EAR TO THE GROUND

The Division of Earth Science (EAR) is part of the Directorate for Geosciences (GEO) at the National Science Foundation (NSF).

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IN THIS ISSUE

A network of levees and wetlands protect the low-lying agricultural communities in California's Sacramento-San Joaquin River Delta.
Credit: California Department of Water Resources.

UPDATE FROM THE DIVISION DIRECTOR

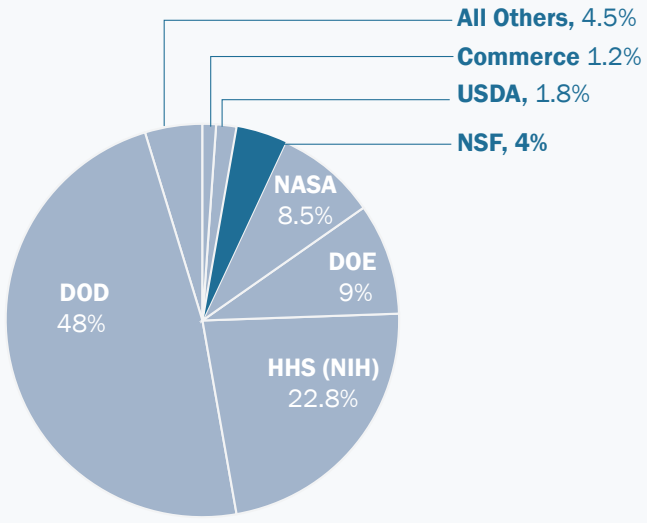
Welcome to the spring/summer 2016 newsletter

NSF: a small agency with big impact

For many of us in Earth Sciences, the National Science Foundation is our main source of research funding. Since coming to the agency as a "rotator" division director in late 2014 I have become increasingly impressed with how well the agency uses its funds to support basic science and education. In this update I share some of that information, which is readily available from sources including NSF's biennial Science and Engineering Indicators reports and from the AAAS R&D Budget and Policy Program.

UPDATE FROM THE DIVISION DIRECTOR (CONT,)

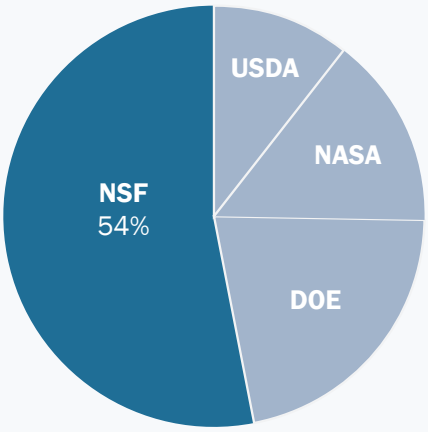
Figure 1. Total R&D by Agency, FY 2105



Source: AAAS 2015, based on OMB and agency R&D data

Fact 1: NSF receives only 4% of federal spending on research and development, which for FY 2015 was $136.5 billion (Figure 1, data from http://www.aaas.org/page/historical-trends-federal-rd).

Figure 2. Proportion of basic research funding by agency, FY2014, excluding Department of Defense and Department of Health and Human Services



Source: NSF 2016 Science and Engineering Indicators Table 5-4

Fact 2: NSF makes the most of its budget. It operates with a very low overhead: most of NSF's budget goes to funding research and related activities (80%), education and educational research (12%), and major research equipment and facilities (3%), with only 6% supporting agency operations (NSF Budget Office, http://dellweb.bfa.nsf.gov

Fact 3: As the only agency whose sole mission is to support basic research, NSF supplies the majority of federally financed, non-defense and non-medical basic research awards to academic institutions (Figure 2, data from http://www.nsf.gov/statistics/2016/nsb20161/#/data).

Although we'd all agree that NSF could always put more money to good use, we can rest assured that it maximizes investments in its fundamental mission, "to advance the progress of science" by funding proposals for research and education made by scientists, engineers and educators across the country.

IPA OPPORTUNITIES WITHIN THE SURFACE EARTH PROCESSES SECTION - Come join our team!

Currently, within the Surface Earth Processes Section in EAR there are multiple opportunities for researchers in the Earth science community to come to NSF as a temporary program director, or rotator. As a rotator you will work closely with other Program Directors in NSF running programs that are critical for supporting basic research in the Earth Sciences. During your tenure at NSF, you will have the ability to recommend which cutting-edge research proposals should be supported, influence new directions in Earth science, and mentor junior research faculty. As a rotator, you are in an excellent position to advance your own professional development by collaborating with a broad sector of the Earth science community from academia, government, and industry. This collaboration will increase your visibility in the broader Earth science enterprise. Importantly, as a temporary program director, you can retain your ties to your current institution and return to it with new insights and experience that will greatly benefit your organization. Your time in Washington, DC will also provide you with the opportunity to enjoy our wonderful and vibrant city. Please consider joining our team! We are confident it will be a rewarding experience.

For more information on the NSF rotator program, please visit: http://www.nsf.gov/careers/rotator/. To discuss specific opportunities, please contact Dr. Alexandra Isern, Section Head, Surface Earth Processes (aisern@nsf.gov; 703.292.7581).

RESEARCH OPPORTUNITIES AT OTHER FEDERAL AGENCIES

Part of NSF's mission is to form partnerships with other agencies to build capacity, leverage resources, and increase the speed of translation from discovery to innovation. In this and subsequent issues of EAR to the Ground, we invite our colleagues from other federal agencies to contribute articles describing possible areas of intersecting research interests and opportunities.

We begin with information about the Department of Energy (DOE)'s geothermal initiatives. Recently EAR staff met with DOE program managers to explore opportunities for Earth scientists to participate in DOE's subsurface research initiatives, including its Energy Field Observatories. New science participants can bring additional talent and expertise to help DOE meet its objectives. The infrastructure represented by DOE's observatories also may present opportunities for basic research that NSF is not well positioned to support independently. DOE Program Manager for Enhanced Geothermal Systems, Lauren Boyd, contributed the following article. New science participants can bring additional talent and expertise to help DOE meet its objectives; interested participants can contact Lauren at her email address below.

The Energy Department's Geothermal Initiatives

Lauren Boyd, Enhanced Geothermal Systems Program Manager, DOE
Lauren.Boyd@ee.doe.gov

Energy sources originating from beneath the Earth's surface satisfy more than 80% of total U.S. energy needs. Finding and effectively exploiting these resources while mitigating impacts of their use constitute major technical and socio-political challenges and opportunities. **The U.S. Department of Energy (DOE) has launched several initiatives to spur geothermal research development and deployment (RD&D), several of which have or will have solicitations open to the greater geosciences community.**

SubTER Pillars

Through ongoing engagement with key stakeholders to help identify high priority technology areas for federal advance-ment, DOE has developed a comprehen-sive RD&D strategy focused around four core pillars:

Wellbore Integrity – New sensors and adaptive materials are needed to ensure sustained integrity of the wellbore environment.

Subsurface Stress and Induced Seismicity – Radically new approaches are needed to guide and optimize sustainable energy strategies and reduce the risks associated with subsurface injection.

Permeability Manipulation – Greater knowledge of coupled processes will lead to improved methods of enhancing, impeding, and eliminating fluid flow.

New Subsurface Signals – DOE seeks to transform our ability to characterize subsurface systems by focusing on four areas of research: new signals, integration of multiple data sets, identification of critical system transitions, and automation.

A critical component of all pillars will be R&D testing at **Energy Field Observatories.** Field tests are critical to the validation of new results and approaches at commercial scale to validate tools, technologies, and methodologies and measure progress.

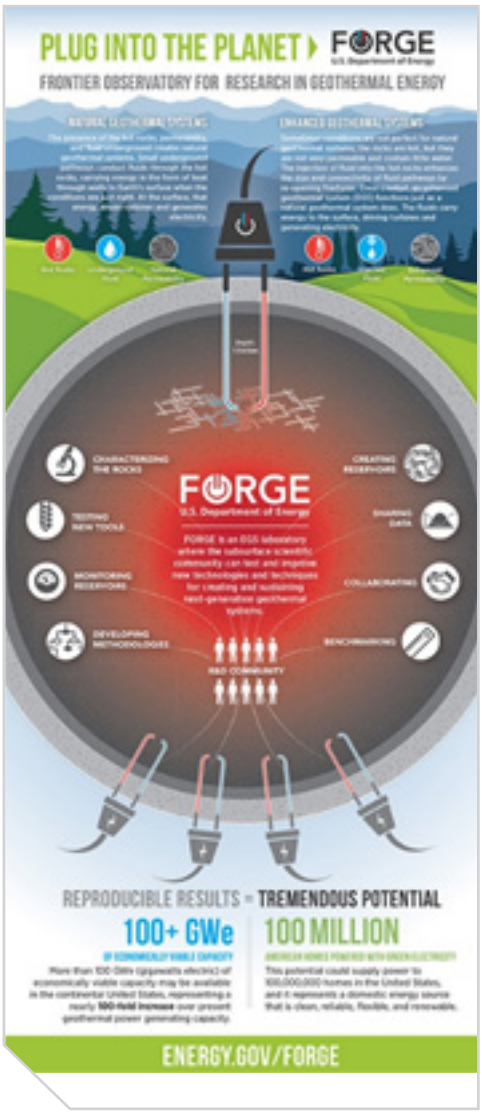
DOE has formed a cross-agency team to address subsurface activities that are aligned with energy production/extraction, subsurface storage of energy and CO2, and subsurface waste disposal and environmental remediation. The Subsurface Technology and Engineering Research, Development, and Deployment initiative, or SubTER, aims to improve energy security, environmental protection, and economic and social benefits by addressing issues including: increasing U.S. electricity production from geothermal reservoirs; safe storage of CO2 to meet greenhouse gas emissions reductions targets; and drinking water protection.

DOE has developed a comprehensive RD&D strategy focused around four core pillars through ongoing engagement with key stakeholders to help identify high priority technology areas for federal advance-ment. A critical component of all pillars will be R&D testing at Energy Field Observatories. Field tests are critical to the validation of new results and approaches at commercial scale to validate tools, technologies, and methodologies and measure progress.

Energy Field Observatories are critical for SubTER, as well as for advancing enhanced geothermal systems (EGS) research, development, and demonstration. Commercialization of EGS would increase current domestic geothermal energy production by an astonishing two orders of magnitude, and as the next step towards EGS deployment, DOE has launched its largest geothermal initiative to date, the Frontier Observatory for Research in Geothermal Energy, FORGE

FORGE will be a laboratory where the community can:

- Gain a fundamental understanding of the key mechanisms controlling EGS reservoir creation and sustainability;
- Develop, test and improve new techniques in an ideal and well characterized EGS environment; and
- Rapidly disseminate and share technical data among researchers, developers, local stakeholders, students, and other interested parties.



In 2015, five teams, each of which proposed a specific site, were selected for Phase 1 participation. Following two subsequent down-selects over the next several years, one final FORGE team and site will emerge and move into the final operations Phase of this initiative. Upon selection, this final site will be fully instrumented and characterized, with primary focus on annual competitive solicitations according to the DOE-crafted EGS roadmap. The FORGE initiative was designed to leverage the vast knowledge and experience in the geothermal and subsurface community to resolve the challenges associated with EGS in a holistic and systematic manner.

Through these critical initiatives, DOE strives to fund cutting-edge geothermal science, and advance our mission to develop clean, reliable, sustainable and affordable energy for the nation. Only through collaboration across subsurface energy and broader geoscience communities can we learn more about the structures of the world beneath our feet and access the vast 100+ gigawatts equivalent (GWe), of clean, renewable energy from EGS.

DATA WITHOUT BORDERS:
UNAVCO Software Enables Data Sharing in the Americas and Beyond

Linda Rowan and Beth Bartel, UNAVCO – Rowan@unavco.org and Bartel@unavco.org

UNAVCO, which operates NSF's geodetic facility, has developed the Dataworks for GNSS software to provide end-to-end, instrument-to-dissemination capabilities for any GNSS network to acquire, manage, and share data independently. The Global Navigation Satellite System (GNSS) includes GPS and other satellite constellations for autonomous and global geo-spatial positioning. Components of Dataworks were developed with support from NASA and the National Science Foundation. The software is modular, flexible, and can be installed locally or in the cloud. UNAVCO has helped several regional GNSS network operators in the Americas implement Dataworks to manage data and metadata, to enhance their capacity to share data, and to advance research and other societal benefits of GNSS data.

At the core of Dataworks is the Geodesy Seamless Archive Centers (GSAC), a software package for managing GNSS data discovery, access, and interaction. This software was originally developed with funding from NASA ROSES and later enhanced through NSF support for European-US data infrastructure collaborations (COOPEUS). GSAC provides a web-based user interface and web services for data and metadata discovery and access, and facilitates research by connecting users to multiple data centers through a single search function.

In the Western Hemisphere, NSF supported the development of the Continuously Operating Caribbean GPS Observational Network (COCONet) throughout the circum-Caribbean. COCONet was initiated after the 2011 Haiti earthquake to provide critical observations of the complex tectonic, atmospheric and oceanic processes in the Caribbean region, for research and for broader impacts, for instance to strengthen risk resiliency. UNAVCO has installed, refurbished and/or integrated existing stations into a network of 143 sites that have GPS/GNSS, many weather stations, and in some cases tide gauge instrumentation. COCONet is a partnership with 28 sovereign nations and 41 distinct administrative entities. Some COCONet partners manage regional networks and need more than GSAC for efficient data management, prompting the creation of Dataworks. The full Dataworks suite adds modules for GNSS receiver control and data download, metadata and data file management, mirroring of station data and metadata from partner GSACs, guidelines and scripts for backup, and extensive software and operator documentation.

With Dataworks, COCONet partner institutions create their own data centers with institutional branding and common functionality, allowing the sharing of data while tracking access and attribution. In addition, COCONet provided support for three institutions, selected via a competitive proposal process, to establish Dataworks-enabled Regional Data Centers (RDCs), with modest funding to support data operations. The RDCs were awarded to the Caribbean Institute for Meteorology and Hydrology (CIMH), Barbados; the Instituto Nicaraguense de Studios Territoriales (INETER), Nicaragua; and Sociedad Colombiana de Geotecnia (SGC), Colombia. RDC technical staff received hands-on training in Boulder, Colorado on running the servers and Dataworks software. RDC support was also provided for the TLALOCNet Data Center, hosted at the Universidad de Guadalajara, Mexico. TLALOCNet is an atmospheric and tectonic GNSS-meteorological network, which leverages NSF and National Autonomous University of Mexico (UNAM) funding to augment and enhance existing GNSS network stations in Mexico. Collectively, the Plate Boundary Observatory (PBO) in the United States, TLALOCNet, and COCONet provide a significant observing network across the Americas that contribute to communications, integration and accessibility of earth observations for the benefit of research. Further, they support broad benefits to society such as precision timing, navigation, surveying, as well as security and risk resiliency. Continued support for these networks will help ensure a better future for all.

Dataworks allows any institution to host regional GNSS data, optionally mirroring relevant holdings in the UNAVCO Data Archive as well as providing data from their own networks. In this way, partners maintain ownership of their data yet have the means to share it in a controlled and attributed way to encourage open data access. By sharing data, data centers tie local and regional data into a global reference frame and contribute to understanding of regional geohazards.

Dataworks is an evolving data management system, with opportunities to enhance its capabilities. Additional development will depend on securing resources, to support plans for improving scalability, expanding supported instrumentation, and testing in a cloud virtual machine (VM) environment to improve access to Dataworks for institutions with limited hardware resources. UNAVCO is seeking new partners to extend the

Figure 5: Stuart Wier and Fran Boler of UNAVCO work with Daison Lowe and Wayne Depradine, both from CIMH Barbados, to run Dataworks software at a Dataworks training class at the UNAVCO Boulder facility in December 2014. (Photo/Beth Bartel, UNAVCO)

Figure 6: The Regional Data Center homepage at CIMH Barbados to provide COCONet data. http://coconet.cimh.edu.bb/coconetgsac/

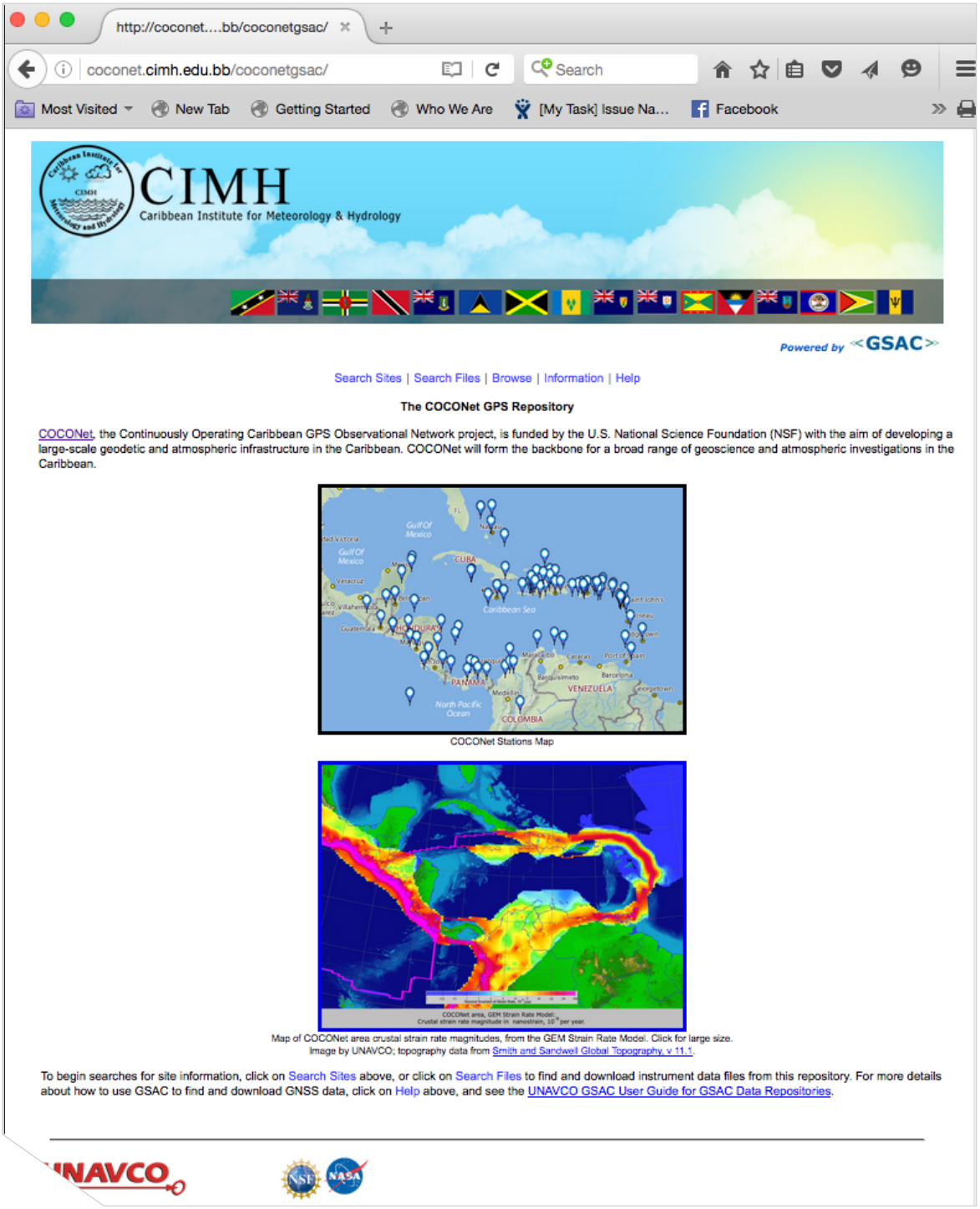


Figure7: A COCONet site at the ranger outpost on Cocos Island, Costa Rica.

Photo by Sarah Doelger, UNAVCO.

Figure 8: Installation of GPS/Meteorologic station CN18 on Swan Islands, Honduras. UNAVCO Field Engineer Michael Fend by the instrument box.

Photo by John Sandru

STUDENT SPOTLIGHTS

Lee Corbett just completed her doctorate at the University of Vermont working in Greenland and Baffin Island with NSF support. She studied "ghost glaciers" that are frozen to the bed and therefore incapable of eroding the underlying landscape. Since ghost glaciers leave behind little physical evidence, determining if and when high-latitude landscapes were covered by non-erosive glacial ice in the past has long challenged geoscientists. Lee used multiple cosmogenic isotopes with different half-lives to assess the history of ancient landscapes that have been preserved beneath non-erosive glacial ice for many glaciations over millions of years.

Celebrating the Fourth of July along the ice-choked Wolstenholme Fjord near Thule, northwest Greenland (July, 2013, photo courtesy of Everett Lasher).

Anny Sainvil, a rising senior at Smith College, spent her summer doing research as a RESESS intern with UNAVCO. She worked with Dr. Kamini Singha and Emily Voytek at Colorado School of Mines. They used a geophysical method of analyzing the temporal and spatial variation of groundwater flow in meadows within the Boulder Creek Critical Zone Observatory in Colorado. She presented her work at the fall 2015 National GSA Conference in Baltimore, MD. Anny is currently studying abroad in Christchurch, New Zealand with Frontiers Abroad and completing field camp and a semester at the University of Canterbury. This summer, she will work with the NSF-funded Keck Geology Consortium Tephrastratigraphy Iceland Project and working on her senior thesis. Anny will embark on a NSF-funded field team with Dr. Erin Pettit, University of Alaska, and take the lead on a special GPR project on the West Antarctic Ice Sheet this upcoming December

If you have a student that you would like to feature in "Student Spotlight", please send 100-150 word article describing their involvement in science and photo to ddomansk@nsf.gov.

JOB ANNOUNCEMENTS

Hydrologic Science (HS)
Vacancy announcements for a permanent and rotating Program Director in HS has recently been released.

Permanent: https://www.usajobs.gov/GetJob/ViewDetails/436382200
Non-permanent: https://www.usajobs.gov/GetJob/ViewDetails/436383100

Program Director, Earth Sciences Division (EAR)
Position focuses on communication, outreach, and portfolio analytics.

Permanent: https://www.usajobs.gov/GetJob/ViewDetails/440791200
Non-Permanent: https://www.usajobs.gov/GetJob/ViewDetails/440792600/

Program Director, Surface Earth Processes Section (SEP)
Position (permanent) focuses on supporting sedimentology, paleoclimatology, land-use dynamics, and low-temperature geochemistry programs within SEP.

https://www.usajobs.gov/GetJob/ViewDetails/440794700

UPCOMING DEADLINES AND TARGET DATES

The GeoPRISMS solicitation has been revised:
NSF 16-560

Dear Colleague Letter: Strengthening Research Capacity as Historically Black Colleges and Universities:
NSF 16-080

Dear Colleague Letter: Grant Opportunities for Academic Liaison with Industry (GOALI):
NSF 16-099

EPSCoR Research Infrastructure Improvement Program Track-1: (RII Track-1) [N]	(NSF 16-557)	Letter of Intent	July 5, 2016
Petrology and Geochemistry (CH)	(NSF 15-557)	Full Proposals Accepted	July 8, 2016
Tectonics	(NSF 16-556)	Full Proposals Accepted	July 8, 2016
Industry/University Cooperative Research Centers Program (I/UCRC) [N]	(NSF 16-504)	Full Proposals Accepted	July 11, 2016
GeoPRISMS Program	(NSF 15-560)	Full Proposals Accepted	July 26, 2016
Faculty Early Career Development Program (CAREER) [N]	(NSF 15-555)		
BIO, CISE, EHR		Full Proposals Accepted	July 20, 2016
ENG		Full Proposals Accepted	July 21, 2016
GEO, MPS, SBE		Full Proposals Accepted	July 22, 2016

Management and Operation of the National Geophysical Observatory for Geoscience (NGEO)	(NSF 16-546)	Letter of Content Full Proposals Accepted	August 1, 2016 December 30, 2016
EPSCoR Research Infrastructure Improvement Program Track-1: (RII Track-1) [N]	(NSF 16-557)	Full Proposals Accepted	August 2, 2016
International Research Experiences for Students (IRES) [N]	(NSF 12-551)	Full Proposal Deadline	August 16, 2016
Advancing Digitization of Biodiversity Collections (ADBC)	(NSF 15-576)	Full Proposal Deadline	Octobert, 14 2016
Paleo Perspectives on Climate Change (P2C2)	(NSF 13-576)	Full Proposal Deadline	Octobert, 17 2016
East Asia and Pacific Summer Institutes for U.S. Graduate Students (EAPSI) [N]	(NSF 15-593)	Full Proposal Deadline	November 10, 2016
Integrated Earth Systems (IES)	(NSF 15-600)	Full Proposal Deadline	November 14, 2016
EarthScope	(NSF 15-578)	Full Proposal Deadline	November 15, 2016
Geophysics (PH)	(NSF 12-598)	Full Proposal Deadline	December 7, 2016
National Science Foundation Research Traineeship (NRT) Program [N]	(NSF 16-503)	Letter of Intent	December 9, 2016
Management and Operation of the National Geophysical Observatory for Geoscience (NGEO)	(NSF 16-546)	Full Proposal Deadline	December 30, 2016
Petrology and Geochemistry (CH)	(NSF 15-557)	Full Proposal Deadline	January 9, 2017
NSF Earth Sciences Postdoctoral Fellowships (EAR-PF)	(NSF 15-568)	Full Proposal Deadline	January 10, 2017
Major Research Instrumentation Program: (MRI) [N]	(NSF 15-504)	Full Proposal Deadline	January 11, 2017
Tectonics	(NSF 16-556)	Full Proposal Deadline	January 13, 2017
National Science Foundation Research Traineeship (NRT) Program [N]	(NSF 16-503)	Full Proposal Deadline	February 7, 2017
Innovation Corps- National Innovation Network Sites Program (I-Corps Sites) [N]	(NSF 16-547)	Full Proposal Deadline	February 9, 2017
Genealogy of Life FY 2016 (GoLife)	(NSF 16-522)	Full Proposal Deadline	March 22, 2017
Earth Sciences: Instrumentation and Facilities (EAR/IF)	(NSF 15-516)	Full Proposal Accepted	Anytime

Experimental Program to Stimulate Competitive Research: Workshop Opportunities (EPS-WO) (EPS-WO) [N]	(NSF 12-588)	Full Proposal Accepted	Anytime
Facilitating Research at Primarily Undergraduate Institutions [N]	(NSF 14-579)	Full Proposal Accepted	Anytime
Geobiology and Low-Temperature Geochemistry	(NSF 15-559)	Full Proposal Accepted	Anytime
Geomorphology and Land Use Dynamics	(NSF 15-560)	Full Proposal Accepted	Anytime
Grant Opportunities for Academic Liaison with Industry (GOALI) [N]	(NSF 12-513)	Supplement Accepted Full Proposal Accepted	Anytime Anytime
Hydrologic Sciences	(NSF 15-558)	Full Proposal Accepted	Anytime
Science of Learning Centers (SLC) [N]		Full Proposal Accepted	Anytime
Sedimentary Geology and Paleobiology (SGP)	(NSF 16-536)	Full Proposal Accepted	Anytime

Proposal & Award Policies & Procedures Guide (PAPPG), (NSF 16-001) has been issued and became effective on January 2016.

@NSF_EAR: Earth Science news from the Division and beyond
@NSF: News and highlights from all directorates at NSF
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@GeoPRISMS: News and updates from the GeoPRISMS Office

The Division of Earth Sciences
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Natinal Science Foundation
4201 Wilson Blvd.
Arlington, VA 22230
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www.nsf.gov

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If you have comments or questions, please contact David Domanski at DDomansk@nsf.gov

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