



20 February 2026

Dear National Science Foundation,

Thank you for the opportunity to comment on the proposed restructuring of the **NSF NCAR** and how NSF NCAR serves us as faculty and research scientists at the **University of Wisconsin (UW)-Madison**. UW-Madison is a founding and active member of the University Corporation for Atmospheric Research (UCAR), NSF NCAR's governing body. We have numerous scientific studies in collaboration with NSF NCAR, on atmospheric and oceanic sciences, space weather, environmental engineering, and Earth system science. Our educational mission has benefited greatly from NSF NCAR's resources.

Like other universities across the United States, UW-Madison directly benefits in this way as a result of NSF NCAR's successful integration of Earth observing facilities, next-generation modeling, high performance computation, and workforce education. The integration provided by NSF NCAR has allowed the United States to be a world leader in atmospheric science and Earth system science. It enables complex, multi-disciplinary projects and ground-breaking discoveries that could not otherwise occur. NSF NCAR facilities and expertise are also key components of our educational mission here in Wisconsin.

Separating the facilities, aircraft, computational capabilities, and scientific expertise would weaken a critical integration that has fostered U.S. success in predictive science essential to our economy and security. Such a separation harms the excellence of our own university research and educational experience for our students. Dismantling NSF NCAR would jeopardize U.S. leadership in the field of Earth system science and the critical role that predictive science plays in our society and economy.

UCAR has been key in enabling NSF NCAR to be this integrator of facilities, computing, and expertise. UCAR was founded with the intent of being the governing body, connecting with the needs of universities like ours across the country. **Any proposal that removes UCAR's or universities' governing role would undermine the partnerships between federal science and university research that has been foundational to the critical weather infrastructure for broad U.S. dominance.** As UCAR is representative of experts from over 120 universities across the country, UCAR should be the group that determines the future of NSF NCAR facilities.

Any future plan for NSF NCAR must maintain its high level of integration. This integration is key to its role supporting research and workforce training at UW-Madison and across the U.S. because NSF NCAR serves as:

- **An educational and collaborative crossroads:** As an academic institution, we recognize the vast opportunities that NSF NCAR has offered over the decades to our students and postdoctoral researchers in support of the next generation of scientists. NCAR and UCAR are responsible annually for hundreds of undergraduate students, graduate students, and postdoctoral researchers participating in fellowships, internships, summer schools, field campaigns, and conferences. Researchers visit for workshops hosted at NSF NCAR and to collaborate with its experts on topics of national importance, with freedom to pursue all ideas. These activities are foundational to the strength of our own programs at UW-Madison. Any future vision of NSF NCAR must retain the free, open, inclusive culture of workforce engagement and training, and facilities like the Mesa Lab that support those collaborations.
- **The heart of community open-source development:** Weather models and observations have been co-developed with U.S. scientific community input at NSF NCAR. NSF NCAR provides the open source code, their data repositories, and the standards and protocols for data access. NSF NCAR has also led the world in open source model development with models like the Weather Research and Forecasting (WRF) model, the Model for Prediction Across Scales (MPAS), and the Community Earth System Model (CESM). The large multi-disciplinary team at NSF NCAR continually develops, tests, and advances these key Earth system models, with an integrated team structure that no academic institution could ever reproduce. As an illustration of our nation's—and the entire world's—dependency on these models, the WRF regional model has over 30,000 registered users across 150 nations, including forecasters at the National Weather Service and the National Centers for Environmental Prediction. WRF-Hydro has supported improved flash flood prediction. WRF-Chem has many air quality applications critical to human health. In addition, the innovative approaches in MPAS have led to its integration into NOAA's Unified Forecast System (UFS)—the very heart of the U.S.'s operational weather forecasting infrastructure. Privatization or reducing access to any of these assets will likely cause the U.S. research community to lag behind its peers in model development, including in AI approaches that leverage these models.
- **The link between terrestrial weather and space weather:** NSF NCAR's origin is the High Altitude Observatory (HAO), a legacy carried on by the HAO Laboratory within NSF NCAR. NSF NCAR provides the modeling capabilities and expertise that integrate the fields of upper atmosphere and space weather within a whole atmosphere-Sun-Earth systems approach. The integration of solar observations with atmospheric research has deepened our understanding and predictive skill of solar events that can damage U.S. infrastructure. Some of this integration occurs through CESM, which facilitates whole atmosphere simulations within a single self-consistent model that includes processes from the Earth's surface to the ionosphere. All components of the CESM model (i.e., land, ocean,

atmosphere, chemistry, ionosphere, etc.) are required for accuracy in whole atmosphere modeling. In addition, because of the parallels between rotating fluid dynamical processes on the Earth and Sun, one can learn a great deal by contrasting them: NSF NCAR is one of the few institutions with comprehensive expertise on both of these rotating spheres. In summary, separating space weather from weather facilities and whole atmosphere expertise weakens the science in both fields.

- **A computational powerhouse:** NSF NCAR's supercomputing is at the heart of U.S. atmospheric science observational and modeling work. NSF NCAR's models require observations to train, evaluate, and forecast. NSF NCAR observations require computing to design experiments, evaluate alternatives, and test theory. NSF NCAR expertise within the Computational and Informational Systems Lab (CISL) and at the NCAR-Wyoming Supercomputer Center (NWSC) are skilled with the techniques and models of this field and is responsive to U.S. atmospheric scientific community needs as no other IT force could ever be. This familiarity with the needs of the atmospheric science field greatly reduces the friction inherent in big data model development on a massive computational system. Free or low-cost access for students and NSF PIs to deploy code and access data and models on these resources is a highly efficient use of NSF resources. It allows for collaboration and student training, and must be continued. Likewise, keeping supercomputing expertise and staffing within NSF NCAR is necessary for the U.S. to continue to excel in weather and Earth system modeling.
- **The intersection of scientific expertise with public science literacy:** The Mesa Lab is a world class research facility, an architectural wonder, and a valuable public science outreach facility. The magic of the Mesa Lab museum has inspired young and old and done much to encourage greater public scientific literacy: it is one of only a few dedicated meteorology museums in the U.S. and one of Boulder's top tourist attractions. The interactive education exhibits are carefully curated in collaboration with NCAR education specialists. In addition, with its setting that is both inspirational and highly conducive to collaboration, the Mesa Lab has been a home for numerous open science gatherings of the kind that produce transformative new ideas and allow American science to dominate. This openness of the meetings at the Mesa Lab sets it apart from the invite-only scientific gatherings that often occur in similarly inspirational settings: NSF NCAR is open to all. The Mesa Lab must be retained as a facility for atmospheric science collaboration, gathering, and public engagement.
- **The bridge between fundamental research and actionable science:** For decades, NSF NCAR had made our nation safer, more resilient, and prosperous, yet many of these benefits will be lost if the federal government dismantles it. NSF NCAR's development of radar warning systems and their research into turbulence and microburst winds have greatly enhanced the safety of the airline industry, saving lives and money. NSF NCAR's severe weather research has greatly improved NOAA's hurricane track forecasts. NSF NCAR's flood risk model is used operationally by the National Weather Service to protect citizens from rising waters. The improved forecast accuracy attributed to NSF NCAR in

terms of floods, droughts, heatwaves, and severe storms has reduced threats to our nation's infrastructure, agriculture, water supply, and public safety. NSF NCAR is also supporting the development of the next-generation CropSmart system to support decision-ready information that can reduce water usage and irrigation costs. It can easily be argued that dismantling NSF NCAR would impose a national security threat at the expense of military readiness and operational efficiency, as the U.S. Army relies on the NSF NCAR-enhanced forecasts that save money, protect troops, and avoid unnecessary mobilization costs.

In NSF's call for comments, there were four topics requested for comment. At the outset, we note that UW-Madison is not interested in directly managing NSF NCAR assets. Our bottom line is that any evaluation of the future of NSF NCAR should be done by UCAR, its governing body, together with NSF in a deliberative approach. We address each question below:

- 1.) First, there is the question of whether NSF NCAR's capabilities and activities are duplicated elsewhere. **Our view is that NSF NCAR's activities are not duplicative because of their primary focus on basic research.** While much of NSF NCAR's basic research leads to actionable science, NSF NCAR's heart is in fundamental scientific investigation. Because NSF NCAR predominantly conducts basic research, its work stands apart from that performed at other federal agencies, including NOAA, DOE, and NASA. In particular, NSF NCAR's commitment to educational activities for the entire academic community is unique in the federal agency landscape. Basic research, as is done at NSF NCAR, falls squarely within the mission of NSF and its investments on behalf of the public taxpayer.
- 2.) Next, there is the question of whether there are transformational possibilities for observational platforms and data that are underexplored. We think that there may well be possibilities for improving U.S. observational capabilities; however, **the organization best situated to determine transformational possibilities is UCAR** because it is composed of a wide range of representatives of the atmospheric science community.
- 3.) There is also the question of whether there are concepts for the management of NSF NCAR that differ substantially from the current model. We believe that any change in management or operational structure must not reduce NSF NCAR's role as an integrator of facilities, computation, and expertise, as it would jeopardize U.S. scientific success. **We view UCAR as the best organization to determine any changes because of its broad representation of the U.S. scientific community.** If there are structural changes that could improve NSF NCAR management, UCAR is the appropriate body to determine the management structure that best facilitates the conditions necessary for scientific advancement.
- 4.) Finally, there is the question of what should be the performance objectives and metrics for a restructured NSF NCAR. We agree that metrics should be defined and that **NSF NCAR, in its current operational model, must be allowed to demonstrate whether it**

can meet those performance metrics. Metrics should include aspects that relate to community engagement, utilization of facilities, and scientific advancement.

NSF NCAR's in-house access to critical resources has been vital to U.S. scientific success, including advanced Earth system models that are increasingly incorporating AI technology, the Derecho supercomputer with the capacity of running nearly 20 quadrillion calculations per second, research aircraft, and advanced radars and instrumentation that support field experiments. All of these resources are critical to the mission of NSF NCAR, and the removal of any one component to a separate entity will hinder scientific progress and diminish the safety and prosperity of our nation. Given that universities, federal agencies, and industry apply many of NSF NCAR's resources, the impact of a dismantlement of NSF NCAR resources would substantially hinder the mission of many organizations across our nation.

Sincerely,

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