

OCEAN OBSERVATORIES INITIATIVE (OOI)

\$43,000,000
-\$1,010,000 / -2.3%

Ocean Observatories Initiative Funding
(Dollars in Millions)

FY 2019 Actual	FY 2020 (TBD)	FY 2021 Request	Change over	
			FY 2019 Actual Amount	Percent
\$44.01	-	\$43.00	-\$1.01	-2.3%

OOI is a networked observatory that includes deployed ocean instrumentation delivering long-term, time-series ocean data sets for multidisciplinary oceanographic research. All data and metadata are openly available to the public at the OOI website.¹

In 2020, the OOI consists of a system of five arrays of instrumented platforms located at critical locations in the ocean and a cyberinfrastructure to deliver the data. The five arrays include:

- Two Global Arrays:
 - Station Papa Array in the Gulf of Alaska
 - Irminger Sea Array off Greenland.
- One Regional Cabled Array which supports seafloor and water column instrumentation and platforms on the continental shelf, slope, and in the ocean basin off the coast of Oregon and Washington.
- Two Coastal Arrays:
 - Endurance Array composed of two lines of moorings, one off the Washington coast and one off the Oregon coast with glider coverage around, along, and between these lines.
 - Pioneer Array composed of a rectangular array of moorings, gliders, and Autonomous Underwater Vehicles (AUVs) deployed on the continental shelf/slope 55 nautical miles south of Martha’s Vineyard, MA.

Data from the OOI instruments are processed, stored, displayed, and served by the OOI Cyberinfrastructure. Users can view and download raw data and data products through the OOI Data Portal.²

The OOI facility supports user needs to conduct research and education across a wide range of science themes, within an expandable observing infrastructure spanning widely-differing ocean domains. The OOI infrastructure supports scientific instrumentation providing interdisciplinary measurements to investigate a spectrum of phenomena and processes including episodic, short-lived events (meteorological, tectonic, volcanic, geological, geophysical, and ecological), and subtler, long-term changes and emergent phenomena in ocean systems (circulation patterns, climate change, ocean acidification, geophysical events, and ecosystem trends).

The overarching scientific themes of the OOI span six multi-disciplinary domains, and each theme incorporates a multitude of research questions.

- *Ocean-Atmosphere Exchange.* Quantifying the air-sea exchange of energy and mass, especially during high winds, is critical to providing estimates of energy and gas exchange between the surface and deep ocean, and improving the predictive capability of storm forecasting and climate change models.
- *Climate Variability, Ocean Circulation, and Ecosystems.* As both a reservoir and distributor of heat and carbon dioxide, the ocean modifies climate, and is also affected by it. Understanding how climate variability will affect ocean circulation, weather patterns, the ocean’s biochemical environment, and marine ecosystems is a compelling driver for multidisciplinary observations.

¹ www.oceanobservatories.org
² www.oceanobservatories.org/data-portal/

- *Turbulent Mixing and Biophysical Interactions.* Mixing occurs over a broad range of scales and plays a major role in transferring energy, materials, and organisms throughout the global ocean. Mixing has a profound influence on primary productivity, plankton community structure, biogeochemical processes (e.g., carbon sequestration) in the surface and the deep ocean, and the transport of material to the deep ocean.
- *Coastal Ocean Dynamics and Ecosystems.* Understanding the spatial and temporal complexity of the coastal ocean is a long-standing challenge. Quantifying the interactions between atmospheric and terrestrial forcing, and coupled physical, chemical, and biological processes is critical to elucidating the role of coastal margins in the global carbon cycle and developing strategies for managing coastal resources.
- *Fluid-Rock Interactions and the Subseafloor Biosphere.* The oceanic crust contains the largest aquifer on Earth. Thermal circulation and reactivity of seawater-derived fluids modifies the mineralogy of oceanic crust and sediments, leads to the formation of hydrothermal vents that support unique micro- and macro-biological communities, can form economically-important mineral deposits, and concentrates methane to form massive methane gas and methane hydrate reservoirs. The role that transient events (e.g., earthquakes, volcanic eruptions, and slope failures) play in these fluid-rock interactions and in the dynamics of benthic and sub-seafloor microbial communities remain largely unknown.
- *Plate-Scale, Ocean Geodynamics.* Lithospheric movements and interactions at plate boundaries at or beneath the seafloor are responsible for short-term events such as earthquakes, tsunamis, and volcanic eruptions. These tectonically active regions are also host to the densest hydrothermal and biological activity in the ocean basins. The degree to which active plate boundaries influence the ocean from a physical, chemical, and biological perspective are largely unexplored.

Current Status

The OOI Program Team successfully completed the FY 2019 Annual Work Plan (AWP) and is currently executing the FY 2020 AWP by operating the in-water instrumentation and completing retrieve/replace at-sea operations on an annual basis for the Global Arrays and the Regional Cabled Array, and on a semi-annual basis for the Coastal Arrays. The OOI Team is conducting quality assurance (QA) and quality control (QC) on the ocean data streams and delivering both raw data and processed datasets and data products to the public via the website. During FY 2019, the OOI website received a significant level of visits with up to 50 users and 135 pageviews per day, with a high percentage being new visitors. The OOI Program Team has made extensive progress in increasing community engagement and has developed and is aggressively executing a new community engagement plan, which includes active outreach by the OOI science team to the science community on the QA/QC methods and procedures being used.

Operations plans at the FY 2021 Request level of \$43.0 million will be developed in partnership with the awardee and the research community to minimize costs, assess impacts of any proposed de-scope activities, and maximize the scientific return of the facility.

Total Obligations for OOI

(Dollars in Millions)

	FY 2019	FY 2020	FY 2021	ESTIMATES ¹				
	Actual	(TBD)	Request	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026
Operations & Maintenance	\$44.01	-	\$43.00	\$43.00	\$43.00	\$43.00	\$43.00	\$43.00

¹ Outyear estimates are for planning purposes only. The current cooperative agreement ends September 2023.

After approval of a resolution in May 2018 by the National Science Board, NSF entered into a new cooperative agreement with the Woods Hole Oceanographic Institution (WHOI) for operation and management of the OOI and management responsibilities were transferred from the Consortium for Ocean

Leadership to WHOI on October 1, 2018. WHOI has major sub-awardees on the OOI Program Team to operate and maintain the marine infrastructure, manage the scientific data, and operate the cyberinfrastructure. The University of Washington operates the OOI Cabled Array. Oregon State University operates the Coastal Endurance Array. WHOI operates the Pioneer Coastal Array as well as the Global Arrays at the two remaining OOI global sites in the Irminger Sea and the Gulf of Alaska, and also serves as the overall Program Management Office (PMO). Management of OOI data is now distributed among the University of Washington, Oregon State University, and WHOI. Rutgers University manages the cyberinfrastructure hardware and WHOI manages the cyberinfrastructure software with support from Raytheon Corporation.

Management and Oversight

- **NSF Structure:** The Division of Ocean Sciences (OCE) in GEO manages OOI operations located within the Integrative Programs Section (IPS). The oversight, conducted through a coordinated effort between the IPS Section Head and the Ocean Sciences Section Head, includes the review of observatory metrics and data quality management, as well as integration of the OOI with any new science or infrastructure proposals and coordination with the science community. Additional NSF oversight of the OOI program is provided by the Integrated Project Team whose core members include the IPS Section Head, the Ocean Sciences Section Head, the Facilities Expert in OCE; the liaison from the Large Facilities Office; the Grants and Agreements Officer from the Cooperative Support Branch; and a representative from CISE's Office of Advanced Cyberinfrastructure.
- **External Structure:** The awardee has a Science Oversight Committee (SOC) that provides input and guidance internally to WHOI for OOI infrastructure planning and management. NSF established the nine-member Ocean Observatories Initiative Facility Board (OOIFB) to provide input and guidance to NSF regarding the operation and management of the OOI. The OOIFB is independent of the SOC and held several meetings during FY 2019.
- **Reviews:** In October 2019, NSF conducted an External Panel OOI Program Annual Review on-site at WHOI, which was a focused review of the data distribution and cyberinfrastructure and community engagement aspects of the OOI program.

Operations Costs

The associated costs for Operations and Maintenance (O&M) of OOI infrastructure in support of scientific research have been and will continue to be solely supported by OCE. Support for scientific research using observatory data will be through the standard NSF proposal submission process to existing science programs in OCE. Since the data are openly available over the internet, researchers around the world also have access to the unique data sets that OOI is producing regardless of the source of their support.

Education and Outreach

The OOI website and cyberinfrastructure provides a portal to enable access to information related to the OOI arrays, science themes, marine technologies, latest research highlights, and live streaming video when available for use in education settings. The internal OOI SOC actively conducts outreach activities regarding the ocean science datasets to researchers, public, and education users.

Renewal/Recompetition/Termination

The new five-year OOI O&M cooperative agreement with WHOI began on October 1, 2018. In preparation for the next recompetition in FY 2022, NSF will continue to conduct an annual program review and engage with the OOIFB to receive input from the Ocean Sciences community. In addition, NSF will hold a focused mid-award program review in 2021 of the performance of the awardee. The information from these activities will be used to determine whether to proceed with renewal or recompetition.