DIRECTORATE FOR GEOSCIENCES (GEO) **$852,980,000**
+$27,360,000 / 3.3%

GEO Funding
(Dollars in Millions)

	FY 2017 Actual	FY 2018 (TBD)	FY 2019 Request	Change over FY 2017 Actual Amount	Change over FY 2017 Actual Percent
Atmospheric & Geospace Sciences (AGS)	$253.37	-	$239.30	-$14.07	-5.6%
Earth Sciences (EAR)	179.13	-	169.23	-9.90	-5.5%
Integrative & Collaborative Education and Research (ICER)	76.38	-	104.95	28.57	37.4%
Ocean Sciences (OCE)	316.74	-	339.50	22.76	7.2%
Total	**$825.62**	**-**	**$852.98**	**$27.36**	**3.3%**

About GEO

GEO supports basic research that advances the frontiers of knowledge and drives technological innovation while improving our understanding of the many processes that create and sustain vital natural resources on which society depends. Our mineral, energy, and water resources result from diverse Earth processes including the planet's water cycle, interactions across the land-ocean interface, the behavior of ice sheets, and geologic processes responsible for hydrocarbon energy sources and strategic minerals. Basic research supported by GEO contributes to the understanding of these processes and the resources that result from them. In addition, lives are saved and property is preserved by better forecasting and understanding of natural environmental hazards such as earthquakes, tornadoes, tsunamis, drought, and solar storms. GEO-supported research improves society's preparation for the effects of these and other disruptive natural events, and GEO prioritizes support for interdisciplinary studies that contribute directly to national research priorities such as mitigating the impacts of hazardous events, and understanding future availability and distribution of fresh water.

GEO activities support and promote many of NSF's Big Ideas. In particular, a number of GEO programs contribute directly to NSF's overarching theme of Navigating the New Arctic (NNA). GEO programs also contribute to Harnessing the Data Revolution for 21st-Century Science and Engineering, Understanding the Rules of Life, and NSF INCLUDES. Leveraging the knowledge and techniques of many other disciplines, GEO strongly promotes the growth of Convergence Research across all fields of science. As part of NNA, and in partnership with the other research directorates and offices, GEO will invest funds in its ICER division to support convergent activities that transcend the traditional disciplinary boundaries of individual NSF directorates and offices. These activities will enable pursuit of fundamental research in Arctic regions. While budget management and reporting for this investment will be the responsibility of GEO, the convergent activities will be overseen and managed collaboratively by the multi-directorate/office NNA leadership team.

In addition, the Office of Polar Programs (OPP) operates as part of the Directorate for Geosciences; more information on OPP can be found in the Office of Polar Programs narrative.

GEO provides about 59 percent of the federal funding for basic research at academic institutions in the atmospheric, earth, and ocean sciences.

Major Investments

GEO Major Investments
(Dollars in Millions)

Area of Investment	FY 2017 Actual	FY 2018 (TBD)	FY 2019 Request	Change over FY 2017 Actual Amount	Change over FY 2017 Actual Percent
CAREER	$16.47	-	$14.02	-$2.45	-14.9%
INFEWS	7.70	-	8.00	0.30	3.9%
IUSE	5.82	-	6.00	0.18	3.1%
NSF I-Corps™	0.60	-	0.60	-	-
NSF Research Traineeship[1]	2.77	-	-	-2.77	-100.0%
PREEVENTS	17.25	-	17.25	-	-
NSF's Big Ideas					
Navigating the New Arctic		*-*	*30.00*	*30.00*	*N/A*
NSF INCLUDES[2]	*2.08*	*-*	*-*	*-2.08*	*-100.0%*

Major investments may have funding overlap and thus should not be summed.

[1] In FY 2019, NRT funding is provided through CISE and EHR.

[2] In FY 2019, NSF INCLUDES funding is provided through the EHR account.

GEO Funding for Centers Programs and Facilities

GEO Funding for Centers Programs
(Dollars in Millions)

	FY 2017 Actual	FY 2018 (TBD)	FY 2019 Request	Change over FY 2017 Actual Amount	Change over FY 2017 Actual Percent
Total	**$5.00**	**-**	**$3.70**	**-$1.30**	**-26.0%**
STC: Center for Dark Energy Biosphere Investigations (OCE)	5.00	-	3.70	-1.30	-26.0%

For detailed information on individual centers programs, please see the NSF-Wide Investments chapter.

GEO Funding for Facilities
(Dollars in Millions)

	FY 2017 Actual	FY 2018 (TBD)	FY 2019 Request	Change over FY 2017 Actual Amount	Change over FY 2017 Actual Percent
Total	**$272.51**	**-**	**$297.33**	**$24.82**	**9.1%**
Academic Research Fleet (ARF)	84.14	-	77.80	-6.34	-7.5%
Arecibo Observatory	4.10	-	3.03	-1.07	-26.1%
Geodesy Advancing Geosciences and EarthScope (GAGE)	11.58	-	10.90	-0.68	-5.9%
International Ocean Discovery Program (IODP)	48.00	-	48.00	0.00	-
National Center for Atmospheric Research (NCAR)	99.70	-	94.70	-5.00	-5.1%
National Nanotechnology Coordinated Infrastructure (NNCI)	0.30	-	-	-0.30	-100.0%
Ocean Observatories Initiative (OOI)[1]	0.34	-	40.00	39.66	11638.8%
Seismological Facilities for Advancement of Geoscience & EarthScope (SAGE)	24.35	-	22.90	-1.45	-6.0%

[1]The FY 2017 budget of $340,000 reflects only the incremental support necessary to enable the potential transition of managing institutions associated with the competition for a new operation and management award of the OOI. FY 2017 operations and maintenance were funded in a prior year.

For detailed information on individual facilities, please see the Facilities and the Major Research Equipment and Facilities Construction chapters.

Funding Profile

GEO Funding Profile

	FY 2017 Actual Estimate	FY 2018 (TBD)	FY 2019 Estimate
Statistics for Competitive Awards:			
Number of Proposals	4,088	-	4,100
Number of New Awards	1,296	-	1,300
Funding Rate	32%	-	32%
Statistics for Research Grants:			
Number of Research Grant Proposals	3,762	-	3,800
Number of Research Grants	1,130	-	1,200
Funding Rate	30%	-	32%
Median Annualized Award Size	$149,623	-	$150,000
Average Annualized Award Size	$189,006	-	$190,000
Average Award Duration, in years	2.8	-	2.8

People Involved in GEO Activities

Number of People Involved in GEO Activities

	FY 2017 Actual Estimate	FY 2018 (TBD)	FY 2019 Estimate
Senior Researchers	4,414	-	4,400
Other Professionals	2,602	-	2,600
Postdoctoral Associates	490	-	500
Graduate Students	2,318	-	2,300
Undergraduate Students	2,145	-	2,200
K-12 Teachers	-	-	-
K-12 Students	-	-	-
Total Number of People	**11,969**	**-**	**12,000**

Program Monitoring and Evaluation

External Program Evaluations and Studies:

- In FY 2017, GEO initiated an evaluation of its Education and Diversity program. Results are expected in late FY 2018 and will be used to inform internal strategic planning activities.
- The Science, Engineering, and Education for Sustainability (SEES) program, which ended in FY 2017, is currently being assessed. The evaluation is being conducted by Manhattan Strategy Group and will (1) examine the effectiveness of SEES, (2) complete a historical review of NSF's sustainability efforts in the past 15 years, and (3) review the SEES portfolio solicitations from 2010 to 2014. Final results from this study are expected in FY 2019.

Workshops and Reports:

In 2015, the National Research Council's Ocean Studies board released *Sea Change: 2015-2025 Decadal Survey of Ocean Sciences*[1]. This report greatly influenced NSF's Division of Ocean Sciences by addressing the strategic investments necessary to ensure a robust ocean science enterprise and providing guidance on research and infrastructure priorities.

In 2017, the National Academies of Sciences, Engineering, and Medicine's Space Studies Board released an *Assessment of the National Science Foundation's 2015 Geospace Portfolio Review*[2]. This study made recommendations for NSF's implementation of prior recommendations of a portfolio review.

Committees of Visitors (COV):

- In 2017, COVs reviewed Education and Diversity programs across GEO and OPP, and all programs in EAR.
- In 2018, COVs will review selected programs in two divisions; AGS and OCE.
- In 2019, a COV will review the AGS Atmosphere Section.

See Performance chapter for additional information regarding the periodic reviews of programs and portfolios of programs by external Committees of Visitors and directorate Advisory Committees not mentioned here.

[1]www.nap.edu/catalog/21655/sea-change-2015-2025-decadal-survey-of-ocean-sciences
[2]www.nap.edu/catalog/24666/assessment-of-the-national-science-foundations-2015-geospace-portfolio-review

DIVISION OF ATMOSPHERIC AND GEOSPACE SCIENCES (AGS) **$239,300,000**
-$14,070,000 / -5.6%

AGS Funding
(Dollars in Millions)

	FY 2017 Actual	FY 2018 (TBD)	FY 2019 Request	Change over FY 2017 Actual Amount	Change over FY 2017 Actual Percent
Total	**$253.37**	**-**	**$239.30**	**-$14.07**	**-5.6%**
Research	**122.71**	**-**	**115.47**	**-7.24**	**-5.9%**
CAREER	4.46	-	4.00	-0.46	-10.4%
Education	**3.33**	**-**	**4.10**	**0.77**	**22.9%**
Infrastructure	**127.32**	**-**	**119.73**	**-7.59**	**-6.0%**
Arecibo Observatory	4.10	-	3.03	-1.07	-26.1%
National Center for Atmospheric Research	99.70	-	94.70	-5.00	-5.0%
Research Resources	23.52	-	22.00	-1.52	-6.5%

AGS Summary

AGS supports fundamental research activities to enable improved understanding of the dynamics of the sun, the physics, chemistry, and dynamics of the Earth's atmosphere and near-space environment, and how the sun interacts with the Earth's atmosphere. Improved understanding supports state-of-the science model development and improved predictability of weather, climate and space weather events. AGS provides support for: (1) basic science projects and (2) the acquisition, maintenance, and operation of observational and cyber-infrastructure facilities and services that enable and support modern day atmospheric and geospace science research activities. AGS support occurs via the traditional individual investigator merit-reviewed multi-year grants, limited duration exploratory research projects, collaborative and multi-investigator group projects, and the research conducted with leadership-class facilities provided by the National Center for Atmospheric Research (NCAR). Through improvements to our understanding of severe weather events, and the development of sophisticated computer models that simulate and forecast such events and their impacts, AGS helps protect life, property, and natural resources, and contributes to the establishment of a weather-ready and space weather-ready nation. AGS-supported scientists lead innovations ranging from the miniaturization of sensors that fly on cubesats, to the creation of high-resolution models that enable prediction of a variety of severe weather hazards. AGS also funds STEM education, fosters the success of early career scientists, and supports the continuing development of a world-class scientific and technical workforce that contributes significantly to the nation's economic vitality.

About 28 percent of the AGS portfolio is available for new research grants. The remainder supports research grants made in prior years and the research infrastructure that supports the capabilities, creativity, and innovation of the atmospheric and geospace science community.

DIVISION OF EARTH SCIENCES (EAR) **$169,230,000**
-$9,900,000 / -5.5%

EAR Funding
(Dollars in Millions)

	FY 2017 Actual	FY 2018 (TBD)	FY 2019 Request	Change over FY 2017 Actual Amount	Change over FY 2017 Actual Percent
Total	**$179.13**	**-**	**$169.23**	**-$9.90**	**-5.5%**
Research	**116.68**	**-**	**110.45**	**-6.23**	**-5.3%**
CAREER	8.48	-	8.02	-0.46	-5.5%
Education	**4.43**	**-**	**4.19**	**-0.24**	**-5.5%**
Infrastructure	**58.02**	**-**	**54.59**	**-3.43**	**-5.9%**
Geodetic Facilities for the Advancement of Geoscience and EarthScope (GAGE)	11.58	-	10.90	-0.68	-5.9%
Seismological Facilities for the Advancement of Geoscience and EarthScope (SAGE)	24.35	-	22.90	-1.45	-6.0%
Research Resources	22.09	-	20.79	-1.30	-5.9%

EAR Summary

EAR supports fundamental research into the structure, composition, and evolution of the Earth, and the life it has sustained over the four and a half billion years of Earth history. The results of this research will lead to a better understanding of Earth's changing environment (past, present, and future), the natural distribution of its mineral, water, biota, and energy resources, and provide methods for predicting and mitigating the effects of geologic hazards such as earthquakes, volcanic eruptions, floods, and landslides.

EAR supports research in geomorphology and land use, hydrologic science, geobiology and low temperature geochemistry, sedimentary geology and paleobiology, geophysics, tectonics, petrology and geochemistry, and integrated Earth systems. In addition to these fundamental research programs, EAR has an Instrumentation and Facilities program that supports community-based, shared-use facilities and the acquisition and development of instrumentation by individual investigators; and an education program that funds a number of activities to attract and support students and young investigators to the field of Earth science.

In general, about 38 percent of the EAR portfolio is available for new research grants and 62 percent is available for continuing grants and the research infrastructure needed by this community.

DIVISION OF INTEGRATIVE AND COLLABORATIVE EDUCATION AND RESEARCH (ICER) **$104,950,000**
+$28,570,000 / 37.4%

ICER Funding
(Dollars in Millions)

	FY 2017 Actual	FY 2018 (TBD)	FY 2019 Request	Change over FY 2017 Actual Amount	Change over FY 2017 Actual Percent
Total	**$76.38**	**-**	**$104.95**	**$28.57**	**37.4%**
Research	**61.55**	**-**	**98.95**	**37.40**	**60.8%**
Big Idea: Navigating the New Arctic	-	-	30.00	30.00	N/A
Education	**14.54**	**-**	**6.00**	**-8.54**	**-58.7%**
Infrastructure	**0.30**	**-**	**-**	**-0.30**	**-100.0%**
National Nanotechnology Coordinated Infrastructure (NNCI)	0.30	-	-	-0.30	-100.0%

ICER Summary

ICER supports novel, complex, or partnership projects in both research and education. These investments cut across traditional boundaries within the geosciences, encouraging interdisciplinary activities and responding directly to critical needs of the entire geoscience community. ICER's principal goals are to develop innovative means to initiate and support geoscience education, attract underrepresented groups to careers in the geosciences, foster the interchange of scientific information nationally and internationally, and to join with other parts of NSF in major integrative research and education efforts. In FY 2019, the division will make strategic investments in multidisciplinary research areas, international activities, education, diversity, and human resource development. The results of these investments will assist in ensuring that the U.S. has a well-educated and diverse workforce in the geosciences and in related technical fields such as resource exploration. Research at the Food-Energy-Water nexus will result in understanding interactions across the FEW nexus, how it is likely to affect our world, and how we can proactively plan for its consequences.

In FY 2019, GEO, in partnership with all of the NSF research directorates and offices, will advance the NNA Big Idea by investing ICER funds to support convergent activities that transcend the traditional disciplinary boundaries of individual NSF directorates and offices. These activities will enable pursuit of fundamental research in the Arctic. While budget management and reporting for this investment will be the responsibility of GEO, the convergent activities will be overseen and managed collaboratively by the multi-directorate/office NNA leadership team.

In general, 48 percent of the ICER portfolio is available for new research grants and 52 percent is available for continuing grants.

DIVISION OF OCEAN SCIENCES (OCE) **$339,500,000**
+$22,760,000 / 7.2%

OCE Funding
(Dollars in Millions)

	FY 2017 Actual	FY 2018 (TBD)	FY 2019 Request	Change over FY 2017 Actual Amount	Change over FY 2017 Actual Percent
Total	**$316.74**	**-**	**$339.50**	**$22.76**	**7.2%**
Research	**167.44**	**-**	**159.86**	**-7.58**	**-4.5%**
CAREER	3.52	-	2.00	-1.52	-43.2%
Centers Funding (total)	5.00	-	3.70	-1.30	-26.0%
STC: Center for Dark Energy Biosphere Investigations	5.00	-	3.70	-1.30	-26.0%
Education	**4.84**	**-**	**4.84**	-	**-**
Infrastructure	**144.46**	**-**	**174.80**	**30.34**	**21.0%**
Academic Research Fleet (ARF)	82.03	-	77.80	-4.23	-5.2%
International Ocean Discovery Program (IODP)	48.00	-	48.00	-	-
Ocean Observatories Initiative (OOI)	0.34	-	40.00	39.66	11638.8%
Polar Logistics	0.09	-	-	-0.09	-100.0%
Research Resources	11.89	-	9.00	-2.89	-24.3%
Facilities Development and Design (total)	2.11	-	-	-2.11	-100.0%
Regional Class Research Vessels (RCRV)	2.11	-	-	-2.11	-100.0%

OCE Summary

OCE supports interdisciplinary research, education, and cutting-edge infrastructure that advances our scientific knowledge of the oceans to support the U.S. economy over the long term, provides vital information regarding national security matters such as sea level rise and harmful algal blooms, and advances U.S. leadership in ocean science and technological innovation. OCE provides support of basic scientific research and technology to better understand changing ocean circulation and other physical parameters, biodiversity and the dynamics of marine organisms and ecosystems, and changing ocean chemistry as exemplified by ocean acidification. OCE also supports research on the geology of the ocean margins and sub-seafloor to investigate the occurrence of methane hydrates, natural hazards associated with earthquakes, tsunamis, and volcanic eruptions, microbial life deep below the seafloor, and other fundamental ocean processes. Ocean education emphasizes the interdisciplinary nature of ocean sciences, and commonly leverages research facilities and infrastructure via telepresence to far and distant seas. Since ocean science requires access to the sea, OCE supports research vessels, deep submergence capability including submersibles and autonomous vehicles, and technologically advanced sensors and instrumentation. Broadly speaking, research, education, and infrastructure funded by OCE addresses the central role of the oceans in a changing Earth and as a national strategic resource, as recognized by numerous reviews by external bodies (e.g., National Academy of Sciences Decadal Survey *Sea Change, 2015-2025*).

In general, 39 percent of the OCE portfolio is available for new research grants, with the rest supporting grants made in prior years and the research infrastructure needed by this community.