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.

X Signed by: Rebecca Adams-Selin
1EB1799BC9F442C...

Dr. Rebecca Adams-Selin,
Principal Scientist, Atmospheric and Environmental Research, Janus Research Group

X Signed by: Bruce Albrecht
FC4523B665D24DA...

Dr. Bruce Albrecht,
Professor Emeritus, Department of Atmospheric Sciences, University of Miami, Miami Florida

X Signed by:
2114FC1BAFCF4E3...

Dr. John Allen,
Professor, Department of Earth and Atmospheric Sciences, Central Michigan University

X DocuSigned by:
53BC252A896645F...

Dr. Elliot Atlas; Professor Emeritus, Department of Atmospheric Sciences, U of Miami, Miami, FL

X Signed by:
846AF2E8A07E4FA...

Dr. Adriana Bailey,
Asst. Professor, University of Michigan, Ann Arbor, MI

X Signed by: Chris Bretherton
6203A85C29FA4B3...

Dr. Chris Bretherton,
Sr. Director of Climate Modeling, Ai2, and Prof. Emeritus, Dept. of Atmos. & Clim. Sci., University of Washington, Seattle, WA

X Signed by: Shane Murphy
657362FC4A3E437...

Dr. Shane Murphy,
Professor, Dept. of Atmospheric Sciences, University of Wyoming, Laramie WY

X Signed by:
6E848E10F9E84CD...

Dr. Stephen Nesbitt,
Professor and Head, Department of Climate, Meteorology & Atmospheric Sciences, University of Illinois Urbana-Champaign

X Signed by:
CD776722A61649B...

Dr. David Nolan,
Professor, Department of Atmospheric Sciences, Rosenstiel School of Marine, Atmospheric, and Earth Sciences, University of Miami

X Signed by:
8064C6EA3C3844D...

Dr. David Parsons,
Emeritus: Director and Presidential Professor, School of Meteorology, University of Oklahoma

X Signed by: Russell Perkins
49829B183934477...

Dr. Russell Perkins,
Research Scientist III, Department of Atmospheric Science, Colorado State University

X Signed by: Claire Pettersen
DB98D8B3A60A447...

Dr. Claire Pettersen,
Assistant Professor, Climate and Space Sciences and Engineering, University of Michigan

Signed by:
X Leila Carvalho
6ADCAD670BAE40C...
Dr. Leila Carvalho,
Professor, Dept. Geography, University of California, Santa Barbara, CA

DocuSigned by:
X Richard Clark
CD75FAF52FF14A1...
Dr. Richard Clark,
Professor of Meteorology Emeritus, Millersville University of Pennsylvania, Millersville, PA

DocuSigned by:
X Paul DeMott
21CB2B7753EA422...
Dr. Paul DeMott,
Senior Research Scientist, Emeritus, Dept. of Atmospheric Science, Colorado State University, Fort Collins, CO

DocuSigned by:
X Belay Demoz
9AA7267EA6F947B...
Dr. Belay Demoz,
Professor, Dept. of Physics, Univ. of Maryland, Baltimore County

DocuSigned by:
X Ankur Desai
373BC39FA8D0434...
Dr. Ankur Desai,
Distinguished Professor and Dept Chair, Dept. of Atmospheric and Oceanic Sciences, University of Wisconsin-Madison, Madison, WI

Signed by:
X Joe Fernando
D98E1359F82F47D...
Dr. Joseph Fernando,
Wayne and Diana Murdy Endowed Professor of Engineering and Geosciences, Notre Dame University, IN

Signed by:
X Zhaoxia Pu
C7C2598A1CE74B6...
Dr. Zhaoxia Pu,
Professor, Atmospheric Sciences, University of Utah

Signed by:
X Robert Rauber
736346A0BEC84F7...
Dr. Robert Rauber,
Professor Emeritus, Department of Climate, Meteorology & Atmospheric Sciences, University of Illinois Urbana-Champaign

Signed by:
X David Raymond
189717ADDE42419...
Dr. David Raymond,
Professor Emeritus of Physics, New Mexico Tech, Socorro NM

Signed by:
X Jens Redemann
FF7364AA24D045B...
Dr. Jens Redemann,
Professor, School of Meteorology, University of Oklahoma, Norman OK

Signed by:
X Greg Roberts
18DF2CD262DA4BE...
Dr. Greg Roberts,
Research Scientist, Dept. of Climate Atmospheric Sciences and Physical Oceanography, Scripps Insitution of Oceanography, University of California San Diego

Signed by:
X Angela Rowe
6374640A77FC4C7...
Dr. Angela Rowe,
Assistant Professor, Dept. of Atmospheric and Oceanic Sciences, University of Wisconsin-Madison, Madison, WI

Signed by:
X Emily Fischer
D930309803B640D...

Dr. Emily Fischer, Professor, Department of Atmospheric Science, Colorado State University, Fort Collins, CO

DocuSigned by:
X Katja Friedrich
3EDAD2597F7E40F...

Dr. Katja Friedrich, Professor and Chair, Department of Atmospheric and Ocean Sciences, University of Colorado in Boulder, CO

DocuSigned by:
X Bart Geerts
30C654F87EDF40C...

Dr. Bart Geerts; Professor, Dept. of Atmospheric Sciences, University of Wyoming, Laramie WY

DocuSigned by:
X
09EF36A5362746E...

Dr. Adam Houston, Professor, Department of Earth and Atmospheric Sciences, University of Nebraska-Lincoln, Lincoln, Nebraska

Signed by:
X
9E711812C14E4F7...

Dr. Jason Keeler, Associate Professor, Department of Earth and Atmospheric Sciences, Central Michigan University

Signed by:
X David Kingsmill
B09050593A17482...

Dr. David Kingsmill, Research Scientist, CIRES, University of Colorado, Boulder, CO

Signed by:
X Courtney Schumacher
DFBC9B3F151841C...

Dr. Courtney Schumacher, Professor, Dept. of Atmospheric Sciences, Texas A&M University, College Station, TX

Signed by:
X Ronald Smith
0F144406AFBA402...

Dr. Ronald Smith, Professor Emeritus, Dept of Earth and Planetary Science, Yale University, New Haven, Connecticut

Signed by:
X Scott Steiger
DDFED2BF2D0C43E...

Dr. Scott Steiger, Professor, Dept. of Atmospheric and Geological Sciences, SUNY Oswego, Oswego, NY

DocuSigned by:
X Bjorn Stevens
2096BB24ACFF493...

Dr. Bjorn Stevens, Professor, Dept. Atmosperic and Oceanic Sciences, UCLA (1999-2009)

DocuSigned by:
X Zeljka Stone
A5B4E2985C91467...

Dr. Zeljka Stone, Research Professor, Physics, New Mexico Tech

Signed by:
X Chenning Tong
26CB357315194DD...

Dr. Chenning Tong, Professor, Dept. of Mechanical Engineeering, Clemson University

Signed by:
X
291953CBD38446A...

Dr. Darin Toohey, Professor, Atmospheric and Oceanic Sciences, University of Colorado Boulder

X DocuSigned by: Pavlos Kollias 3069D7E269F642B...
Dr. Pavlos Kollias,
Professor, School of Marine and Atmospheric Sciences, Stony Brook University, NY

X Signed by: 78C27AD9E6A04BA...
Dr. June Wang,
Director, New York State Mesonet, University at Albany

X Signed by: David Kristovich AF1C803A4D474E9...
Dr. David Kristovich
Principal Research Scientist, University of Illinois in Urbana-Champaign, Urbana, IL

X Signed by: Robert Wood 0763E1090C814B3...
Dr. Robert Wood,
Professor, Atmospheric and Climate Science, University of Washington, Seattle, WA

X Signed by: Zach Lebo A296AA315EEE48B...
Dr. Zach Lebo,
Associate Professor, School of Meteorology, University of Oklahoma, Norman, OK

X Signed by: Sandra Yuter 6D68994F1F42401...
Dr. Sandra Yuter,
Distinguished Professor, Department of Marine, Earth and Atmospheric Science, North Carolina State University, Raleigh, NC

X Signed by: Julie Lundquist 93EE2A64D6B8478...
Dr. Julie Lundquist,
Professor, Depts of Earth & Planetary Sciences, Mechanical Engineering, Johns Hopkins University, Baltimore, MD

X Signed by: Paquita Zuidema 17740BE63D62419...
Dr. Paquita Zuidema,
Professor and Chair, Dept. of Atmospheric Sciences, U of Miami, Miami, FL

X DocuSigned by: Jessica Lundquist E3F673A364B64DD...
Dr. Jessica Lundquist,
Professor, Civil and Environmental Engineering, University of Washington, Seattle, WA

X DocuSigned by: Jeffrey Pierce BE48724ECE2C41B...
Dr. Jeffrey Pierce,
Professor and Associate Department Head, Dept. of Atmospheric Science, Colorado State U., Fort Collins, CO

X Signed by: Jay Mace 0C6765576300469...
Dr. Jay Mace,
Professor, Department of Atmospheric Science, University of Utah

X Signed by: Jeffrey Collett 8663CD64C37D454...
Dr. Jeffrey Collett,
University Distinguished Professor, Dept. of Atmospheric Science, Colorado State University, Fort Collins, CO

X Signed by: Paul Markowski BA1E5EF20E824A7...
Dr. Paul Markowski,
Professor, Department of Meteorology, Pennsylvania State University

Signed by: X Shane Mayor C61B257D57EA4D4... **Dr. Shane Mayor, Professor, Earth and Environmental Sciences Department, California State University Chico**	
DocuSigned by: X Greg McFarquhar A0CE75C2A367470... **Dr. Greg McFarquhar, Professor, School of Meteorology, University of Oklahoma; and Director, Cooperative Institute for Severe and High Impact Weather Research and Operations**	
Signed by: X F64D975CC20E491... **Dr. Justin Minder, Professor, Department of Meteorology, University of Albany New York**	