a prototype system, subsystem, process, product, service, or tool in a relevant or test environment (its potential is demonstrated).

RL 7 (Demonstration): Prototype system, process, product, service or tool demonstrated in an operational or other relevant environment (functionality is demonstrated in near-real world environment; subsystem components fully integrated into system).

RL 8 (Demonstration): Finalized system, process, product, service or tool tested, and shown to operate or function as expected within the user's environment; user training and documentation completed; operator or user approval given.

RL 9 (Deployment): System, process, product, service or tool deployed and used routinely.