

OCEAN OBSERVATORIES INITIATIVE (OOI)

\$38,000,000
-\$6,080,000 / -13.8%

Ocean Observatories Initiative Funding

(Dollars in Millions)

FY 2018 Actual	FY 2018 (TBD)	FY 2020 Request	Change over	
			FY 2018 Actual Amount	Percent
\$44.08	-	\$38.00	-\$6.08	-13.8%

The Ocean Observatories Initiative began in FY 2009 as a MREFC construction project. In FY 2016, OOI transitioned from the MREFC construction effort to the management and operations phase and is now referred to as the OOI Program.

OOI is a networked ocean-focused research observatory with arrays of instrumented buoys, profilers, gliders, and autonomous vehicles within different open-ocean and coastal regions, as well as a cabled array of instrumented platforms and profilers on or above the seafloor over the Juan de Fuca tectonic plate. This networked system of instruments, platforms, and arrays enables researchers to examine complex, interlinked physical, chemical, biological, and geological processes operating throughout the coastal regions and to investigate a spectrum of phenomena and processes including episodic, short-lived events (meteorological, tectonic, volcanic, geological, geophysical, and ecological), and more subtle, long-term changes and emergent phenomena in ocean systems (circulation patterns, climate change, ocean acidity, geophysical events, and ecosystem trends).

The OOI facility provides the public, educators, students, and researchers with: (1) OOI long-term time series data sets (raw data and metadata are processed via conventional algorithms and quality control methods); (2) an *in-situ* ocean laboratory capability to allow OOI users to submit proposals for development and application of new technologies by connecting their instruments or concepts to the OOI network; and (3) OOI tools that will support undergraduate classroom applications of the OOI, as well as public outreach through informal education. Currently, the OOI delivers data/metadata and education tools to the public via the OOI website¹.

Since the operations and maintenance phase of the project started in January 2016, the OOI CI system infrastructure has served over 150 million user requests and delivered over 100TB of data to users from over 100 distinct countries across the globe.

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.
- *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

¹ www.oceanobservatories.org

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 is successfully operating the in-water instrumentation, transmitting ocean data to storage, and incrementally delivering processed datasets and data products via the website. During FY 2018 the OOI website received over 31 million visits/requests from over 50 countries and approximately 20 T bytes of data were transferred. Annual Work Plan activities for refurbishment and redeployments of the moorings, instruments, and platforms were completed as planned. Data quality management methodology continues to mature with the transfer of this responsibility to the Marine Implementing Organizations under the new award. It includes active outreach by the OOI science team to the science community on the quality assurance/quality control (QA/QC) methods and procedures being used.

Operations plans at the FY 2020 Request level of \$38.0 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 2018	FY 2019	FY 2020	ESTIMATES ¹				
	Actual	(TBD)	Request	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025
Operations & Maintenance	\$44.08	-	\$38.00	\$38.00	\$38.00	\$38.00	\$38.00	\$38.00

¹ Outyear estimates are for planning purposes only.

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 (COL) 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 (UW) operates the OOI Cabled Array. Oregon State University (OSU) operates the Coastal Endurance Array. WHOI operates the Pioneer Coastal Array as well as the Global Arrays at the three remaining OOI global sites in the Irminger Sea, the North Pacific and the

Sothorn Ocean (the Argentine Basin Array was recovered without replacement in 2018), and also serves as the overall Program Management Office (PMO). Management of OOI data is now distributed between UW, OSU and WHOI. Rutgers University manages the cyberinfrastructure and Raytheon Corporation provides project management support, systems engineering, and software services for the OOI cyberinfrastructure.

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 Section Head for Integrative Programs and the Section Head for Ocean Science in OCE; and two members from within BFA from the Cooperative Support Branch and the Large Facilities Office.
- **External Structure:** The awardee has a Science Oversight Committee (SOC) which provides input and guidance internally to WHOI for OOI infrastructure planning and management. In FY 2017, 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 2017 and FY 2018. The OOIFB also established a Subcommittee focused specifically on the topics of Data Delivery and Cyberinfrastructure (DDCI) and developed a timeline for reviewing and assessing the performance of the data delivery system.
- **Reviews:** In December 2017, NSF conducted a review of the OOI Glider Operations Program component. In June 2018, NSF conducted an in-depth review of the readiness for transition with participation from both the COL OOI Team and the new WHOI OOI Team. In FY 2019, NSF will conduct a focused review of the DDCI and Community Engagement aspects of the OOI Program.

Operations Costs

Operations and management in support of scientific research began in FY 2013 with the deployment of the first OOI instruments. The associated costs have been and will continue to be supported by OCE. Support for research using observatory data will be through the standard NSF proposal submission process to existing science programs in OCE; however, because the data are freely available over the internet, researchers around the world have access to the unique data sets OOI is producing regardless of the source of their support.

Education and Outreach

The OOI website and cyberinfrastructure provides an education portal to enable undergraduate level tools for education. The internal OOI SOC actively conducts outreach activities regarding the ocean science datasets to researchers, public, and education users.

Renewal/Recompetition/Termination

A successful NSF merit review of the proposal for the OOI facility took place in 2017 and 2018, and the new five-year OOI Operations and Management 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. The cooperative agreement with COL is operating under a No-Cost Extension through June 30, 2019 to support award closeout activities.