

NATIONAL CENTER FOR ATMOSPHERIC RESEARCH (NCAR)

\$103,700,000
-\$48,740,000 / -32.0%

National Center for Atmospheric Research Funding
(Dollars in Millions)

FY 2019 Actual ¹	FY 2020 (TBD)	FY 2021 Request	Change over FY 2019 Actual	
			Amount	Percent
\$152.44	-	\$103.70	-\$48.74	-32.0%

¹ FY 2019 Actual obligations include \$17.80 million for continuity of operations into FY 2020 as well as \$30.94 million in funds reobligated from prior award.

NCAR is an NSF-sponsored FFRDC serving a broad research community, including atmospheric and geospace scientists and researchers in complementary areas of the environmental sciences and geosciences. Based in Boulder, Colorado, NCAR is managed under a cooperative agreement between NSF and the University Corporation for Atmospheric Research (UCAR), a university-governed and university-serving organization comprising 117 degree-granting academic institutions.

NCAR provides world-class research programs, services, and facilities that enable the research community to advance our understanding of the sun-atmosphere system. These include the 534-petaflops NCAR-Wyoming Supercomputing Center, the Mauna Loa Solar Observatory, two research aircraft, a transportable ground-based radar system, an atmospheric sounder, and other surface sensing systems. NCAR staff work in close partnership with academic and other researchers. In 2019, 93 percent of NCAR’s 746 peer-reviewed publications were published in collaboration with authors at other institutions, and NCAR hosted 1,119 academic visitors from 343 different institutions.

Total Obligations for NCAR
(Dollars in Millions)

	FY 2019 Actual ¹	FY 2020 (TBD)	FY 2021 Request	ESTIMATES ²				
				FY 2022	FY 2023	FY 2024	FY 2025	FY 2026
Aircraft Support	\$11.00	-	\$10.50	\$10.50	\$10.50	\$10.50	\$10.50	\$10.50
Computational Infrastructure	37.70	-	33.70	33.70	33.70	33.70	33.70	33.70
Other Facility Support	31.09	-	27.50	27.50	27.50	27.50	27.50	27.50
Research & Education Support	41.71	-	32.00	32.00	32.00	32.00	32.00	32.00
Facility Upgrades	30.94	-	-	-	-	-	-	-
Total	\$152.44	-	\$103.70	\$103.70	\$103.70	\$103.70	\$103.70	\$103.70

¹ FY 2019 Actual obligations include \$17.890 million for continuity of operations into FY 2020 as well as \$30.94 million in funds reobligated from prior award.

² Outyear estimates are for planning purposes only. The current cooperative agreement ends September 2023.

For information on continuity of operations funding, see the opening narrative of this chapter.

Facility Upgrades: In FY 2018, NSF awarded \$26.64 million for essential upgrades to NCAR’s facilities and programs. This includes a major renovation of the Research Aviation Facility, which is now underway.

Partnerships and Other Funding Sources

NCAR leverages NSF support with funding provided by other federal agencies and non-federal sources. In FY 2019, NCAR received approximately \$49.76 million in support from other federal agencies, including the National Aeronautics and Space Administration (NASA), the National Oceanic and Atmospheric

Major Multi-User Research Facilities

Administration (NOAA), the Department of Energy (DOE), the Department of Defense (DOD), and the Federal Aviation Administration (FAA), and \$11.58 million from non-federal sources. This funding supports research collaborations that directly enhance NCAR's NSF-sponsored research and facilities.

Major Investments in FY 2021

In FY 2021, investments at NCAR will focus on fundamental research aimed at improving our ability to predict atmospheric, chemical, and space weather hazards, and increasing our understanding of the variability in the Earth's climate system at regional and global scales. In all of these areas, NCAR scientists will work with their university colleagues to further understand the fundamental processes that control the Earth's climate and weather systems. This will include research thrusts in areas such as the role of the chemical composition of the atmosphere, the structure and nature of hurricanes and other severe weather events, and the impacts of processes on the surface of the Sun on space weather and weather on Earth. A continuous process of community prioritization will inform activities undertaken in FY 2021.

Advanced Observational Facilities

NCAR operates two NSF aircraft: a C-130Q Hercules and a Gulfstream-V, both of which are highly modified and equipped with specialized instrumentation, to enable the support of research activities designed to provide new insights into atmospheric chemical processes, the dynamics and coupling of the atmosphere's layers, and interactions between the atmosphere and Earth's surface. The two aircraft will support community-originated projects deemed by NSF, via separately-managed external peer review, to be of exceptional scientific merit, consistent with the research prioritization mentioned above. In addition to the C-130Q and G-V aircraft, NCAR provides support for a number of other atmospheric and solar observing platforms including specialized Doppler weather radars, lidar systems, upper atmosphere observing capabilities, an advanced coronagraph, and other experimental systems. During 2019, NCAR's aircraft and other facilities supported community field campaigns that studied lightning, in-cloud icing, lake-system high impact weather, surface-atmosphere heat and water exchange, east Pacific tropical convection, and the total solar eclipse. Instrumentation deployed at the NCAR Mauna Loa Solar Observatory monitors the entire solar atmosphere and its critical magnetic environment. These observations are broadly used to improve fundamental understanding of solar activity, space weather, and solar storm characterization, and to better inform forecasts of the latter which can result in the disruption to critical civilian (and military) infrastructure.

Petascale Computational Infrastructure

NCAR operates a petascale supercomputing facility in Cheyenne, Wyoming (the NCAR-Wyoming Supercomputing Center), that supports high-end community modeling and data analysis programs in atmospheric, solar, and other Earth Systems processes and has over 1,800 unique users. These include the Community Earth System Model, the Weather Research and Forecasting Models (WRF), and the Model for Prediction Across Scales, which use mathematical formulas to simulate and better understand the chemical and physical processes that drive Earth's climate and weather system. NCAR leads the development of these community models and supports many thousands of researchers in the U.S. and worldwide—for example, in 2019, the cumulative number of registered WRF users exceeded 48,600, and was growing by an average of 4,100 per year. NCAR also maintains extensive data archives, providing access to a vast collection of observational, experimental, and modeling data, together with sophisticated analysis and visualization facilities, and training and support for users of all levels.

Research and Education Support

As an internationally recognized center of excellence, NCAR operates scientific research programs that include the following areas:

- studies of large-scale atmospheric and ocean dynamics that contribute to an understanding of the past and present Earth System processes;
- global and regional atmospheric chemistry, including atmospheric connections to geochemical and

- biogeochemical cycles;
- the variable nature of the sun and the physics of the corona and the interaction of the solar wind with the Earth's magnetic field;
- the physics of clouds, thunderstorms, precipitation formation, and their interactions and effects on local and regional weather; and
- examination of human society's impact on atmospheric composition, weather, and climate, and response to global environmental change.

Research collaborations with university colleagues are integral to NCAR's success as an institution, and NCAR serves as a focal and meeting point for the broader atmospheric and related sciences community. NCAR also maintains extensive partnerships and collaborations with the private sector through directed research and technology transfer. This work focuses on developing information and analysis platforms tailored to the specific needs of stakeholders in a variety of sectors, including energy, aviation, and agriculture.

Educational activities include the SOARS (Significant Opportunities in Atmospheric Research and Science) program that integrates research, education, and mentoring to bridge the undergraduate-to-graduate transition and to broaden participation in the atmospheric and related sciences. NCAR further supports the scientific community by providing fellowships, internships, workshops, and colloquia for students and visiting scientists, and disseminates knowledge of the geosciences. Professional training courses, innovative and award-winning science education websites, as well as the directed activities of NCAR's education and outreach programs, are further examples of how NSF's goal of integrating research and education is attained through NCAR activities.

Management and Oversight

- **NSF Structure:** NSF's Division of Atmospheric and Geospace Sciences (AGS) within GEO, the Division of Acquisition and Cooperative Support (DACs), and the Large Facilities Office (LFO) oversee NCAR and the cooperative agreement under which UCAR manages NCAR. The cooperative agreement encourages interactions between NCAR scientists and AGS staff and ensures close coordination between AGS and NCAR management. The cooperative agreement contains requirements for AGS's oversight of the NCAR program and UCAR management activities that affect NCAR. UCAR submits for AGS approval an annual program plan for NCAR that details how resources will be used, and an annual report on the previous year's scientific accomplishments and achievements. UCAR also reports annually to NSF on its activities as NCAR's manager. Annual strategic planning by AGS, UCAR, and NCAR ensures that scientific and facility priorities align with those of NSF.
- **External Structure:** UCAR works in partnership with NSF and the university community to ensure that NCAR's strategic mission is implemented effectively and for the benefit of NCAR's stakeholders in the atmospheric and geospace sciences.
- **Reviews:** A Committee of Visitors (COVs) is convened periodically to evaluate AGS activities, including the oversight of NCAR. The next AGS COV is expected to take place in FY 2020. In FY 2018, as part of the recompetition process (see below), NSF conducted an extensive review of UCAR's financial viability and accounting systems. No significant issues were raised.
- **AGS conducts periodic comprehensive reviews of NCAR's science programs and facilities, and UCAR's management of NCAR.** The most recent review was conducted as a series of site visits to NCAR by teams comprising members of the research community with expertise in the atmospheric and related sciences and in the management of scientific centers and facilities. The site visit teams found that NCAR continues to be a world-leading research center, providing essential services and capabilities that foster excellence throughout the atmospheric and geospace sciences community.

Renewal/Recompetition/Termination

The cooperative agreement for the management and operation of NCAR was recently recompleted. Following an extensive and robust proposal review process, a new award was made to UCAR. This award began on October 1, 2018, and is for five years, extendable for a further five years subject to satisfactory performance. The decision on whether to extend the award will be based upon the outcome of a comprehensive review of NCAR's science programs and management that is expected to be held at approximately the mid-point of the award, during FY 2021.



The NCAR Mesa Laboratory, designed by architect I.M. Pei, in Boulder, CO. *Credit: UCAR.*