

To: NSF_NCAR@nsf.gov

Who we are: A group of 53 scientists who, in recent years, have led research projects enabled by the NSF NCAR *observational facilities*. This letter represents our consensus response to the recent NSF Dear Colleague Letter “[NSF Intent to Restructure Critical Weather Infrastructure](#)”

Why atmospheric measurement technology is essential to weather prediction.

The cost of hazardous weather conditions, in terms of property, insurance costs, reduced productivity, human health and life continues to climb. As a nation, we need to work tirelessly to better predict and to reduce impacts on health, aviation, ground transport, infrastructure, and the electric grid. NCAR was created in the 1960s at a time when high-level support was needed to advance the promising new technology of numerical weather prediction (NWP) that was pioneered at universities such as Princeton and the University of Chicago. This central support remains as critical as ever, especially as AI computational breakthroughs create opportunities to accelerate probabilistic forecasting not just on standard week-long horizons but also on seasonal timescales, with profound impacts on society, including agriculture, water resource planning, tourism, and insurance.

NSF NCAR supports, amongst other activities, the collection of specialized measurements of the weather, including clouds and precipitation, winds and turbulence, wildfire smoke and air quality, from the surface to the upper atmosphere, over land and sea. These measurements have been and remain essential to inform model representations and predictions that are critically important to make the United States a more weather-ready nation.

NSF NCAR has long served as a central hub that delivers high-quality atmospheric measurements from well-calibrated, reliable, and often novel instruments that are deployed on unique platforms during intensive field operation periods. NSF has funded us (the authors of this letter) and many other scientists based at universities across the nation to conduct research using data from NCAR probes and platforms deployed to target specific weather phenomena, including tornadoes and other hazardous weather. Such deployments, often in coordination with a wide range of public and private partners and stakeholders, as well as other federal agencies, have enabled significant progress in the fundamental understanding of underlying physical processes in the atmosphere. This understanding has led to a better representation of these processes in NWP models at time scales from hours to seasons, which, in turn, has resulted in better awareness of and preparation for storm impacts, leading to reduced loss of life and economic costs of severe and high-impact weather.

Today, our physically based understanding of atmospheric processes is the basis of success of AI prediction models. Trained by a long record of observations (assimilated into dynamical models), AI models are improving medium range (1-2 weeks) forecast skill. AI and machine learning techniques are also being used to produce more refined, short-term forecasts and nowcasts. However, just like the physically based models that NCAR helped pioneer, AI-based forecast and warning systems are ultimately limited by the quality of the observations against which they are evaluated.

The predictive capacity of models (both dynamical and AI models) is constrained by *observations* that are assimilated to define the model's initial state. Dynamical models contain representations of physical processes in the atmosphere, such as cloud formation. These representations are developed and refined using specialized in situ measurements made on the

ground and aloft, and remote measurements from space and from the ground. *New measurement technologies can lead not only to transformational new understanding of atmospheric processes, they may also transition into the operational domain*, resulting in a better description of initial conditions, better training data, and better predictions. A good example is the demonstration that dual-polarization S-band radar measurements—pioneered by NCAR (the S-POL radar) and others in the 1990s—yielded a better understanding of how precipitation grows in clouds, and a better quantitative precipitation estimation. Consequently, NOAA upgraded the NEXRAD national weather radar network to dual-polarization some 15 years ago. More recently, NCAR developed the Micro Pulse Differential Absorption Lidar, which makes highly accurate, reliable, and affordable measurements of water vapor in the lower troposphere—a critical measurement for severe storm prediction. This new technology could become a key component of regional “mesonets” that water and energy utilities are keen to have access to for more informed decision making, e.g., on public safety power shutdowns.

NSF NCAR’s role in advancing and deploying atmospheric measurement technology.

While NCAR continues to push the envelope of measurement technology, it also serves a unique role in making this technology available to the broader US research community through the NSF Facility and Instrument Request Process ([FIRP](#)). *This is a role that cannot be filled by other agencies due to their focused, mission-driven priorities.* For example, NOAA also maintains atmospheric research aircraft, but they are dedicated 100% to hurricane reconnaissance during 6 months of the year. NSF’s airborne and ground-based facilities have supported societally relevant research on a wide range of critical topics, including turbulence that may endanger commercial flights, severe hail-producing thunderstorms that wipe out crops, intense rainfall events that lead to flooding, destructive wildfires and their downstream air quality impacts, snowfall and hazardous winter weather, and water security.

NCAR also supports seamless integration between facility and user-supplied instruments on their observing platforms, which other agencies cannot easily do. *This creates unparalleled opportunities to design custom and comprehensive observing systems to address the most difficult weather-ready challenges.* In addition, NCAR has a unique paradigm whereby scientists from universities, other agencies and the private sector are able to work with NCAR scientists, technicians, engineers and other support staff to transform their ideas into collection of high quality scientific data that test critical hypotheses and lead to enhanced scientific understanding. NCAR and non-NCAR scientists collaborate on every aspect of the project as NCAR is uniquely positioned to provide end-to-end support for observational campaigns, including their experimental design, platform deployments, project operations, data quality assurance, and data curation. This is necessary to produce the highest-quality datasets and enable their rapid public release to accelerate scientific discovery and strengthen preparedness for future weather-related hazards and associated risks.

Certain instruments and platforms within the NSF Facilities for Atmospheric Research and Education ([FARE](#)) program are managed by university P/Is. These so-called Community Instrumentation and Facilities (CIF) can be requested under the NSF FIRP for NSF-funded field and laboratory research. But data quality, platform/instrument reliability, and end-to-end support for large field campaigns would suffer if all NSF-base-funded platforms and instruments were distributed and served by an array of university P/Is.

NSF NCAR's aircraft for atmospheric research

One particularly critical role that NSF NCAR plays is in managing airborne platforms and airborne instrumentation that can be requested by the research community in the United States. The aircraft are modified to fly state-of-the-art instrumentation. NCAR handles modifications, certification, flight planning, and flight operations, ensuring safe and effective flights for scientific discovery. While researchers from across the country can integrate their own instrumentation on the aircraft and entrain students in atmospheric technology, NCAR handles the technical and engineering support and management of logistics and regulations, as only a national center with longstanding expertise can. That is the practice of other countries conducting airborne atmospheric research. NCAR staff play a critical role in calibrating, validating, and curating the acquired datasets for rapid public dissemination. Their essential work ensures that high-quality data are made accessible, in ready-to-access formats to support weather-related research and to confront weather simulations.

We discourage NSF delegating the management of and access to the NSF NCAR C-130 and G-V to other federal entities that operate large aircraft for atmospheric research and/or weather observations, such as NASA Airborne, NOAA, DOE Atmospheric Radiation Measurement (ARM), or the Naval Research Lab (NRL). Similarly we discourage delegation to the private sector. The reason is that fundamental research and experimental instrument deployment would be thwarted. For instance, NASA has a long record of interest in storms, including hurricanes and extratropical storms, mainly to validate and augment spaceborne surface precipitation estimation (TRMM, GPM). This mission focus makes fundamental research on precipitation growth, e.g., ice multiplication, very difficult. We know that abundant secondary ice particle production occurs in some cloud conditions, but we still do not fully understand these conditions and that hampers cloud parameterizations in NWP models. Better understanding requires dedicated airborne measurements. Closer collaboration of the NCAR Research Aviation Facility with their counterparts at other federal entities is always welcome, including on technical/engineering/certification issues, but NCAR has a well-defined niche focusing on the science underlying weather predictability.

Summary. *We urge NSF to continue to house its Lower Atmosphere Observing Facilities (LAOF), including both the airborne and ground-based capabilities, at a national center. A central hub that houses the facilities, the technical and scientific expertise, and data management service is essential for continued leadership in atmospheric technology, and for access to this technology by the NSF-funded community to advance understanding and prediction of weather. In this regard, NCAR fills a unique niche that cannot be filled by other federal agencies, universities, or the private sector.*

In the last decade or so, other countries, especially in Europe (the European Centre for Medium Range Weather Forecasting), have outperformed the United States in weather prediction. This is ironic because Europe experiences no tropical cyclones and no intense tornadoes. *With the rapidly escalating cost of hazardous weather conditions in this country, the United States should urgently reclaim its leadership and establish the gold standard in weather prediction.* There is no question that dismantling NCAR is a step in the wrong direction. NCAR can be improved. Dismantling and rebuilding a national center will be far more time-consuming and expensive.

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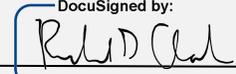
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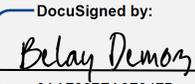
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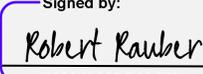
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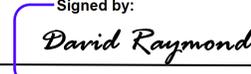
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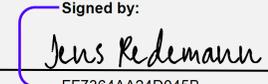
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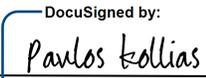
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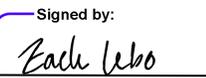
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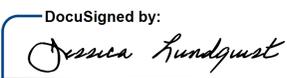
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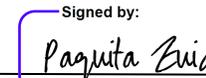
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