

GEODETIC FACILITY FOR THE ADVANCEMENT OF GEOSCIENCE (GAGE)

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Geodetic Facility for the Advancement of Geoscience Funding

(Dollars in Millions)

FY 2022 Actual	FY 2023 Estimate	FY 2024 Request	Change over FY 2023 Estimate Base	
	Base		Amount	Percent
\$13.94	\$14.55	\$15.18	\$0.63	4.3%

Brief Description

The Geodetic Facility for the Advancement of GEoscience is a distributed, multi-user facility that enables a diverse research community to make advances in understanding Earth processes that would otherwise not be possible, through broad access to geodetic instrumentation, field training and support, and data services. GAGE operates networks of Global Positioning System (GPS) and Global Navigational Satellite Systems instruments; provides geodetic and related geophysical instrumentation for field experiments; supports data archiving, quality control, and distribution; and provides education and outreach activities that serve a wide range of audiences.

Meeting Scientific Community Needs

To serve the research needs of the broad Earth science community, GAGE is organized under three primary service areas: Geodetic Infrastructure, Geodetic Data Services, and Education and Community Engagement. GAGE users can access data and educational products via the internet at no cost. Scientists making use of equipment, training, and other resources provided by GAGE typically are funded via awards from NSF, the U.S. Geological Survey (USGS), the National Aeronautics and Space Administration (NASA), and other agencies. NSF-sponsored users are generally supported by the Division of Earth Sciences (EAR), the Division of Ocean Sciences (OCE), and OPP. GAGE's ongoing operations and maintenance of continuous GPS regional networks, deployment of portable geodetic instruments, and provision of data enables researchers to address major Earth science questions.

Demand for data, equipment, and other resources provided via GAGE remains high. In FY 2022, data from the facility was downloaded by over 80,000 unique IP addresses. Field experiments using equipment and field engineering assistance continue at an average annual level of approximately 100 projects. GAGE also facilitates three different summer internship programs at the community college, undergraduate, and graduate school levels that primarily focus on students from groups that are underrepresented in geosciences. These programs have consistently produced scientific and professional benefits for the participating students by advancing knowledge and awareness of geoscience career paths as indicated in pre- and post-participation survey results. Interns also enhanced their computational and scientific communication skills.

Status of the Facility

GAGE is currently operating in year five of a seven-year NSF award, and the capabilities provided by the facility have evolved based on input from a series of community engagement activities, including

Major Facilities

an NSF-sponsored workshop entitled “Future Seismic and Geodetic Facility Needs in the Geosciences”, held in 2015.¹ EAR continues to evaluate NSF’s geophysical facilities to best enable emerging research directions. In 2018, EAR commissioned a National Academies of Sciences, Engineering, and Medicine decadal survey that identified top research priorities for the Earth sciences for the next decade. Released in July 2020, *A Vision for NSF Earth Sciences 2020-2030: Earth in Time*² reaffirmed the importance of NSF’s geodetic and seismic facilities in advancing Earth science research over the next decade.

As part of the decadal survey process, a workshop entitled *Management Models for Future Seismological and Geodetic Facilities and Capabilities* was held to review the strengths and weaknesses of different management models for NSF geophysical facilities.³ Following the release of the workshop report, EAR announced that, at the time of the next competition for their management and operations, the current Seismological Facility for the Advancement of GEoscience (SAGE) and GAGE facilities would be consolidated into a single facility with a single operator.⁴

In FY 2020, GEO commissioned a portfolio review from a subcommittee of its Advisory Committee to inform planning for the future, consolidated geophysical facility. The group reviewed possible geophysical instrumentation and sensor networks that a new facility might support to address the science priorities highlighted in the decadal survey. Additionally, the portfolio review report, which was completed in FY 2021, emphasized the importance of developing partnerships in support of elements of SAGE and GAGE that are mission critical for other Federal agencies. EAR is working to define the best path forward for a future facility and is undertaking efforts to expand existing federal partnerships.

Governance Structure and Partnerships

NSF Governance Structure

NSF oversight is provided by EAR, working cooperatively with OPP, the Office of the General Counsel, the Office of Legislative and Public Affairs, and the Office of Budget, Finance, and Award Management (BFA). Within BFA, the Large Facilities Office advises program staff and assists with agency oversight. The GEO facilities team and the Chief Officer for Research Facilities also provide high-level guidance, support, and oversight.

External Governance Structure

The GAGE facility awardee is a 501(c)(3) nonprofit corporation governed by a Board of Directors elected by institutional representatives. As of January 1, 2023, UNAVCO, which managed GAGE since the start of the current award in FY 2018, and the Incorporated Research Institutions for Seismology (IRIS), Inc., merged to form the EarthScope Consortium, Inc., with over 170 institutional members. This consortium now manages both GAGE and SAGE as discrete major facilities. Board members vet program decisions associated with GAGE management and operation through consultation with EarthScope Consortium staff and GAGE advisory committees.

¹ www.iris.edu/hq/files/workshops/2015/05/fusg/reports/futures_report_high.pdf

² www.nap.edu/catalog/25761/a-vision-for-nsf-earth-sciences-2020-2030-earth-in

³ www.nap.edu/catalog/25536/management-models-for-future-seismological-and-geodetic-facilities-and-capabilities

⁴ www.nsf.gov/pubs/2020/nsf20037/nsf20037.jsp

Partnerships and Other Funding Sources

The GAGE facility is primarily supported by EAR with additional support provided by OPP. NASA funding for GAGE enables satellite orbit and clock corrections and the refinement of the International Terrestrial Reference Frame. USGS provides support for ShakeAlert, its earthquake early warning program. EarthScope Consortium also leverages the GAGE award to partner with commercial entities that use the data for autonomous vehicle navigation.

Funding

Total Obligations for GAGE

(Dollars in Millions)

	FY 2022	FY 2023	FY 2024	ESTIMATES ¹				
	Actual	Estimate Base	Request	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029
Operations & Maintenance	\$13.94	\$14.55	\$15.18	\$16.50	\$16.50	\$16.50	\$16.50	\$16.50

¹ Outyear estimates are for planning purposes only. The current cooperative agreement ends in September 2025. In 2020, NSF announced preparation for a competition for a future single, unified geophysical facility as the successor to GAGE and SAGE.

NSF is currently implementing recommendations from the research community and prior facility reviews, that include innovations in multi-constellation instrumentation for more precise measurements of Earth’s surface and to improve studies of near-surface processes (e.g., water storage and flux); moving data services for the facility to the cloud; and recapitalizing aging instrumentation. EAR is evaluating different strategies to address aging instrumentation and plans to phase in recapitalization over the current GAGE award period.

Reviews and Reports

NSF externally reviews components of the GAGE facility on an annual basis. In 2022, NSF conducted a review of the GAGE Education and Community Engagement activity, which was described by reviewers as “unparalleled and impactful” and having “an outsize[d] influence on Earth-sciences culture”. NSF conducted a full management review of GAGE in September 2021, and the panel commended UNAVCO for its strong overall performance in operating and maintaining GAGE. NSF will conduct a follow-up review of the full facility in 2023.

Renewal/Recompetition/Disposition

In 2020, NSF announced preparation for a competition for a future single, unified geophysical facility as the successor to GAGE and SAGE. NSF plans to evolve components of GAGE and SAGE through the competition for the future facility to enable advances in the scientific priorities established by the *Earth in Time* decadal survey. NSF is considering the recommendations in the portfolio review to formulate a strategy for continued support of this important community research resource. Disposition is not being considered at this time.

While the GAGE award was initially planned to end in 2023, NSF announced in June 2021 that it would extend the current awards for operations of both SAGE and GAGE to ensure continuity of services until 2025. This extension will allow NSF to work with agency partners to thoughtfully respond to the recommendations in the portfolio review.