

## U.S. GLOBAL CHANGE RESEARCH PROGRAM (USGCRP)

### Total Funding for USGCRP

(Dollars in Millions)

	FY 2015 Actual	FY 2016 Estimate	FY 2017 Request
Biological Sciences	\$66.00	\$116.11	\$125.00
Geosciences	202.09	201.09	201.09
Mathematical and Physical Sciences	13.37	3.50	3.50
Social, Behavioral and Economic Sciences	17.98	17.98	17.98
<b>Total</b>	<b>\$299.44</b>	<b>\$338.68</b>	<b>\$347.57</b>

Totals may not add due to rounding.

Global change encompasses a wide range of planetary- and regional-scale changes in the Earth's natural and human systems. These changes involve atmospheric and ocean circulation and composition, the water cycle, biogeochemical cycles, land and sea ice, biological diversity, marine and terrestrial ecosystem health, resource and land use, urbanization, economic development, and more. The U.S. Global Change Research Program (USGCRP) provides the Nation and the world with the scientific knowledge necessary for understanding and predicting climate change and environmental responses, managing risk, and anticipating opportunities that may result from changes in climate and climate variability. Research conducted through the USGCRP ([www.globalchange.gov](http://www.globalchange.gov)) builds on the scientific advances of recent decades and deepens our understanding of how the interplay between human and natural systems affects the climate system and how the changing climate impacts those systems. The USGCRP involves thirteen U.S. agencies in a concerted interagency program of basic research, comprehensive observations, integrative modeling, and new approaches for translating scientific information for use by decision-makers. NSF provides support for a broad range of fundamental research activities that provide the scientific basis for climate-related policy and decisions.

The Earth's climate is determined by highly complex interactions between and among the atmosphere, hydrosphere, cryosphere, geosphere, and biosphere – all significantly influenced by human activities. NSF programs address these components by investing in fundamental discovery that utilizes the full range of intellectual resources of the scientific community, and research infrastructure that provides state-of-the-art capabilities. NSF strongly encourages interdisciplinary approaches, and focuses on fundamental Earth system processes and the consequences of change. High priorities for the agency include: data acquisition and information management activities necessary to support, and disseminate the results of, global change research; the enhancement of models designed to improve our understanding of Earth system processes and of feedbacks between ecosystems and the physical climate; the development of new, innovative Earth observing instruments and networks; the development of advanced analytic research methods; and preparation of a scientific workforce equipped to deal with the complexities of global change. NSF also supports fundamental research on the processes used by organizations to identify and evaluate policies for mitigation, adaptation, and other responses to varying environmental conditions. NSF-supported research on the science of impacts, vulnerability, and resilience as well as the enhancement and development of a range of climate and process models will continue to make an important contribution to climate assessment activities.

### **FY 2017 Areas of Emphasis**

NSF's FY 2017 investment in USGCRP increases by \$8.89 million, or 2.6 percent, above the FY 2016 Estimate. The additional investment is associated with the increase in National Ecological Observatory Network (NEON) operations and maintenance (O&M). Because advancing scientific understanding

requires a multi-faceted approach, NSF's emphasis areas span multiple USGCRP program component areas. In FY 2017, NSF will engage with other USGCRP agencies on priorities for intra-seasonal to centennial predictability, predictions, and projections; water cycle research; understanding the impacts of global change on the Arctic region and effects on global climate; and fundamental research on actionable science. The major USGCRP foci for NSF include:

**Improving our knowledge of Earth's past and present climate variability and change** – NSF participates in the Multidisciplinary Earth and Human Understanding, Integrated Modeling, and Integrated Observations program component areas (PCAs) through activities to document and understand long-term climate cycles across the globe, as well as to better understand the natural variability of climate and the processes responsible for climate changes using a range of paleoclimate and instrumental data and modeling approaches. NSF also supports activities to improve our understanding of the frequency and intensity of extreme climate events, particularly wet and dry extremes of the water cycle, their causes, and how those may be manifested in the future. Upgrading and expanding critical environmental observing systems are vital to these efforts.

**Improving our understanding of natural and human forces of climate change** – NSF supports the Multidisciplinary Earth and Human Understanding PCA through activities spanning a broad range of disciplines and topics that seek to better understand the physical, geological, chemical, biological, and human components of the Earth system and their interactions. Examples of major foci include fundamental research on all aspects of the carbon cycle, the water cycle, atmospheric composition and greenhouse gas processes, marine and terrestrial ecosystems, and ocean and atmospheric circulations that both drive and respond to climate and global change. Human drivers of change include urbanization, population growth, and economic and technological development over a range of temporal scales. NSF has a strong commitment to fostering new interdisciplinary research approaches that allow exploration of the interdependencies across these areas.

**Improving our capability to model and predict future conditions and impacts** – NSF contributes to the Multidisciplinary Earth and Human Understanding and Integrated Modeling PCAs through research to examine major feedback processes between the climate and natural and human systems and will incorporate these into the next generation Community Earth System Model (CESM). High priority will be given to developing more complete representations of coupled interactive atmospheric chemistry, terrestrial and marine ecosystems, biogeochemical cycling, and middle atmospheric processes. NSF will continue to devote significant resources to advancing climate modeling capabilities from global and centennial to regional and decadal scales. In addition, NSF is encouraging the development of ecosystem and water models at regional scales, as well as models that integrate human system components such as risk, vulnerability, and decision-making.

**Assessing the Nation's vulnerability to current and anticipated impacts of climate change** – A key focus of the USGCRP is developing better means of assessing the impacts of climate change and the vulnerability and resilience of both human and natural systems to those changes, particularly in highly sensitive regions such as the Arctic. NSF participates in the Multidisciplinary Earth and Human Understanding, Integrated Modeling, Integrated Observations, and the Science of Adaptation and Science to Inform Adaptation Decisions PCAs through support of the basic research that underpins ongoing global change assessment and analysis efforts, particularly in developing the range of models needed for these assessments. NSF will support fundamental research regarding the science of adaptation, defined as the adjustment in natural or human systems to a new or changing environment that exploits beneficial opportunities or moderates negative effects. This research ranges from developing the theoretical framework for evaluating adaptation options (and avoiding unintended consequences of adaptation choices) to risk assessment and decision making. NSF will continue interdisciplinary research (including human

factors) in water sustainability, biodiversity, ocean acidification, and vulnerable areas, particularly in the rapidly changing Arctic.

**Providing climate information and decision support tools** – NSF participates in the Science of Adaptation and Science to Inform Adaptation Decisions PCA through basic research on how humans impact climate and other natural systems, how people respond to changing natural conditions, and how human and natural systems engage in complex interactions across multiple spatial, temporal, and organizational scales. Support will continue for basic research on decision making under uncertainty associated with climate change, as well as for developing and testing decision-support tools that can be used by stakeholders to improve their decision making processes.

**USGCRP Funding by Program Component Area (PCA)**

(Dollars in Millions)

	FY 2015 Actual	FY 2016 Estimate	FY 2017 Request
Integrated Observations	\$50.00	\$93.04	\$114.00
Multidisciplinary Earth and Human System Understanding	191.54	197.61	185.54
Integrated Modeling	42.15	32.28	32.28
Science of Adaptation and Science to Inform Adaptation Decisions	15.75	15.75	15.75
<b>Total</b>	<b>\$299.44</b>	<b>\$338.68</b>	<b>\$347.57</b>

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