2019 Technology Demonstration

From July 18 - August 1, 2019, NOAA Office of Ocean Exploration and Research (OER) and partners will conduct a technology demonstration off the east coast of the United States, from Virginia to Rhode Island, on NOAA Ship *Okeanos Explorer*. The demonstration will test new and emerging technologies and evaluate how existing technologies could be integrated into NOAA operations. NOAA OER is the only federal program dedicated to exploring our deep ocean and improving our understanding of U.S. deep waters, providing information needed to strengthen the economy, health, and security of our nation. Technology demonstrations are necessary to further the OER objective of mapping and characterizing the U.S. Exclusive Economic Zone by 2030. During the **2019 Technology Demonstration**, our at-sea and shore-based science teams will work together to explore the potential for new technologies and novel applications to contribute to greater scientific understanding and the exploration of our deep ocean.

NOAA Ship *Okeanos Explorer* is the only U.S. federal vessel dedicated to exploring our largely unknown ocean for the purpose of discovery and the advancement of knowledge. The ship is equipped with a state-of-the-art, dual-body remotely operated vehicle (ROV) capable of diving to 6,000-meter depths, as well as four different types of mapping sonars that collect high-resolution data about the seafloor and the water column. *Okeanos Explorer* takes every opportunity to survey the ocean, identify new habitats, species, and resources; and contribute critical information to enhance our understanding of the ocean. *Image courtesy of Art Howard, GFOE, Windows to the Deep 2018.*

Objectives

The primary objectives of this demonstration are to test, integrate, and evaluate emerging and existing technologies for potential use in meeting the data requirements of OER, its partners, and the larger oceanographic research community. The secondary objective of this demonstration is to provide authoritative and actionable data to regional stakeholders. Finally, this demonstration will contribute to NOAA's Atlantic Seafloor Partnership for Integrated Research and Exploration (ASPIRE) campaign. ASPIRE is a collaborative, multinational field campaign that provides publicly accessible baseline data to increase our understanding of the North Atlantic Ocean and to provide data critical to emerging blue economy priorities, characterization, and management.

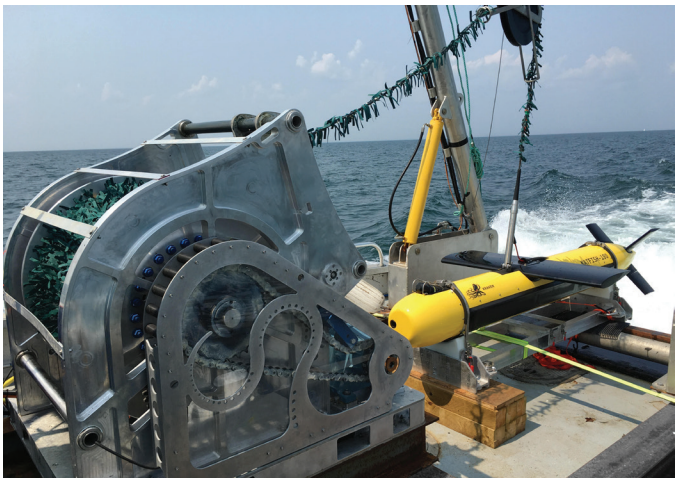
What technologies will be demonstrated?

New technologies and novel integrations will aid and accelerate the fulfillment of NOAA OER's mapping and characterization goals, and were the driving force behind the selection of the technologies being demonstrated during this year. Five instruments will be tested or integrated, including the deployment of a **REMUS 600 Autonomous Underwater Vehicle** in partnership with NOAA Office of Coast Survey (OCS) and a towed **Kraken Robotics KATFISH with Synthetic Aperture Sonar** in partnership with Kraken Robotics and ThayerMahan, Inc. Technologies to be integrated on remotely operated vehicle (ROV) *Deep Discoverer* include a new high-resolution **360-degree camera** from Massachusetts Institute of Technology, a **Kraken Robotics SeaVision laser scanner**, and a **One Way Travel Time Inverted Ultra Short Baseline** navigation system from the Woods Hole Oceanographic Institution.

NOAA Ship *Okeanos Explorer*'s crew members work to recover the remotely operated vehicle *Deep Discoverer*. *Image courtesy of NOAA Office of Ocean Exploration and Research, Océano Profundo 2018.*

- **Remus 600 Autonomous Underwater Vehicle**
  Autonomous underwater vehicles (AUVs) will become increasingly integral to achieving OER mapping and characterization goals by the 2030 target, acting as a force multiplier during mapping and ROV operations, particularly with the ability for multiple units to work in concert. OER will work with OCS to test operations on an OCS-owned AUV. The Remus 600 AUV is equipped with an EM 3002 multibeam sonar system that allows for extremely high-resolution mapping. The testing of this commercial AUV will allow OER and partners to better understand the launch and recovery process, the acquisition and processing of AUV data, staffing and storage needs, as well as how AUV operations might fit into current *Okeanos Explorer* mapping and ROV explorations.

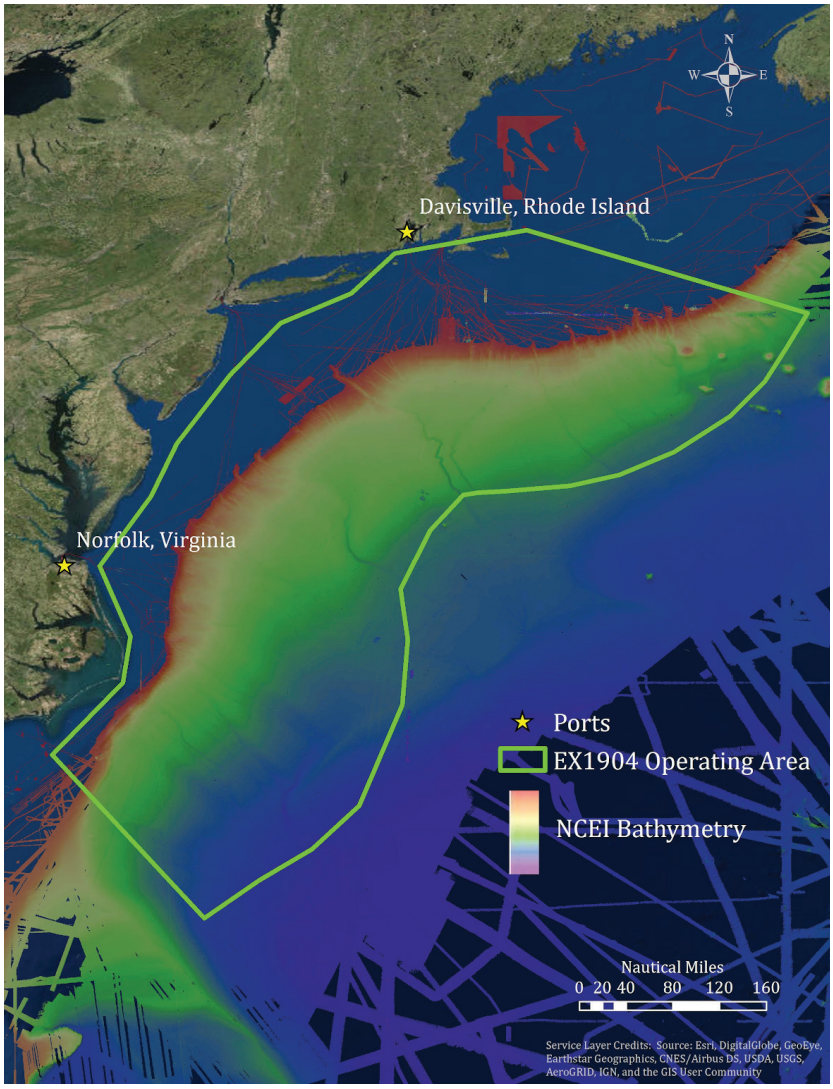
- **Kraken Robotics towed KATFISH with Synthetic Aperture Sonar**
  In 2018, OER and Kraken Underwater Systems began a partnership to jointly advance ocean exploration imaging technology. In the spirit of this collaboration, the 2019 Technology Demonstration will serve as an opportunity to test the Kraken towed KATFISH with Synthetic Aperture Sonar (SAS). KATFISH operates at shallower depths (<300 meters/984 feet) compared to current instruments on the *Okeanos Explorer*, giving it the potential to fill a gap in depth data identified by OER and its partners. The KATFISH system is comprised of an actively controlled smart towfish, SAS imaging, bathymetry and gap-filler sonars, launch and recovery system, operator console, and visualization software. The system collects 3D bathymetry and ultra-high-resolution seabed imagery, providing detailed images of the seafloor and objects on it with 30 times more detail than a conventional side scan sonar.



KATFISH™ System, Kraken KATFISH™ Intelligent Towed SAS System and Tentacle™ intelligent Winch System aboard R/V *Discovery*. *Image courtesy of Kraken Robotics.*

- **Massachusetts Institute of Technology 'Maka'oi' 360-degree camera**

  The Massachusetts Institute of Technology has developed a 360-degree camera that will be mounted to ROV *Deep Discoverer* and collect footage during all of the 2019 Technology Demonstration dives. The system is comprised of six compact 4K studio cameras housed within a spherical aluminum/titanium unit. The housing is currently rated to a depth of 4,000 meters (13,123 feet), but designed to tolerate up to 4,500 meters (14,764 feet) with a wide safety margin. The camera operator will be able to view the footage in real time and adjust each camera individually or in groups. The proximate goal is the creation of studio-caliber 360-degree video from the deep for virtual reality, augmented reality, documentary, and planetarium release. More experimentally, the ultimate goal is on-ship stitching of the video, giving the operator a real-time, live 360-degree view from the ROV.



Map showing the general demonstration operating area (green polygon) and current publicly available multibeam bathymetry data.

- **Kraken Robotics SeaVision laser scanner**

  One objective of the NOAA-Kraken partnership is to test the SeaVision laser line scanning systems at deep-ocean depths. The SeaVision laser scanner uses a line of laser light to generate high-resolution, 3D representations of objects on the seafloor, including biological and archaeological targets. Unlike traditional black and white scans, SeaVision brings subsea laser imaging into vivid, full color. Practical applications include precise measurements of benthic organisms in order to accurately estimate the age and growth rates of these organisms, and highly accurate measurements of percentage of benthic cover, one of the most frequently reported metrics in marine ecological studies.

- **One-Way Travel-Time Inverted Ultra-Short-Baseline navigation system**

  This navigation system is in development at the Woods Hole Oceanographic Institution to support multi-AUV navigation capability. This work leverages an NSF grant and builds upon a project previously supported through OER's Federally Funded Opportunity (FFO). The aim is to develop a low-power acoustic navigation system for application with an array of autonomous vehicles. The system provides a single acoustic source that can be used for the navigation of multiple subsea vehicles, with no time or frequency sharing required. Three separate dives at a variety of depths will be conducted to test this technology, which will be mounted to ROV *Deep Discoverer*.

Why It Matters

The **2019 Technology Demonstration** will enable OER and its partners to develop additional methods of exploration, refine and improve existing operations, and evaluate how new data types can improve baseline observations and seafloor characterization. By leading national efforts to explore our ocean, and by making ocean exploration more accessible, OER is filling gaps in the basic understanding of U.S. deep waters and seafloor and providing critical deep-ocean data needed to sustain and accelerate the economy, health, and security of our nation. Using the latest tools and technologies, such as those being demonstrated on this expedition, OER explores previously unknown areas of our deep ocean to make valuable scientific, economic, and cultural discoveries.

Follow Along Live!

Anyone with an internet connection can follow along with the demonstration as video is streamed live to shore. Additional information will be available on the Ocean Explorer website throughout the demonstration.

oceanexplorer.noaa.gov/okeanos/explorations/ex1904/

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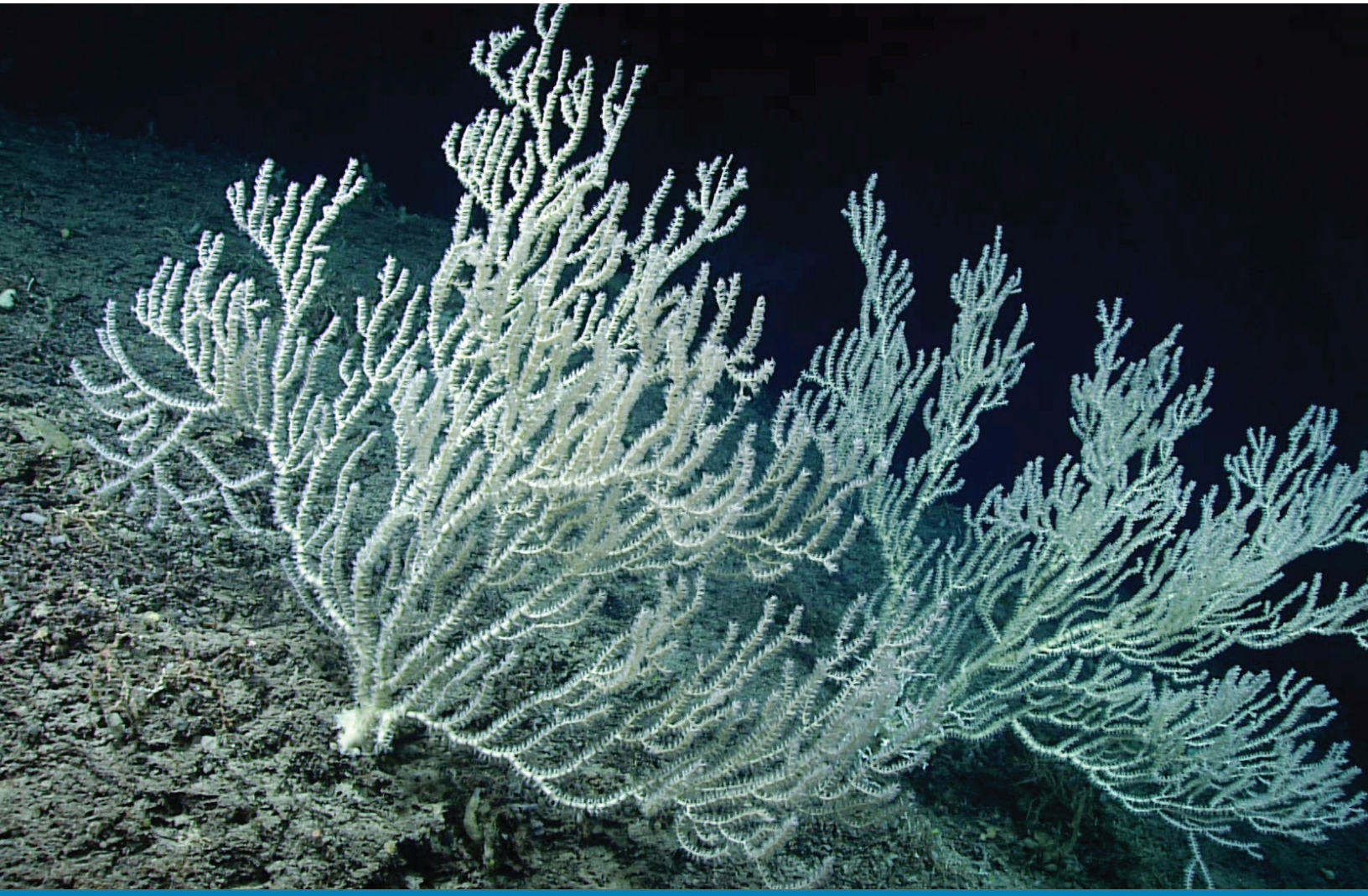

Ocean Exploration and Research

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