

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

Climate and global change have pervasive effects on the U.S. through their impacts on the environment, natural resources, and the economy. Global change encompasses a wide range of planetary-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 of the impacts of a changing climate on those systems. The USGCRP involves thirteen U.S. agencies in a concerted interagency program of basic research, comprehensive observations, integrative modeling, and development of products for decision-makers. NSF provides support for a broad range of fundamental research activities that provide a sound 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; research infrastructure that provides advanced capabilities; and innovative educational activities. NSF strongly encourages interdisciplinary approaches, and focuses particularly on fundamental Earth system processes and the consequences of change. High priorities for the agency include: data acquisition and information management activities necessary for 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 be key contributions to the National Climate Assessment. NSF is leading the development of a new strategic plan for the USGCRP, which is expected to be completed by the end of 2011.

### U.S. Global Change Research Program Funding

(Dollars in Millions)

	FY 2010 Omnibus Actual	FY 2010 Enacted/ Annualized FY 2011 CR	FY 2012 Request
Biological Sciences	\$81.00	\$81.00	\$89.00
Geosciences	194.00	194.00	245.00
Mathematical and Physical Sciences	7.77	7.28	9.03
Social, Behavioral and Economic Sciences	18.48	18.48	58.98
Office of Polar Programs	18.30	18.30	23.10
<b>Total, U.S. Global Change Research Program</b>	<b>\$319.55</b>	<b>\$319.06</b>	<b>\$425.11</b>

Totals may not add due to rounding.

### **FY 2012 Areas of Emphasis**

NSF's FY 2012 investment in USGCRP increases by \$106.05 million, or 33 percent, over the FY 2010 Enacted level. NSF's USGCRP investments reflect two major integrated NSF initiatives, the Science, Engineering, and Education for Sustainability (SEES) and the Cyberinfrastructure Framework for 21<sup>st</sup> Century Science and Engineering (CIF21). The major USGCRP foci in FY 2012 include:

**Improving our knowledge of Earth's past and present climate variability and change** – NSF investments include 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 in the past and how those may be manifested in the future. Upgrading and expanding critical environmental observing systems and ensuring data quality and access are integral parts of NSF's investments that will be supported under the CIF21 Data and Access to Cyberinfrastructure components

**Improving our understanding of natural and human forces of climate change** – NSF activities in this area span 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 development. NSF has a strong commitment to fostering new interdisciplinary research approaches that allow exploration of the interdependencies across these areas. Such efforts will be enhanced with the sustainability focus under the SEES Integrated Science and Engineering thrust.

**Improving our capability to model and predict future conditions and impacts** – NSF-supported research will 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. These efforts will depend on new computational resources and tools that will be developed through the CIF21 efforts in computational infrastructure.

**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. NSF supports the basic research that underpins the National Climate Assessment, including developing models that can be used for these assessments. For example, NSF-supported researchers are developing integrated river-basin models to address often competing water management issues that affect stream flow, such as protecting endangered species, meeting agricultural needs, and honoring transboundary water rights agreements. NSF will support fundamental research regarding the science of adaptation, from developing the theoretical framework for evaluating adaptation options (and avoiding unintended consequences of adaptation choices) to risk assessment and decision making. Under the SEES Integrated Science and Engineering Research on Environmental, Economic, and Engineering systems, NSF will continue interdisciplinary research (including human factors) in water sustainability, biodiversity, and ocean

acidification and initiate new efforts in particularly vulnerable areas such as the Arctic and coastal regions.

**Providing climate information and decision support tools** – NSF supports 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.

