

U.S. GLOBAL CHANGE RESEARCH PROGRAM (USGCRP)

U.S. Global Change Research Program

(Dollars in Millions)

	FY 2021	FY 2022	FY 2023
	Actual	(TBD)	Request ¹
BIO	\$155.00	-	\$237.15
CISE	-	-	40.00
GEO	329.00	-	515.37
MPS	9.83	-	34.63
SBE	18.25	-	25.14
OISE	-	-	5.00
OPP	56.11	-	56.11
Total	\$568.19	-	\$913.40

¹Funding includes resources for agency-wide initiatives.

Overview

NSF investments in climate and global change research span climate science, impacts, adaptation and mitigation strategies, and solutions. As part of NSF's holistic approach to addressing global change, NSF's investments aligned with USGCRP are complemented by investments in research to advance America's clean energy future—from foundational and use-inspired knowledge in physics, chemistry, biology, materials science, and computing to large-scale systems engineering computation, and advanced cyberinfrastructure. More information on these complementary investments can be found in the Clean Energy Technology narrative in this chapter.

NSF addresses climate and global change issues through investments that advance frontiers of knowledge, provide state-of-the-art instrumentation and facilities, develop new analytical methods, and enable cross-disciplinary collaborations while also cultivating a diverse, highly trained workforce and developing educational resources. NSF's climate and global change-related programs support the research and related activities to advance fundamental understanding of physical, chemical, biological, and human systems, and the interactions among them. Programs encourage interdisciplinary and integrated approaches to studying Earth system processes and the consequences of change, including how humans respond to changing environments and the impacts on ecosystems and the essential services they provide.

NSF invests in the fundamental research at the heart of global change issues. Long-term, continuous, and consistent observational records are essential for testing hypotheses quantitatively and are thus a cornerstone of global change research. NSF supports a variety of research observing and sensing networks that complement, and are dependent on, the climate monitoring systems maintained by its federal partners. The results of NSF investments have helped communities address challenges associated with mitigation, adaptation, and other responses to a changing environment.

Past investments have helped inform the National Climate Assessment and several other technical reports mandated by the Global Change Research Act of 1990. Investments have also aided U.S. communities to develop mitigation and adaptation strategies to address both challenges and

opportunities derived from a changing environment. The fundamental knowledge gained through NSF disciplinary and cross-cutting programs focusing on the coupled natural-human-built system are critical in developing effective solutions to these challenges and capitalizing on opportunities.

Goals

1. Advance scientific knowledge of the integrated natural and human components of the earth system; and
2. Inform decisions: provide the scientific basis to enable decisions on adaptation and mitigation.

FY 2023 USGCRP Funding

Several investments of note are planned in FY 2023. NSF will develop regional climate impact integration hubs, focused on climate innovation, mitigation, adaptation, and equity. Hubs will have a regional focus, providing innovative solutions to relevant regional climate impacts that draw on all fields of science and engineering as well as local knowledge. A networked structure will connect, inspire, and include diverse scientific talent from across the Nation while a strong focus on outcome-oriented research will help to address the climate imperative.

A fundamental step in implementing the impact integration hubs is creating a National Discovery Cloud (NDC) for Climate. The NDC for Climate will federate access to advanced compute, data, software, and networking resources from multiple sources, including NSF-funded advanced computing resources, edge resources located at NSF major facilities, and capabilities deployed at other compute- and data-intensive NSF research facilities, as well as commercial cloud computing resources. In addition, the NDC for Climate will incorporate systems to curate, federate, and provide access to data from multiple sources. These approaches will enable new scientific discoveries by supporting the broad examination and reexamination of collected data, and by supporting scientific analysis of combinations of data from different sources. The NDC for Climate will further NSF's commitment to equity by democratizing access to research resources and necessary support services.

At a smaller scale, additional new and expanded climate activities are planned in FY 2023. Key investments include:

- A new investment through GEO on large-scale interdisciplinary work on climate change. Building on the strong foundation of fundamental research supported across GEO, this investment will transcend disciplinary boundaries and focus on topics of direct national importance at resolutions and scales needed by decisionmakers such as forecasting drought and water availability on timescales of months to years at local and regional scales.
- Expanded support for computation and cyberinfrastructure development, focused on revolutionizing data structures and architectures through an Open Science Initiative. This initiative will develop the data infrastructure necessary to address critical questions on climate and its impacts, enable an open science framework which is more accessible to artificial intelligence and machine learning systems, and support a scientific community and workforce trained to use these resources.
- Expanded education, equity, and workforce development opportunities will emphasize climate equity and the inclusion of all Americans in the growing green economy and research enterprise.
- In FY 2023, NSF will expand support for greenhouse gas (GHG) measurement and monitoring. NSF-supported projects examine GHG flux measurements as well as work on emerging technologies

that are essential in enhancing GHG monitoring and measurement capabilities.

Investments by Program Component Area (PCA)

USGCRP Funding by Program Component Area

(Dollars in Millions)

	FY 2021	FY 2022	FY 2023
	Actual	(TBD)	Request
Integrated Observations	\$177.94	-	\$194.71
Multidisciplinary Earth and Human System Understanding	331.47	-	597.70
Integrated Modeling	47.24	-	67.29
Information Management and Sharing	-	-	40.00
Science of Adaptation and Science to Inform Adaptation Decisions	11.53	-	13.70
Total	\$568.19	-	\$913.40

Integrated Observations: NSF supports advanced capabilities to observe the physical, chemical, biological, and human components of the Earth system over multiple space and time scales. Facilities such as the Academic Research Fleet and the National Ecological Observatory Network assist the Nation in gaining a fundamental scientific understanding of the Earth and monitor important variations, trends, and feedback processes between natural and human systems.

Multidisciplinary Earth and Human System Understanding: NSF improves our knowledge of the Earth's past and present climate variability and change through activities to document and understand climate cycles across the globe, as well as to better understand the natural variability of climate and the processes responsible for global changes using a range of paleoclimate and instrumental data and modeling approaches. NSF also supports activities that advance our understanding of the complex interactions between, within and among the components of integrated socio-environmental systems, such as improving our understanding of the frequency and intensity of extreme climate events and the impacts of these events on natural and human systems.

Integrated Modeling: NSF will continue to devote significant resources to advancing climate and integrated modeling capabilities. Since there is increasingly deep interplay among observations and modeling at multiple spatial and temporal scales, a high priority will be given to developing more complete representations—models of coupled interactive atmospheric chemistry and processes, ecosystems, biogeochemical cycling, and integrated socio-environmental systems.

Information Management and Sharing: NSF will invest in activities that advance our capability to collect, store, access, visualize, and share data and information about the integrated Earth system, the vulnerabilities of integrated human-natural systems to global change, and the responses to these vulnerabilities.

Science of Adaptation and Science to Inform Adaptation Decisions: A key focus of the USGCRP is developing better means of assessing and responding to the impacts of global change as well as the vulnerability and resilience of both human and natural systems to those changes, particularly in highly sensitive regions such as the Arctic and Antarctic. In addition to supporting research that will inform mitigation and adaptation decisions, NSF will support fundamental research regarding the science of adaptation, defined as the adjustment in natural and/or human systems to a new or changing environment that exploits beneficial opportunities or moderates negative effects.