DIRECTORATE FOR GEOSCIENCES (GEO) $1,393,830,000
+$80,300,000 / 6.1%

GEO Funding
(Dollars in Millions)

	FY 2015 Actual	FY 2016 Estimate	FY 2017 Request	Change Over FY 2016 Estimate Amount	Change Over FY 2016 Estimate Percent
Atmospheric and Geospace Sciences (AGS)	$252.18	$253.67	$267.92	$14.25	5.6%
Earth Sciences (EAR)	178.31	179.39	191.68	12.29	6.9%
Integrative and Collaborative Education and Research (ICER)	84.22	83.74	94.95	11.22	13.4%
Ocean Sciences (OCE)	361.31	359.89	379.42	19.53	5.4%
Polar Programs (PLR)	443.02	441.85	464.86	23.01	5.2%
U.S. Antarctic Logistical Support (USALS)	*[67.52]*	*[67.52]*	*[67.52]*	-	-
Total, GEO	**$1,319.04**	**$1,318.54**	**$1,398.83**	**$80.30**	**6.1%**

Totals may not add due to rounding.

The FY 2017 Budget Request for GEO is $1,398.83 million, of which $1,319.56 million is discretionary funding and $79.27 million is new mandatory funding. The major focus of the mandatory funding is support for disciplinary and interdisciplinary research activities, principally through the support of early career investigators. Across the geosciences, special attention will be paid to new or early-career researchers. Most early-career researchers supported by GEO are funded through standing programs and increases to these activities should enable support of additional early-career researchers. Mandatory funding will also support one-time investments to enhance infrastructure at a number of key geoscience facilities. Increases include: NCAR ($1.03 million), GAGE ($1.50 million), SAGE ($2.60 million), Antarctic infrastructure ($8.0 million), and Arctic logistics ($3.0 million).

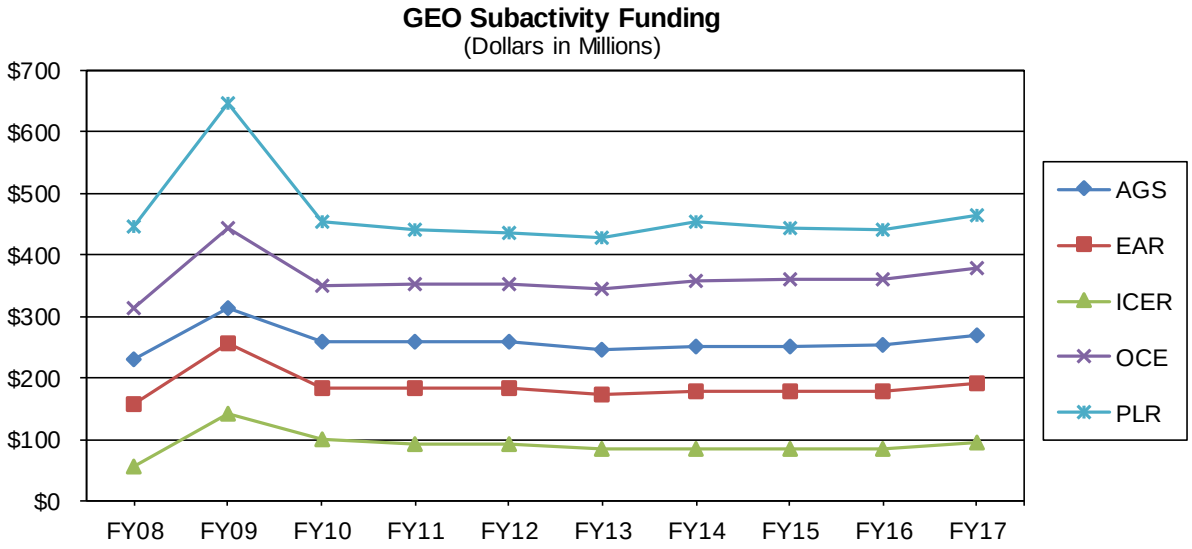
About GEO

GEO supports basic research that advances the frontiers of knowledge and drives technological innovation while improving our understanding of the many processes that affect the global environment. These processes include the planetary water cycle, geologic interactions that cross the land-ocean interface, and the behavior of ice sheets. Lives are saved and property is preserved through better prediction and understanding of natural environmental hazards such as earthquakes, tornados, hurricanes, tsunamis, drought, and solar storms. Basic research supported by GEO enables preparation for and subsequent mitigation of, or adaptation to, the effects of these and other disruptive natural events. Support is provided for interdisciplinary studies that contribute directly to national research priorities such as: mitigating the impacts of hazardous events; developing and deploying integrated ocean observing capabilities to support ecosystem-based management; and understanding future availability and distribution of fresh water. Another focus is understanding the Earth's polar regions – research that spans not only atmospheric, earth, and ocean processes, but other NSF-supported disciplines.

As the primary U.S. supporter of fundamental research in the polar regions, NSF, through GEO, provides interagency leadership for U.S. polar activities. In the Arctic, NSF helps coordinate research planning as directed by the Arctic Research Policy Act of 1984. The NSF Director chairs the Interagency Arctic Research Policy Committee created for this purpose, which is now a component of the President's National Science and Technology Council (NSTC). In the Antarctic, per Presidential Memorandum 6646, GEO manages all U.S. activities as a single, integrated program, making Antarctic research possible for scientists

supported by NSF and by other U.S. federal agencies. The latter include the National Aeronautics and Space Administration (NASA), the National Oceanic and Atmospheric Administration (NOAA), the U.S. Geological Survey (USGS), the Smithsonian Institution, and the Department of Energy (DOE). The U.S. Antarctic Program research activity funded by NSF also supports leadership by the U.S. Department of State in the governance of the continent and Southern Ocean under the aegis of the Antarctic Treaty.

GEO provides about 59 percent of the federal funding for basic research at academic institutions in the geosciences and polar regions.



FY 2009 reflects both the FY 2009 omnibus appropriation and funding provided through the American Recovery and Reinvestment Act of 2009 (P.L. 111-5).

FY 2017 Summary by Division

- AGS's FY 2017 Request emphasizes support for two NSF-wide emphasis areas: 1) Risk and Resilience through PREEVENTS (Prediction of and Resilience against Extreme Events), and 2) the Innovations at the Nexus of Food, Energy, and Water Systems (INFEWS) investment. Support continues for the NSF-wide Science, Engineering, and Education for Sustainability (SEES) investment, which ends in FY 2017. AGS priorities include maintaining support for disciplinary and interdisciplinary research activities in atmospheric sciences, and in important geospace frontier areas, including understanding of space weather events, and the observational infrastructure required to conduct modern research, including overseeing operation of the National Center for Atmospheric Research (NCAR)-Wyoming Supercomputing Center.

- EAR's FY 2017 Request is focused on support for PREEVENTS and INFEWS. Supporting SEES, maintaining support for disciplinary and interdisciplinary research activities, and the observational infrastructure required to conduct modern research also remain priorities.

- ICER's FY 2017 Request includes support for PREEVENTS and INFEWS. Support will continue for priority areas such as Cyberinfrastructure Framework for 21st Century Science, Engineering, and Education (CIF21) and SEES. GEO is initiating, through the ICER division, a new activity to support mid-scale research infrastructure, which will address those projects that are above the funding ceiling for the Major Research Infrastructure (MRI) program but below the threshold to be considered for

Major Research Equipment and Facilities Construction (MREFC) funding. ICER will also provide some support for the operations and maintenance of the Ocean Observatories Initiative (OOI), enabling OCE to maintain a strong research portfolio.

- OCE's FY 2017 Request includes support for basic ocean research, education, and infrastructure, as part of its internal programs as well as via the GEO initiatives PREEVENTS and INFEWS. OCE also supports SEES and partners with other NSF directorates in support of the Long-Term Ecological Research (LTER) program. OCE programs further support Executive Order 13547 establishing a National Ocean Policy (NOP).[1] OCE continues to invest in OOI and the International Ocean Discovery Program (IODP), and is continuing to develop potential new Regional Class Research Vessels (RCRV), construction funds for which are requested in the MREFC account.

- PLR's FY 2017 Request is focused on maintaining strong disciplinary programs; targeted basic research in cross-foundation and interagency priorities; and supporting and improving the efficiency of critical facilities that enable research in both polar regions, including planning to realize NSF's long-term vision for continued U.S. presence in Antarctica. Support is also provided for PREEVENTS and INFEWS.

Major Investments

GEO Major Investments
(Dollars in Millions)

Area of Investment	FY 2015 Actual	FY 2016 Estimate	FY 2017 Request	Change Over FY 2016 Estimate Amount	Change Over FY 2016 Estimate Percent
ADVANCE	$4.11	$4.11	$4.11	-	-
CAREER	16.18	13.81	14.00	0.19	1.4%
CIF21	10.99	11.00	12.21	1.21	11.0%
NSCI	-	-	3.50	3.50	N/A
NSF I-Corps™	0.92	0.60	0.60	-	-
NSF INCLUDES	-	2.57	2.44	-0.13	-5.1%
INFEWS	-	5.00	10.00	5.00	100.0%
IUSE	10.90	6.50	6.00	-0.50	-7.7%
NRT[1]	6.63	4.43	3.32	-1.11	-25.1%
Risk and Resilience	-	17.75	17.75	-	-
SEES	59.00	34.00	18.50	-15.50	-45.6%

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

[1] Outyear commitments for Integrative Graduate Education and Research Traineeship (IGERT) are included in the NRT line and are $2.04 million in FY 2015, $610,000 in FY 2016, and zero in FY 2017.

- ADVANCE: GEO will continue to participate in the NSF-wide program ADVANCE at a level of $4.11 million as part of its ongoing commitment to broaden participation to build strategies and models to increase the participation, retention, and advancement of women in all STEM academic careers.

- CAREER: GEO support for the CAREER program will increase $190,000, to a total of $14.0 million, reflecting GEO's continuing commitment to supporting the next generation of scientists.

[1] Executive Order 13547 – Stewardship of the Ocean, Our Coasts, and the Great Lakes. July 19, 2010. www.whitehouse.gov/the-press-office/executive-order-stewardship-ocean-our-coasts-and-great-lakes

- CIF21: GEO's investment will increase $1.21 million, to a total of $12.21 million in FY 2017. The increase is largely related to GEO's participation in the new Data Science Pilots activity.

- NSF Innovation Corps (I-Corps™): GEO support remains level at $600,000, reflecting continued support of I-Corps™ Nodes.

- National Strategic Computing Initiative (NSCI) ($3.50 million): As the role of large-scale computation in the geosciences expands, GEO will emphasize, through NSCI, activities to analyze the large complex data sets generated through modeling and simulations, and to assimilate real-time data into models and forecasts.

- NSF INCLUDES (Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science): In FY 2017, NSF continues to emphasize NSF INCLUDES, which started in FY 2016 and aims to promote broader participation in the sciences. GEO support decreases by $310,000, to a total of $2.44 million.

- INFEWS: In FY 2017, NSF is continuing to build an interdisciplinary investment to study the food-energy-water nexus through INFEWS. Support for this activity in FY 2017 totals $10.0 million, double the FY 2016 estimate.

- Improving Undergraduate STEM Education (IUSE): Support for the NSF-wide IUSE activity decreases by $500,000 to a total of $6.0 million.

- NSF Research Traineeship (NRT): GEO will continue to fund STEM graduate students in areas of national priority and support the development of transformative and scalable models for STEM graduate education. Support for NRT decreases to $3.32 million in FY 2017, reflecting the completion of funding commitments for the prior program IGERT.

- Risk and Resilience: In FY 2017, NSF is continuing a new activity to enhance national risk and resilience to hazardous events initiated in FY 2016. GEO plays a key role in advancing understanding of natural hazards such as tornados, hurricanes, earthquakes, and disruptive space weather events, and is maintaining its investment of $17.75 million in PREEVENTS.

- SEES: SEES programs began a planned ramp-down in FY 2015, and in FY 2017, this phase-out will continue. GEO support for SEES decreases $5.50 million, to $18.50 million.

GEO Funding for Centers Programs and Facilities

GEO Funding for Centers Programs
(Dollars in Millions)

	FY 2015 Actual	FY 2016 Estimate	FY 2017 Request	Change Over FY 2016 Estimate Amount	Change Over FY 2016 Estimate Percent
Total, Centers Programs	**$10.32**	**$5.00**	**$5.00**	**-**	**-**
Center for Multiscale Atmospheric Processes (AGS)	2.66	-	-	-	-
Center for Coastal Margin Observation and Prediction (OCE)	2.66	-	-	-	-
Center for Dark Energy Biosphere Investigations (OCE)	5.00	5.00	5.00	-	-

Totals may not add due to rounding.

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

- FY 2016 marks the planned retirement of two Science and Technology Centers (STC): the Center for Multiscale Atmospheric Processes in AGS and the Center for Coastal Margin Observation and Prediction in OCE. In FY 2017, OCE support continues for the Center for Dark Energy Biosphere Investigations at a level of $5.0 million.

GEO Funding for Facilities

(Dollars in Millions)

	FY 2015 Actual	FY 2016 Estimate	FY 2017 Request	Change Over FY 2016 Estimate Amount	Change Over FY 2016 Estimate Percent
Total, Facilities	**$645.61**	**$634.35**	**$643.80**	**$9.45**	**1.5%**
Academic Research Fleet (OCE)	82.00	86.80	84.80	-2.00	-2.3%
Arctic Research Support and Logistics (PLR)	56.78	39.41	42.41	3.00	7.6%
Arecibo Observatory (AGS)	4.00	4.10	4.10	-	-
Geodesy Advancing Geosciences and EarthScope (EAR)	11.58	11.58	13.08	1.50	13.0%
IceCube Neutrino Observatory (PLR)	3.45	3.45	3.50	0.05	1.4%
International Ocean Discovery Program (OCE)	48.00	48.00	48.00	-	-
National Center for Atmospheric Research (AGS)	98.70	99.70	101.00	1.30	1.3%
National Nanotechnology Coordinated Infrastructure (ICER)	0.30	0.30	0.30	-	-
Ocean Observatories Initiative (OCE and ICER)	55.00	55.00	50.00	-5.00	-9.1%
Seismological Facilities for the Advancement of Geosciences and EarthScope (EAR)	24.35	24.35	26.95	2.60	10.7%
U.S. Antarctic Facilities and Logistics (PLR)	193.93	194.14	202.14	8.00	4.1%
U.S. Antarctic Logistical Support (PLR)	67.52	67.52	67.52	-	-

Totals may not add due to rounding.

For detailed information on individual facilities, please see the Facilities chapter.

- Support for the Academic Research Fleet decreases $2.0 million, to a total of $84.80 million, reflecting the ramp-down in planning for the construction of Regional Class Research Vessels as this project transitions to construction supported by the MREFC account.

- Arctic Research Support and Logistics increases $3.0 million, to a total of $ 42.41 million, enabling increased use of marine platforms, such as the newly available *Sikuliaq*, for oceanographic research.

- Arecibo Observatory support remains steady at $4.10 million. The Directorate for Mathematical and Physical Sciences (MPS) leads this activity.

- Support for Geodesy Advancing Geosciences and EarthScope (GAGE) increases $1.50 million, to $13.08 million. This increase is required for the facility to continue supporting the user community at current levels while upgrading instrumentation.

- Funding for the IceCube Neutrino Observatory increases $50,000, to a total of $3.50 million, in support of this facility at the South Pole.

- Funding for the International Ocean Discovery Program (IODP) is maintained at $48.0 million.

- The National Center for Atmospheric Research (NCAR) will increase $1.30 million, to a total of $101.0 million. The increase will allow continued research and service at approximately the FY 2016 level to continue.

- The Ocean Observatories Initiative (OOI) represents a bold step forward in ocean observing for basic research, providing near real-time access to instrumented networks on the sea floor and in the water column at strategic locations around the globe. FY 2016 saw the initiation of full operation of the network, and in FY 2017 will scale back somewhat to $50.0 million (-$5.0 million) as operation and maintenance of OOI assets is competed.

- Support for Seismological Facilities for the Advancement of Geosciences and EarthScope (SAGE) increases $2.60 million, to $26.95 million. This increase is required for the facility to continue supporting the user community at current levels and to upgrade/replace aging infrastructure.

- U.S. Antarctic Facilities and Logistics support increases $8.0 million, to a total of $202.14 million. $5.0 million of this increase will augment the $18.50 million that is annually spent on implementing the Blue Ribbon Panel (BRP) recommendations. Preconstruction planning for the Antarctic Infrastructure Modernization for Science (AIMS) project will be funded at $5.0 million.

Summary and Funding Profile

GEO supports investment in disciplinary and interdisciplinary research and education as well as research infrastructure such as NCAR, the Academic Research Fleet, and research stations in the Arctic and Antarctic.

In FY 2017, the number of research grant proposals is expected to increase above FY 2016 and GEO expects to award about 1,400 research grants. Average annual award size and duration are not expected to materially fluctuate in FY 2015 through FY 2017.

Operations and maintenance funding for GEO-supported user facilities and infrastructure comprises about 52 percent of GEO's FY 2017 Request. GEO has increased operations budgets for some facilities in FY 2017 in order to maintain current operational capacity.

GEO Funding Profile

	FY 2015 Actual Estimate	FY 2016 Estimate	FY 2017 Estimate
Statistics for Competitive Awards:			
Number of Proposals	5,814	5,900	6,300
Number of New Awards	1,465	1,500	1,600
Funding Rate	25%	25%	25%
Statistics for Research Grants:			
Number of Research Grant Proposals	5,300	5,600	6,000
Number of Research Grants	1,240	1,300	1,400
Funding Rate	23%	23%	23%
Median Annualized Award Size	$142,954	$145,000	$145,000
Average Annualized Award Size	$183,266	$185,000	$185,000
Average Award Duration, in years	2.7	2.7	2.7

Program Monitoring and Evaluation

Workshops and Reports

- An *ad hoc* committee of members of the geospace science community was charged in January of 2015 to conduct a portfolio review for the geospace sciences in AGS. That committee is expected to deliver a final report with recommendations by February 2016. The report will then be reviewed by the National Academies of Science (NAS) in 2016.

- A Meeting of Experts convened by NAS was held on October 29, 2015 to discuss the NSF Earth Sciences-funded workshop report on *Future Seismic and Geodetic Facility Needs in the Geosciences*.[2] The participants provided individual perspectives on the relative importance of various current and emerging facility capabilities needed to support future Earth Sciences science and research directions. The discussions inform the development of the solicitation to re-compete EAR's geophysical facilities that will be issued in early CY 2016.

- In 2015 two notable reports were received:
  - The NAS completed a study of OCE's research and infrastructure portfolio, *Sea Change: Decadal Survey of Ocean Sciences 2015-2025*.[3] Initiated in FY 2013 and delivered in FY 2015, this study evaluated potential scientific emphases and the infrastructure required to achieve transformative research within these areas. The report provided insight on future scientific research directions, and made specific recommendations regarding OCE infrastructure investment. This report is helping to guide strategic decisions within OCE.
  - The NAS released *A Strategic Vision for NSF Investments in Antarctica and Southern Ocean Research,*[4] identifying opportunities and challenges for Antarctic and Southern Ocean research, and suggesting research priorities for the coming decade. This and prior related reports help shape research directions in the region.

Committees of Visitors (COV)

- In 2015, COV's reviewed OCE's ocean research and education programs, and AGS' NCAR and facilities section. The COV's reports were presented to the Advisory Committee for Geosciences, which convened in April and October of 2015. Reports and GEO responses to them are publically available through the NSF web site.[5]
- In 2016, COVs will review programs in AGS and PLR.
- In 2017, COVs will review programs in EAR, AGS, and OCE.

The Performance chapter provides details regarding the periodic reviews of programs and portfolios of programs by external Committees of Visitors and directorate Advisory Committees. Please see this chapter for additional information.

[2] www.iris.edu/hq/files/workshops/2015/05/fusg/reports/futures_report_high.pdf
[3] www.nap.edu/catalog/21655/sea-change-2015-2025-decadal-survey-of-ocean-sciences
[4] www.nap.edu/catalog/21741/a-strategic-vision-for-nsf-investments-in-antarctic-and-southern-ocean-research
[5] www.nsf.gov/geo/acgeo_cov.jsp

Number of People Involved in GEO Activities

	FY 2015 Actual Estimate	FY 2016 Estimate	FY 2017 Estimate
Senior Researchers	5,133	5,200	5,500
Other Professionals	2,776	2,800	3,000
Postdoctoral Associates	594	600	600
Graduate Students	2,505	2,500	2,700
Undergraduate Students	2,243	2,300	2,400
Total Number of People	**13,251**	**13,400**	**14,200**

DIVISION OF ATMOSPHERIC AND GEOSPACE SCIENCE (AGS)

$267,920,000
+$14,250,000 / 5.6%

AGS Funding
(Dollars in Millions)

	FY 2015 Actual	FY 2016 Estimate	FY 2017 Request	Change Over FY 2016 Estimate Amount	Change Over FY 2016 Estimate Percent
Total, AGS	**$252.18**	**$253.67**	**$267.92**	**$14.25**	**5.6%**
Research	**119.56**	**123.73**	**129.58**	**5.85**	**4.7%**
CAREER	5.90	5.04	5.04	-	-
Centers Funding (total)	2.66	-	-	-	N/A
STC: Multiscale Modeling of Atmospheric Processes	2.66	-	-	-	N/A
Education	**6.11**	**2.64**	**2.64**	**-**	**-**
Infrastructure	**126.51**	**127.30**	**135.70**	**8.40**	**6.6%**
NCAR	98.70	99.70	101.00	1.30	1.3%
Arecibo Observatory	4.00	4.10	4.10	-	-
Research Resources	23.81	23.50	30.60	7.10	30.2%

Totals may not add due to rounding.

The FY 2017 Budget Request for AGS is $267.92 million, of which $253.67 million is discretionary funding and $14.25 is new mandatory funding. The mandatory funding is within the Research ($5.85 million), NCAR ($1.30 million) and Research Resources ($7.10 million) lines in the above table.

The mission of AGS is to extend intellectual frontiers in atmospheric and geospace sciences by making responsible investments in fundamental research, technology development, and education that enable discoveries, nurture a vibrant, diverse scientific workforce, and help attain a prosperous and sustainable future. AGS supports activities to further understanding of the dynamics of the sun and the physics, chemistry, and dynamics of the Earth's atmosphere and near-space environment. 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. Although the majority of AGS support is through traditional individual investigator merit reviewed, multi-year grants, the division also supports small-scale, limited duration exploratory research projects; collaborative or multi-investigator group projects focusing on a particular project, subject, or activity; large center or center-like projects; and funding for the research conducted at facilities provided by NSF's NCAR, which extends and enhances research at universities. More information on NCAR is available in the Facilities chapter. The division will continue support in key areas of fundamental atmospheric and geospace science, including efforts to improve understanding of the dynamics, predictability, and impacts of extreme atmospheric and space weather events, and development of fundamental knowledge to support predictability and improve adaptation to and resilience with respect to short and long-term variability in weather.

About 26 percent of the AGS portfolio is available to support new research grants. The remainder supports research grants made in prior years and the research infrastructure needed by this community.

FY 2017 Summary

All funding decreases/increases represent change over the FY 2016 Estimate.

Research

- Support for the AGS disciplinary and interdisciplinary research programs increases by $5.85 million, to a total of $129.58 million, to support basic research into understanding weather and precipitation variability and extreme atmospheric and space weather phenomena, and improving the fundamentals that lead to better predictability of extreme events.
- AGS will increase support for NSF's INFEWS activity by $1.0 million, to a total of $1.50 million.
- AGS will maintain support the NSF Risk and Resilience initiative at a level of $3.0 million through GEO's PREEVENTS activity.
- Investments in the SEES portfolio decrease by $5.0 million, to $5.0 million, as the SEES Earth Systems Modeling (EaSM) program ramps down.
- Support for early-career researchers remains an AGS priority. The division will maintain support for CAREER grants at $5.04 million.

Education

- Support for education activities across AGS is maintained at $2.64 million, reflecting the division's continuing commitment to the Research Experiences for Undergraduates (REU) program and support for postdoctoral fellows.

Infrastructure

- Funding for the Arecibo Observatory will remain at $4.10 million.
- NCAR support is increased by $1.30 million, to a total of $101.0 million. This increase will support innovation and a one-time revitalization of its infrastructure for advancing the understanding of high-impact atmospheric and space weather hazards.
- Research Resources are allocated $30.60 million, an increase of $7.10 million, to support the development of advanced technologies for high resolution observations of hazardous weather, and space weather events, for improved predictability, and to support data management and accessibility tools needed by the research community.

DIVISION OF EARTH SCIENCES (EAR) $191,680,000
+$12,290,000 / 6.9%

EAR Funding
(Dollars in Millions)

	FY 2015 Actual	FY 2016 Estimate	FY 2017 Request	Change Over FY 2016 Estimate Amount	Change Over FY 2016 Estimate Percent
Total, EAR	**$178.31**	**$179.39**	**$191.68**	**$12.29**	**6.9%**
Research	**115.86**	**116.46**	**123.65**	**7.19**	**6.2%**
CAREER	6.43	5.58	5.77	0.19	3.4%
Education	**4.49**	**5.00**	**5.00**	**-**	**-**
Infrastructure	**57.96**	**57.93**	**63.03**	**5.10**	**8.8%**
Geodesy Advancing Geosciences and EarthScope (GAGE)	11.58	11.58	13.08	1.50	13.0%
Seismological Facilities for the Advancement of Geosciences and EarthScope (SAGE)	24.35	24.35	26.95	2.60	10.7%
Research Resources	22.03	22.00	23.00	1.00	4.5%

Totals may not add due to rounding.

The FY 2017 Budget Request for EAR is $191.68 million, of which $179.39 million is discretionary funding and $12.29 million is new mandatory funding. The mandatory funding is within the Research ($5.75 million), Education ($1.44 million), GAGE ($1.50 million), SAGE ($2.60 million), and Research Resources ($1.0 million) lines in the above table.

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 water, food, 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; EarthScope, a large-scale facility with an associated science program focused on studying the structure and tectonics of the North American continent; and an education program that funds a number of activities to attract and support students and young investigators to the field of earth science.

About 30 percent of the EAR portfolio is available to support new research grants. The remaining 70 percent supports research grants made in prior years and the research infrastructure needed by this community.

FY 2017 Summary

All funding decreases/increases represent change over the FY 2016 Estimate.

Research

- Disciplinary and interdisciplinary research programs in EAR will increase by $7.19 million, to a total of $123.65 million.
- EAR will increase support for INFEWS by $2.0 million, to a total of $3.72 million.
- Support for Risk and Resilience research will be maintained at $4.75 million through GEO's PREEVENTS activity.
- CAREER funding will be supported at a level of $5.77 million, an increase of $190,000, reflecting EAR's continued commitment to supporting early career investigators.

Education

- EAR's support for education activities will be maintained at $5.0 million. Research Experiences for Undergraduates (REU) sites will be supported at $1.52 million, and support for EAR Postdoctoral Fellowships will be funded at $1.73 million, reflecting EAR's commitment to workforce development.

Infrastructure

- EAR will increase investment in SAGE (+$2.60 million, to a total of $26.95 million) and GAGE (+$1.50 million, to a total of $13.08 million), respectively), allowing for replacement and upgrade of key instrumentation to continue to serve growing communities of researchers.
- Increased funding of $1.0 million, to a total of $23.0 million, will enable EAR's Instrumentation and Facilities Program to provide more support for multi-user regional and national facilities.

DIVISION OF INTEGRATIVE AND COLLABORATIVE EDUCATION AND RESEARCH

$94,950,000
+$11,220,000 / 13.4%

ICER Funding
(Dollars in Millions)

	FY 2015 Actual	FY 2016 Estimate	FY 2017 Request	Change Over FY 2016 Estimate Amount	Change Over FY 2016 Estimate Percent
Total, ICER	**$84.22**	**$83.74**	**$94.95**	**$11.22**	**13.4%**
Research	**50.99**	**54.24**	**63.33**	**9.09**	**16.8%**
CAREER	0.11	-	-	-	N/A
Education	**18.93**	**15.20**	**14.32**	**-0.88**	**-5.8%**
Infrastructure	**14.30**	**14.30**	**17.30**	**3.00**	**21.0%**
Midscale Research Infrastructure	-	-	10.00	10.00	N/A
National Nanotechnology Coordinated Infrastructure	0.30	0.30	0.30	-	-
Ocean Observatories Initiative	14.00	14.00	7.00	-7.00	-50.0%

Totals may not add due to rounding.

The FY 2017 Budget Request for ICER is $94.95 million, of which $84.77 million is discretionary funding and $10.18 million is new mandatory funding. The mandatory funding is within the Research ($10.18 million) line in the above table.

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 2017, the division will make strategic investments in multidisciplinary research areas, international activities, education, diversity, and human resource development.

In general, 43 percent of the ICER portfolio is available for new research grants and the remaining 57 percent supports continuing grants made in previous years.

FY 2017 Summary

All funding decreases/increases represent change over the FY 2016 Estimate.

Research

- ICER will continue support for NSF's INFEWS investment at a level of $2.78 million.
- An NSF-wide thrust on Risk and Resilience research will continue to be supported through GEO's PREEVENTS activity at $4.0 million.
- ICER will support activities in SEES totaling $7.0 million in FY 2017, a reduction of $3.0 million, reflecting the phasing out of this activity.
- ICER supports a varied portfolio of international collaborative activities. In FY 2017, this will again total $6.50 million, and emphasize collaborative research across the Americas and activities sponsored by the Belmont Forum, a group of the world's leading and emerging funding agencies focused on providing international, multi-lateral research opportunities for sustainability.

- In FY 2017, ICER will restore investment in large cross-division research projects (+$7.50 million). Last funded through ICER in FY 2014, the division has historically played a key role in facilitating the support of emerging fields across the geosciences.

Education

- In FY 2017, the ICER education portfolio is decreased by $880,000 to $14.32 million. ICER funds most of GEO's NSF-wide education programs.

Infrastructure

- ICER provides GEO's contribution to the National Nanotechnology Coordinated Infrastructure, which is maintained at $300,000.
- In FY 2017, ICER will provide $7.0 million, a decrease of $7.0 million, in support of operation and maintenance for the Ocean Observatories Initiative (OOI). This temporary support, from FY 2015 - FY 2017, helps enable OCE to maintain a robust research enterprise while transitioning its' facilities in response to the National Academy of Sciences' report *Sea Change: Decadal Survey of Ocean Sciences 2015-2025*,[6] released in January, 2015.
- Mid-Scale Infrastructure: Support for this new activity will enable GEO to invest in emerging infrastructure beyond the scope of the MRI program, but smaller than what is typically funded through NSF's MREFC account. Initial GEO funding will be $10.0 million.

[6] www.nap.edu/catalog/21655/sea-change-2015-2025-decadal-survey-of-ocean-sciences

DIVISION OF OCEAN SCIENCES (OCE) $379,420,000
+$19,530,000 / 5.4%

OCE Funding
(Dollars in Millions)

	FY 2015 Actual	FY 2016 Estimate	FY 2017 Request	Change Over FY 2016 Estimate Amount	Change Over FY 2016 Estimate Percent
Total, OCE	**$361.31**	**$359.89**	**$379.42**	**$19.53**	**5.4%**
Research	**173.74**	**175.56**	**193.89**	**18.33**	**10.4%**
CAREER	2.53	2.16	2.16	-	-
Centers Funding (total)	7.66	5.00	5.00	-	-
STC: Coastal Margin Observation and Prediction	2.66	-	-	-	N/A
STC: Dark Energy Biosphere Investigations	5.00	5.00	5.00	-	-
Education	**5.25**	**2.73**	**2.73**	**-**	**-**
Infrastructure	**182.32**	**181.60**	**182.80**	**1.20**	**0.7%**
Academic Research Fleet	79.87	83.80	82.80	-1.00	-1.2%
International Ocean Discovery Program (IODP)	48.00	48.00	48.00	-	-
Ocean Observatories Initiative (OOI)	41.00	41.00	43.00	2.00	4.9%
Research Resources	11.32	5.80	7.00	1.20	20.7%
Facilities Pre-Construction Planning (total)	2.13	3.00	2.00	-1.00	-33.3%
Regional Class Research Vessels (RCRV)	2.13	3.00	2.00	-1.00	-33.3%

Totals may not add due to rounding.

The FY 2017 Budget Request for OCE is $379.42 million, of which $359.89 million is discretionary funding and $19.53 million is new mandatory funding. The mandatory funding is within the Research ($18.33 million) and Research Resources ($1.20 million) lines in the above table.

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, provide vital information regarding national security matters such as sea level rise, and to advance U.S. leadership in ocean science. OCE provides support of basic scientific research 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 stability of methane hydrates, natural hazards associated with earthquakes and volcanic eruptions, microbial life deep below the seafloor, and other fundamental ocean processes. Ocean education emphasizes undergraduate REU programs and the interdisciplinary nature of ocean sciences, and commonly leverages off 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), as well as in the President's 2010 Executive Order 13547 establishing a National Ocean Policy (NOP) and creating a National Ocean Council (NOC).[7]

[7] Executive Order 13547 – Stewardship of the Ocean, Our Coasts, and the Great Lakes. July 19, 2010. www.whitehouse.gov/the-press-office/executive-order-stewardship-ocean-our-coasts-and-great-lakes

In FY 2017, research emphases in OCE will continue to be guided by *Science for an Ocean Nation: Update of the Ocean Research Priorities Plan*, [8] which was published by the NSTC Subcommittee on Ocean Science and Technology (SOST) in 2013. This report identifies national research priorities in key areas of interaction between society and the ocean. These priorities include improved understanding of marine ecosystems, marine biodiversity, the impact of increased atmospheric carbon dioxide on ocean acidification, ocean observing, changing conditions in the Arctic, hazards and extreme events, and the enhancement of infrastructure to support ocean and coastal research. Specifically for FY 2017, OCE's budget reflects steps forward to a re-alignment of the balance between research and technology funding and support for large infrastructure, as per the suite of recommendations made by the National Research Council/National Academy of Sciences' highly influential report, *Sea Change: 2015-2025 Decadal Survey of Ocean Sciences*.[9]

In general, 32 percent of the OCE portfolio is available for new research grants in basic science and technological innovation. The remaining 68 percent supports the major research infrastructure of the Academic Research Fleet, the International Ocean Discovery Program, and the Ocean Observatories Initiative, and supports awards made in prior years.

FY 2017 Summary

All funding decreases/increases represent change over the FY 2016 Estimate.

Research

- OCE's budget for disciplinary and interdisciplinary research will increase by $17.08 million, to a total of $174.50 million, which reflects bolstering ocean science research programs as per *Sea Change* recommendations, and also through specific investment in studying ocean-based mechanisms active along the land/ocean interface (e.g., sea level change over local, regional, and global scales).
- In FY 2017, OCE will support the Long-Term Ecological Research (LTER) program at a level of $5.75 million (+$1.0 million) to accommodate at least one new coastal location.
- OCE will continue support at $5.0 million for the NSF-wide thrust on Risk and Resilience research through the PREEVENTS activity.

Education

- There is no change in OCE support ($2.73 million) for REU programs or other interdisciplinary education efforts.

Infrastructure

- OCE is decreasing support of ship operations within the Academic Research Fleet by $1.0 million, to a level of $82.80 million, due to the decrease in overall number of vessels and efficiencies gained by technological investment. This decrease is consistent with the recommendations from *Sea Change*. OCE will continue to support the planned development of Regional Class Research Vessels (RCRVs) at $2.0 million (- $1.0 million), which is consistent with long-term planning needs.
- Funding is requested for continued support for operations of the drilling vessel, *JOIDES Resolution*, as part of the U.S. contribution to the IODP. The FY 2017 Request of $48.0 million maintains level funding with no decrease in operations.
- Support for operations and maintenance of the Ocean Observatories Initiative (OOI) will be increased $2.0 million, to $43.0 million. This will be supplemented by $7.0 million from ICER, bringing the total operations and maintenance for OOI to $50.0 million, which is an overall decrease of $5.0 million. This is consistent with the recommendations from *Sea Change*.

[8] www.whitehouse.gov/sites/default/files/microsites/ostp/ocean_research_plan_2013.pdf
[9] www.nap.edu/catalog/21655/sea-change-2015-2025-decadal-survey-of-ocean-sciences

DIVISION OF POLAR PROGRAMS (PLR) $464,860,000
+$23,010,000 / 5.2%

PLR Funding
(Dollars in Millions)

	FY 2015 Actual	FY 2016 Estimate	FY 2017 Request	Change Over FY 2016 Estimate Amount	Change Over FY 2016 Estimate Percent
Total, PLR	**$443.02**	**$441.85**	**$464.86**	**$23.01**	**5.2%**
Research	**111.30**	**128.00**	**139.82**	**11.82**	**9.2%**
CAREER	1.21	1.03	1.03	-	-
Education	**3.37**	**2.71**	**2.35**	**-0.36**	**-13.3%**
Infrastructure	**328.35**	**311.14**	**322.69**	**11.55**	**3.7%**
Arctic Research Support and Logistics	56.52	39.41	42.41	3.00	7.6%
IceCube Neutrino Observatory (IceCube)	3.45	3.45	3.50	0.05	1.4%
U.S. Antarctic Facilities and Logistics	194.20	194.14	202.14	8.00	4.1%
U.S. Antarctic Logistical Support	67.52	67.52	67.52	-	-
Polar Environment, Safety, and Health (PESH)	6.66	6.62	7.12	0.50	7.6%
Facilities Pre-Construction Planning	3.70	14.50	5.00	-9.50	-65.5%

Totals may not add due to rounding.

The FY 2017 Budget Request for PLR is $464.86 million, of which $441.84 million is discretionary funding and $23.02 million is new mandatory funding. The mandatory funding is within the Research ($11.52 million), Arctic Research Support and Logistics ($3.0 million), Antarctic Facilitates and Logistics ($8.0 million), and Polar Environment, Safety, and Health ($500,000) lines in the above table.

The Division of Polar Programs (PLR) provides interagency leadership and is the primary U.S. supporter of research in the polar regions. Arctic Sciences supports research in social, earth systems, and a broad range of natural sciences; its' Research Support and Logistics program responds to research by assisting researchers with access to the Arctic and the planning and sharing of results with local Arctic communities. Antarctic Sciences funds research in a broad range of areas for which access to Antarctica and/or the Southern Ocean is essential to advancing the scientific frontiers. Antarctic Facilities and Logistics enables research in Antarctica on behalf of the U.S. government through a network of stations, labs, equipment, and logistical resources. The Polar Environment, Safety, and Health (PESH) section provides oversight for the environmental, safety, and health aspects of research and operations conducted in polar regions.

PLR's FY 2017 Request reflects three key priorities: (1) maintaining strong disciplinary programs that provide a basis for investments in cross-disciplinary science programs; (2) focusing basic research on cross-foundation (e.g., INFEWS, PREEVENTS) and interagency priorities; and (3) supporting and improving the efficiency of critical facilities that enable research in both polar regions. For Antarctica, the primary objective is to continue progress on a multi-year commitment toward more efficient and cost-effective science support as recommended by the U.S. Antarctic Program (USAP) Blue Ribbon Panel (BRP) report, *More and Better Science in Antarctica through Increased Logistical Effectiveness*.[10] NSF issued a formal response to this report in March 2013.[11] Emphases include safety and health improvements, investments with positive net present value, and facilities renewal at McMurdo and Palmer stations. Additionally, the Antarctic sciences community is planning for the more effective observational approaches and science

[10] www.nsf.gov/od/opp/usap_special_review/usap_brp/rpt/index.jsp
[11] www.nsf.gov/news/news_summ.jsp?cntn_id=127345&org=NSF&from=news

priorities that were respectively outlined in 2011 and 2015 NRC reports; *Future Science Opportunities in Antarctica and the Southern Ocean*[12] and *A Strategic Vision for NSF Investments in Antarctic and Southern Ocean Research.*[13] For the Arctic, shared cross-directorate basic research objectives, the Interagency Arctic Research Policy Committee's (IARPC) *Arctic Research Plan: FY 2013-2017,*[14] and the *National Ocean Policy Implementation Strategy*[15] inform science investment priorities.

PLR funds both research and the necessary research support in the form of logistics and infrastructure. About 13 percent of PLR's funds are available for new research grants each year. The supporting logistics and infrastructure budget is 70 percent of overall funds, with the remainder supporting research awards made in prior years.

FY 2017 Summary

All funding decreases/increases represent change over the FY 2016 Estimate.

Research

- Funding for research increases by $11.82 million, to a total of $139.82 million.
- Approximately $8.52 million of the increase is directed toward land/ocean/ice interface and sea level change, including related critical supporting science infrastructure.
- An investment of $1.0 million in the cross-directorate INFEWS activity will fund research for understanding the mechanisms that enable sustainability and resiliency of global water, food, and energy resources.
- A continued investment of $1.0 million will fund polar research efforts contributing to the cross-directorate Risk and Resilience emphasis area through the PREEVENTS program.
- Research funding dedicated to SEES will decrease (-$1.50 million), to a total of $1.50 million, as focus areas related to earth systems modeling and Arctic sustainability end.

Education

- Funding decreases (-$360,000) to a total of $2.35 million, due to the end of funding for IGERT commitments.

Infrastructure

- Arctic Research Support and Logistics: This program provides support for Arctic researchers, including access to airplanes, helicopters, research vessels including icebreakers, and field camps for approximately 150 projects in remote sites in Alaska, Greenland, Canada, Arctic Scandinavia, Russia, and the Arctic Ocean. Summit Station on the Greenland ice cap operates as a year-round international site for a variety of atmospheric and geophysical measurements. An increase (+$3.0 million) to a total of $42.41 million, enables increased use of marine platforms, such as the newly available *Sikuliaq*, for oceanographic research.
- IceCube Neutrino Observatory: PLR continues to match the MPS contribution, at $3.50 million, that includes an increase of $50,000 in FY 2017 for operation and maintenance.
- U.S. Antarctic Facilities and Logistics: Funding provides all necessary infrastructure, instrumentation, and logistics for scientists from all disciplines and all U.S. agencies performing research in Antarctica. This support includes forward staging facilities in New Zealand and South America; operation of three year-round stations in Antarctica; Department of Defense fixed-wing aircraft, contracted rotary- and fixed-wing aircraft; two leased research vessels; and icebreaking services from the U.S. Coast Guard

[12] www.nap.edu/catalog.php?record_id=13169
[13] www.nap.edu/catalog/21741/a-strategic-vision-for-nsf-investments-in-antarctic-and-southern-ocean-research
[14] www.nsf.gov/od/opp/arctic/iarpc/arc_res_plan_index.jsp
[15] www.whitehouse.gov/administration/eop/oceans/implementationplan

in support of annual resupply efforts. This budget request of $202.14 million includes an $8.0 million increase. Approximately $23.50 million (+$5.0 million) will be spent on implementing the BRP recommendations, allowing for timely replacement of the Ross Island ground station that is critical for weather and other satellite data transfer. Within this amount, $5.0 million is for advancing the Antarctic Infrastructure Modernization for Science (AIMS) project to redevelop McMurdo Station toward Preliminary Design Review. This comprehensive redevelopment of McMurdo involves replacement and reconfiguration of core science, operations, and logistics support facilities for more efficient and effective support of Antarctic science.

- Polar Environment, Safety and Health: Funding is provided for implementation of both environmental protection and environmental stewardship to minimize the environmental impact of PLR-supported activities in polar regions, as well as programs to ensure the safety and health of participants in Antarctica, and certain Arctic operating locations. An increase of $50,000, to a total of $7.12 million, permits development of a suite of web-based tools for managing the secure transfer of polar participants' medical information and environmental permitting and reporting that is required for compliance with the Antarctic Treaty and U.S. implementing legislation.