

U.S. GLOBAL CHANGE RESEARCH PROGRAM (USGCRP)

U.S. Global Change Research Program Funding^{1,2} (Dollars in Millions)

| | FY 2023 | FY 2024 (TBD) | FY 2025 Request |
|--------------|-----------------|------------------|--------------------|
| | Base Plan | | |
| BIO | \$211.71 | - | \$242.00 |
| CISE | 30.00 | - | 30.00 |
| GEO Programs | 355.60 | - | 371.60 |
| GEO: OPP | 197.26 | - | 206.14 |
| MPS | 12.00 | - | 12.54 |
| SBE | 20.00 | - | 20.90 |
| OISE | 15.50 | - | 12.00 |
| IA | 2.00 | - | 2.00 |
| Total | \$844.07 | - | \$897.18 |

¹ Funding displayed may have overlap with other topics and programs.

² Other Climate investments of \$152.30 million in the FY 2025 Request, outside the CET and USGCRP defined crosscuts, are not captured here.

Overview

As indicated in the Fifth National Climate Assessment,¹ communities across the country and the world are experiencing the effects of a changing climate, including more frequent and severe flooding, more destructive wildfires, heavier rainfall, and more extreme heat waves. These and other climate changes are increasing the risk of infrastructure failure; disruption to vital public services; threats to ecosystems and species that provide benefits to people; and heat-related illness and death and other health impacts. In the U.S. and worldwide, we have experienced severe disruption to essential systems—including food, water, health, energy, transportation, and natural and managed ecosystems—that help keep people safe and healthy. People who are already vulnerable due to socioeconomic inequality and past and current marginalization are disproportionately harmed by the impacts of climate change and have lower capacity to adapt.^{2,3}

The research needed to inform responses and solutions to these challenges require better understanding of climate and global change risks affecting interconnected natural and human systems, how the behavior of those systems affects risks to society, and the social context and consequences of measures to reduce risks. Enhancing the integration of social and natural sciences in all stages of research, and the use of transdisciplinary approaches to collaborative research, are critical to advancing knowledge and the ability to inform decisions. In addition, it is paramount that participation in global change research be more inclusive and engage with populations, communities, and organizations that face higher risks from climate and global change. USGCRP has fully recognized

¹ <https://nca2023.globalchange.gov/>

² www.ipcc.ch/report/ar6/wg2/

³ <https://nap.nationalacademies.org/catalog/26435/communities-climate-change-and-health-equity-proceedings-of-a-workshop>

this need and has developed a framework in its new Strategic Plan (2022-2031)⁴ to better equip the Nation and the world to respond to change and manage critical risks.

Goals

1. **Advancing Science:** Advance scientific knowledge of interconnected natural and human systems and risks to society from global change.
2. **Collaborating Internationally:** Build global capacity to respond to global change through international cooperation and collaboration.
3. **Engaging the Nation:** Enhance the Nation's ability to understand and respond to global change by expanding participation in the Federal research enterprise.
4. **Informing Decisions:** Provide accessible, usable information to inform decisions on mitigation, adaptation, and resilience.

NSF investments in global change research span climate science, impacts, adaptation and mitigation strategies, and solutions leading to greater resiliency. 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 with access to educational resources to develop the next generation of global change researchers. 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 resilience, mitigation, adaptation, and other responses to a changing environment.

NSF invests in broadening participation activities including capacity building, research centers, partnerships, and alliances. These investments seek to foster a just, equitable and inclusive research community that reflects the diversity of the U.S, develop a workforce with the skills required to understand how the Earth system can continue to sustain society, and engage with populations, communities, and organizations that are directly affected by global change.

⁴ www.globalchange.gov/browse/reports/us-global-change-research-program-2022%E2%80%932031-strategic-plan

NSF invests in international partnerships to meet global change challenges by supporting research collaborations that foster team science, community-engaged research, and use knowledge-to-action frameworks. These convergent, interdisciplinary research collaborations bring together studies of any number of topics (such as greenhouse gas emissions, atmospheric and oceanic circulation drivers, impacts of natural and built environments, human behavior, and policy constraints) coupled with innovative artificial intelligence and computational and data science solutions, to help assess or mitigate community impacts and/or lead to technology developments.

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.

FY 2025 USGCRP Funding

Several investments of note are planned in FY 2025, and NSF will expand its activities related to risk and resilience, including efforts that will:

- improve climate hazard and disaster resilience in communities,
- develop technologies needed to advance resilience research,
- support research on the human health implications of climate change, and
- grow the human capital to take on the climate challenges of today and tomorrow.

NSF will also initiate activities for new approaches related to design in extreme environments that will meet the challenges of changing climates spanning rural and urban communities and natural and built environments, such as:

- sustainable, smart and resilient civil infrastructure and materials for extreme natural hazards and/or needs,
- robotics for extraordinary settings or human-robot interactions,
- interdisciplinary research to create evidence-based solutions that strengthen human, economic and societal resilience to changing natural environments,
- agriculture and manufacturing for extreme sustainability, and
- semiconductors, microelectronics, and communications that meet extreme performance requirements.

NSF will continue to explore ways to identify and address barriers to equity and participation in the study of the Earth system. Efforts include enhancing the support of early-career researchers from a variety of institutions, ensuring support for postdoctoral fellows from groups underrepresented in global change fields of study, and providing fellowships for students to participate in research on resilience and equity.

Investments by Program Component Area (PCA)

USGCRP Funding by Program Component Area^{1,2}
(Dollars in Millions)

| | FY 2023 | | |
|-------------------------------|-----------------|---------------|-----------------|
| | Base Plan | FY 2024 (TBD) | FY 2025 Request |
| Advancing Science | \$655.37 | - | \$672.54 |
| Collaborating Internationally | 66.97 | - | 75.02 |
| Engaging the Nation | 24.04 | - | 40.47 |
| Informing Decisions | 97.69 | - | 109.15 |
| Total | \$844.07 | - | \$897.18 |

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Advancing Science

NSF investments improve knowledge of the Earth’s past and present climate variability 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, 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.

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, Ocean Observatories Initiative, 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.

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 with predictive capabilities at regional and local scales. This will include continued investment in the National Discovery Cloud for Climate that will federate advanced compute, data, software and networking resources, democratizing access to a cyberinfrastructure ecosystem that is increasingly necessary to further climate-related S&E.

Collaborating Internationally

Climate and resilience science don’t adhere to national borders but are globally important topics engaging the international community of researchers. Through NSF’s international partnerships including the Interamerican Institute for Global Change Research and the Belmont Forum, researchers from around the world are working to build a resilient planet.

Engaging the Nation

Preparing a future workforce that represents the diversity of the Nation and understands the complex interdependencies of the climate, human, and other earth systems is critical for the U.S. A knowledgeable workforce can contribute to sustainable economic growth, reduced environmental impacts, and foster a more resilient planet. Also important will be efforts to engage the public in resilience through informal learning contexts such as exhibitions and public engagement in scientific research. In FY 2025, NSF will continue a new effort to be initiated in FY 2024 to support student fellowships in resilience science. Focus On Recruiting Emerging Climate and Adaptation Scientists and Transformers (FORECAST) seeks to facilitate the transition from status quo graduate career preparation to a student-centered model with a particular emphasis on building entrepreneurial and innovation capacity.

Informing 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 in the Arctic and Antarctic. In addition to supporting research that will inform mitigation and adaptation decisions and extreme design in the age of climate change, 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.

