

**NATIONAL CENTER FOR ATMOSPHERIC RESEARCH (NCAR)****\$104,000,000****\$0****National Center for Atmospheric Research Funding**

(Dollars in Millions)

FY 2020 Actual	FY 2021 Estimate	FY 2022 Request	Change over	
			FY 2021 Estimate Amount	Percent
\$99.70	\$104.00	\$104.00	-	-

**Brief Description**

NCAR is an NSF-sponsored Federally Funded Research and Development Center devoted to service, research, and education in support of the atmospheric and related science research community. NCAR operates world-class observational facilities and computing infrastructure, conducts extensive in-house research, maintains vigorous programs of education, outreach, and the promotion of diversity, and cultivates extensive national and international collaborations. NCAR also carries out research and development on behalf of other organizations, most commonly other U.S. Government agencies.

Major NCAR facilities include the Mesa Laboratory in Boulder, CO; the Research Aviation Facility in nearby Broomfield, CO; the NCAR-Wyoming Supercomputing Center in Cheyenne, WY; and the Mauna Loa Solar Observatory on Mauna Loa, HI.

**Scientific Purpose**

The NCAR mission is to understand the behavior of the atmosphere and related Earth and geospace systems; to support, enhance, and extend the capabilities of the university community and the broader scientific community, nationally and internationally; and to foster the transfer of knowledge and technology for the betterment of life on Earth. NCAR fulfills this mission with highly integrated programs organized around three overlapping primary areas of activity: cutting edge airborne and ground-based observational facilities, community weather and climate models with many thousands of users, and petascale high-performance computing. These are accompanied by a broad portfolio of programs supporting education, career development, public engagement, and increasing diversity in the geosciences. NCAR scientists also collaborate extensively throughout the academic, private, and government sectors. NCAR's programs are guided by the NCAR Strategic Plan, which emphasizes three overlapping priorities: 1) enhancing and building on NCAR's core strengths in fundamental research in the atmospheric and related sciences; 2) promoting integrated Earth System Science; and 3) advancing actionable science, to help address society's most pressing environmental challenges.

**Status of the Facility**

NCAR is operated for NSF by the University Corporation for Atmospheric Research, a consortium of 120 member universities in the U.S. and overseas. The majority of NCAR's programs have continued without interruption during the COVID-19 pandemic, with most community workshops, visitors' programs and other collaborations taking place remotely. Observational field campaigns involving NCAR's ground-based facilities and aircraft have, however, been severely impacted due to travel restrictions and other logistical challenges. It is hoped that these will be resumed in FY 2022, beginning with those that had been postponed in FY 2020 and FY 2021.

Several significant infrastructure improvement projects are at or close to completion, including a full overhaul of the primary heating and cooling systems at the NCAR Mesa Laboratory that will result in considerable increases in efficiency and reduced operating costs. A major renovation of the NCAR Research Aviation Facility at the Rocky Mountain Metropolitan Airport will provide new, state-of-the-art laboratory, engineering, and technical space in support of the two NCAR-operated research aircraft and the community of scientists and engineers that use them.



Mesa Lab. Credit: Copyright University Corporation for Atmospheric Research (UCAR), by Carlye Calvin, licensed under a Creative Commons Attribution-NonCommercial 4.0 International (CC BY-NC 4.0) License, via OpenSky.

The installation of a powerful new supercomputer at the NCAR-Wyoming Supercomputing Center will result in a more than threefold increase in the computing speeds available to the Center's users in the Earth System Science research community. The new system, to be called 'Derecho' following a statewide naming competition among Wyoming school students, will become operational in early 2022.

### Meeting Intellectual Community Needs

NCAR connects to its user stakeholders by providing the community with models, cyberinfrastructure, observing facilities, and collaborative opportunities, in addition to education, outreach, and training that are essential to its research community. FY20 highlights include:

- The Weather Research Forecast Model (WRF) continued to see strong user interest, with the cumulative number of WRF registrations standing at over 52,000 as of the end of the FY and new model registrations averaging about 4,000 per year for the past three years. NCAR hosted the annual weather model Users' Workshop in June 2020, with 595 registered participants. NCAR also conducted one WRF tutorial in January 2020, which attracted 49 students. (The second WRF tutorial, typically held in summer, was deferred due to COVID-19 restrictions).
- An improved version of the Community Earth System Model (CESM 2.2.0) was released in September 2020. CESM 2.2.0 provides a wider variety of configurations for users (allowing deeper insights into atmospheric processes), and updates to the ocean, land-surface, chemistry, geospace and atmospheric subcomponents. Comprehensive simulations performed with CESM 2.2.0 will shape community inputs to the next Intergovernmental Panel on Climate Change (IPCC) assessment.
- NCAR's 534-petaflop high-performance computer (Cheyenne) and its Globally Accessible Data Environment (GLADE) were used by almost 1,800 individuals at 275 universities. During the year, utilization of the primary NCAR supercomputer increased to 97% (with 99% availability). In addition, NCAR maintains and provides simplified access to multi-terabyte datasets relevant to the atmospheric research community. The NCAR Research Data Archive delivered more than 7.3 PB of data to 14,000 unique users.
- In FY 2020, NCAR was able to provide support for only one local observational field campaign; all others were postponed due to the COVID pandemic. Looking ahead, requests were approved for 15 future observational field campaigns involving 16 individual observing platforms and systems.
- Every year, NCAR hosts a wide variety of community events including workshops, colloquia, conferences, symposia, and tutorials. In FY 2020, a total of 100 events (426 individual sessions) were hosted: 174 workshops, 224 tutorials, 22 conferences, and 6 colloquia with an average audience of 83 attendees per event and an estimated total audience of 35,609. The majority of these events were held virtually due to COVID-19-related restrictions.

## Major Facilities

- Students, scientists, engineers, weather forecasters, and other professionals from around the country and the world visit NCAR to collaborate with scientific, educational, or technical staff. They take part in community workshops and strategic discussions, conduct independent research, participate in and/or oversee student, post-doctoral, and professional projects. In FY 2020, NCAR hosted 412 visitors from 169 different institutions in 37 U.S. states and 27 countries, the majority virtually.
- In FY 2020, NCAR staff served as graduate advisors or committee members for 202 graduate students. Eighteen of those are working on their M.S. degree and 184 are working on their Ph.D. Seventy-three percent of these students attend U.S. universities, whereas 27% study at schools in 24 different countries worldwide.
- Of NCAR staffs 746 peer-reviewed publications in FY 2020, 93% were published in collaboration with authors at other institutions.
- NCAR, in collaboration with the UCAR COMET program and Millersville University, published the remaining two of a total of ten online lessons that comprise the *Collaborative Research: Synergistic Environments in Graduate and Undergraduate Education in Atmospheric Instrumentation and Measurement Training (SEGUE)* course. These free, online lessons target students at the advanced undergraduate and graduate level and focus on the science involved in measuring basic atmospheric parameters. As of September 2020, more than 20,200 learners completed sessions spread across the various lessons, and 73 learners completed the entire course, which provides a total of approximately 20 hours of atmospheric instrumentation training.
- During the onset of the pandemic in spring of 2020, NCAR staff supported over 40 managers from GEO Research Experience for Undergraduates (REU) internship programs around the country to share ideas, adapt, and plan their summer programs by holding three weekly Zoom drop-in sessions. Staff also developed an eight-week Professional Development Series for 45 undergraduate interns from the NSF Ocean Sciences REU program that was created for the pandemic.

## Governance Structure and Partnerships

### NSF Governance Structure

NSF oversight is provided by a team of program officers in the Division of Atmospheric and Geospace Sciences (AGS) working cooperatively with staff from GEO, the Office of Budget, Finance, and Award Management (BFA), and the Office of the General Counsel. Within BFA, the Large Facilities Office and Division of Acquisition and Cooperative Support provide advice and guidance to program staff and assist with agency oversight and assurance. Programmatic oversight and a major part of NCAR's funding is provided by AGS. The award with UCAR through which NCAR is managed and funded contains terms and conditions that support AGS's oversight of the NCAR program and includes requirements for UCAR's management of the Center. These include a provision that UCAR submit for AGS approval an annual program operating plan that provides details about how resources will be used in that fiscal year. In addition, NCAR summarizes its past year's accomplishments in an annual scientific report and UCAR must report annually on its management of NCAR. Close coordination between AGS, UCAR, and NCAR helps ensure that scientific and facility priorities remain consistent with those of NSF. AGS program officers and management interact regularly with NCAR leadership and staff at all levels to ensure that NCAR's services and facilities support the evolving needs of PIs funded through AGS core programs. Additional oversight is applied for significant infrastructure upgrades, NCAR-managed community field campaigns, and other complex projects. While project oversight typically involves monthly videoconferences attended by relevant UCAR/NCAR personnel, the core NSF NCAR Integrated Project Team and other program staff as appropriate, frequent ad hoc interactions by e-mail, telephone, and video conference form the basis of AGS's oversight of NCAR and UCAR.

External Governance Structure

As a consortium of universities and the manager of the national center, UCAR has the responsibility to engage the atmospheric and related sciences community, including universities and the broader scientific community, in its governance, planning and program implementation. Strong involvement of the external community is essential for effective NCAR science and facility planning, especially on longer time scales.



Gulf Stream V research aircraft. Credit: Copyright, University Corporation for Atmospheric Research (UCAR), by Chad Slattery, licensed under a Creative Commons Attribution-NonCommercial 4.0 International (CC BY-NC 4.0) License, via OpenSky.

Formal mechanisms by which NCAR and UCAR receive community advice and input include a dedicated subcommittee of the UCAR Board of Trustees; standing external advisory committees for each NCAR laboratory, the NCAR Director and certain targeted initiatives; advisory panels for the allocation of computational and observational resources; governance bodies for the community models; and *ad hoc* panels providing advice on matters such as technical requirements for the next supercomputing upgrade. NSF staff often attend these meetings as observers, receive their reports, and discuss their findings, recommendations, and any necessary actions with NCAR/UCAR management. NSF may supplement this information with other activities such as NASEM studies or community workshops.

Partnerships and Other Funding Sources

To support, enhance, and extend the capabilities of the university community and the broader scientific community, NCAR leverages NSF support with funding provided by other federal agencies and non-federal sources. In addition to NSF’s \$104.00 million planned FY 2021 investment, NCAR received approximately \$44.8 million in support from other federal agencies, including the National Aeronautics and Space Administration, the National Oceanic and Atmospheric Administration, the Department of Energy, the Department of Defense, and the Federal Aviation Administration, and \$13.0 million from non-federal sources. This funding supports research collaboration that enhances and extends NCAR’s NSF-supported research goals or facilities missions.

**Funding**

Total Obligations for NCAR								
(Dollars in Millions)								
	FY 2020	FY 2021	FY 2022	ESTIMATES <sup>1</sup>				
	Actual	Estimate	Request	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027
Aircraft Support	\$10.28	\$10.50	\$10.50	\$10.50	\$10.50	\$10.50	\$10.50	\$10.50
Computational Infrastructure	34.28	34.00	34.00	34.00	34.00	34.00	34.00	34.00
Other Facility Support	23.16	27.50	27.50	27.50	27.50	27.50	27.50	27.50
Research and Education Support	31.98	32.00	32.00	32.00	32.00	32.00	32.00	32.00
<b>TOTAL</b>	<b>\$99.70</b>	<b>\$104.00</b>	<b>\$104.00</b>	<b>\$104.00</b>	<b>\$104.00</b>	<b>\$104.00</b>	<b>\$104.00</b>	<b>\$104.00</b>

<sup>1</sup> Outyear estimates are for planning purposes only. The current cooperative agreement ends September 2023.

The current five-year cooperative agreement for the management and operation of NCAR began on October 1, 2018 and may be extended for a further five-year period subject to NSF’s determination of satisfactory performance by the awardee. The annual amount of the award is determined by NSF’s priorities, the amount authorized by the NSB, and the availability of funds. Most major recurrent infrastructure costs are accommodated within this core funding—including periodic technology upgrades to the NCAR supercomputers, periodic aircraft inspections and maintenance, and buildings upgrades and maintenance. Additional funding may be provided for specific projects, such as the award of funding to renovate the NSF-owned NCAR Research Aviation Facility in 2018.

## *Major Facilities*

### **Reviews**

The next comprehensive review of NCAR's science, facilities and management will involve virtual site visits by teams of experts from the scientific community and will take place in mid-2021. A Business Systems Review will be conducted during FY 2022.

### **Renewal/Recompetition/Termination**

The award to manage and operate NCAR for a period of five years was made to the University Corporation for Atmospheric Research (UCAR) with a start date of October 1, 2018. This award may be extended for a further five-year term subject to satisfactory performance by the awardee. A determination of satisfactory performance will be informed primarily by the findings of a comprehensive mid-term scientific and management review, planned to take place during the third year of the award (FY 2021). If UCAR's performance is considered satisfactory, they may be invited to submit a renewal proposal for a second five-year term that will be reviewed by an external panel.