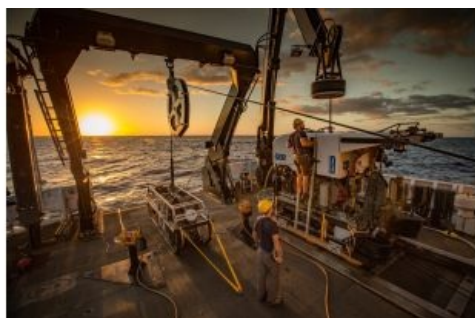


IDENTIFYING AND FILLING GAPS IN BATHYMETRIC COVERAGE DEEPER THAN 200M

This is NOAA's Plan for Deep Ocean Mapping of US Waters



NOAA is using a systematic approach to map all US waters in support of Seabed 2030 objectives and to contribute to the complete mapping of the world's oceans in the next ten years. Mapping within US waters is a national goal that will only be accomplished through strong coordination and partnerships with other federal agencies, academia and the private sector.

The Nippon Foundation - General Bathymetric Chart of the Oceans (GEBCO) Seabed 2030 project has revitalized international and national interest in ocean floor mapping (Smith, 2018). Across US oceans, coasts, and Great Lakes waters, the National Oceanic and Atmospheric Administration (NOAA) is the primary agency responsible for seafloor mapping and nautical charting with several other federal, academic, and industry partners contributing seafloor mapping data within US waters.



Figure 1: Launch of the remotely operated vehicle. (Courtesy: Art Howard, GFOE, Windows to the Deep 2018)

Since its inception, the NOAA Office of Ocean Exploration and Research (OER) has been focused on using the best available technologies and methods to acquire baseline mapping of the deep ocean seafloor environment in areas that are unexplored. Working closely with NOAA's Office of Coast Survey (OCS), whose surveying and charting responsibilities span all US waters, other agencies, academia, and industry partners, OER is prioritizing baseline mapping activities as part of a larger NOAA mapping initiative.

NOAA is using a systematic approach to map all US waters in support of Seabed 2030 objectives and to contribute to the complete mapping of the world's oceans by 2030. NOAA is also supporting efforts to compile all bathymetric data into the freely available GEBCO Ocean Map. OER operations are primarily focused on offshore environments

deeper than 200m. As a fundamental component of exploration, OER views bathymetric data acquisition as a means to support further exploration efforts, resource identification, and improved understanding of deepwater ecosystems.



Figure 2: Dataloggers in the ROV control room. (Courtesy: DEEP Search 2019 - BOEM, USGS, NOAA)

Recognizing the challenge in mapping such an expansive area, close coordination of future mapping efforts among various partners is paramount, as is discovery of data holdings that are not currently in publicly available archives. This article provides a synopsis of the current state of mapping of US waters deeper than 200m (>200m) to provide a benchmark against which progress can be measured. This work builds off of previously published analyses (Westington et al., 2018) and is focused on acquisition of mapping data in water depths >200m.

Defining the Metrics and Tracking

The Seabed 2030 Project has an ambitious goal to map the world's oceans by 2030. In order to meet this timeline, it is critical to know the scope of the work involved and align survey assets. With the release of GEBCO2019 (see additional resources below), the current state of global mapping is at approximately 15%, a 6% increase from analysis conducted the previous year (Mayer et al., 2018).



Figure 3: Camera focus of the main ROV HD camera. (Courtesy: NOAA Office of Ocean Exploration and Research, 2016 Deepwater Exploration of the Marianas)

Inspired by these international efforts, in 2017, a team from NOAA OCS, National Centers for Environmental Information (NCEI), and the University of New Hampshire prepared a bathymetry coverage and gap analysis of sounding density and GIS map service to inform a US ocean and coastal mapping strategy for US waters and contribute to the international Seabed 2030 initiative. This Bathymetry Gap Analysis, which can be found on NOAA's GeoPlatform hosted at NCEI, evaluates the bathymetry data that are available through the IHO Data Center for Digital Bathymetry, (Westington et al., 2018). As of October 2018, only 43% of US oceans, coasts, and Great Lakes waters extending from shore to the US Exclusive Economic Zone (EEZ) limits are considered minimally mapped.

NOAA, in partnership with government, academia, and industry, is developing a coordinated approach to map all US oceans, coasts, and Great Lakes waters in support of Seabed 2030 objectives. With an emphasis on deep water exploration, NOAA OER seeks to achieve 100% mapping of the deep ocean seafloor (>200m depth) by 2030. In order to identify the scope of work for this portion of US waters and set a baseline to track progress, an evaluation of the US Bathymetry Gap Analysis was conducted. Methods were developed between NOAA OER, OCS, and NCEI to identify and compute the areas mapped for depths >200m. As of August 2019, approximately 49% of US waters >200m were estimated to be unmapped (51% mapped). For the purposes of this analysis, the area of US waters >200m depth were split into 13 regions for computational purposes.



Figure 4: Remotely operated vehicle Deep Discoverer being prepared for deployment on the Okeanos aft deck. (Courtesy: NOAA Office of Ocean Exploration and Research, 2016 Deepwater Exploration of the Marianas)

This 49% reflects an area equal to ~5 million km² that remain unmapped and unexplored with the largest gaps in water depths between 5000m to 6000m (44 %). OER is using these analyses to help make decisions for future site selections for ocean exploration as well as collaborative partnership projects and funding opportunities.

As expected, the mapping data distribution is not uniform across the US EEZ regions. For the contiguous US regions (East Coast, West Coast, Gulf of Mexico), a higher percentage of US waters are mapped, in contrast to many areas in the Pacific and Alaska regions where there are large gaps in coverage. The remote locations of these unmapped areas hinder dedicated mapping efforts. OER and partners focused on some of these regions in the Pacific Islands during a three-year campaign (2014 - 2017 Campaign to Address Pacific monument Science, Technology, & Ocean NEEds or CAPSTONE) which mapped ~ 364,000 km² of US waters, but overall, these regions remain poorly explored (for further details see Kennedy et al., 2019).



Figure 5: Remotely operated vehicle Deep Discoverer being recovered. (Courtesy: NOAA Office of Ocean Exploration and Research, 2016 Deepwater Exploration of the Marianas)

OER Contributions to Seabed 2030

NOAA OER is leveraging its mission to explore our deep ocean and make ocean exploration data more accessible by filling mapping data gaps within US and international waters. Additionally, OER is providing critical deep-ocean data, information, and awareness needed to sustain and accelerate the economy, health, and security of our nation. The documentation of the systematic approach NOAA OER is using to identify mapping gaps in the seafloor (>200 m) over the next decade is an integral part of consistent reporting of metrics to help the US achieve its goal of mapping all US oceans, coasts, and Great Lakes waters by 2030. It is worth noting that while exploration activities are being prioritized within US waters this does not preclude OER from funding activities and supporting partnerships in ocean exploration efforts that are outside of US waters.

Mapping within US waters is a national goal that will only be accomplished through strong coordination and partnerships with other federal agencies, academia, and the private sector. As NOAA rises to meet the objectives set forth in Seabed 2030, an alignment of partnerships, initiatives, and technologies are coalescing to meet these goals. Over the next decade, OER will incorporate a blended solution that explores a variety of modalities, funding mechanisms, and technologies, leveraging fit-for-use applications for deep ocean exploration. NOAA OER is prioritizing the systematic mapping of US waters in deep water areas that remain unexplored and, with its NOAA partners in OCS, plans to consistently track progress towards fully mapping the US oceans, coasts, and Great Lakes waters.



Figure 6: The remotely operated vehicle ROPOS control room on board NOAA Ship Henry B. Bigelow. (Courtesy: Peter

Additional resources

OER Digital Atlas: https://www.ncddc.noaa.gov/website/google_maps/OE/mapsOE.htm

This site hosts an interactive map in which users can select / explore any OER funded expedition and have access to all data generated during that cruise.

Okeanos Atlas: <https://service.ncddc.noaa.gov/website/EXAtlas/viewer.htm>

This site allows users to view data collected by NOAA Ship *Okeanos Explorer* on a cruise by cruise basis, including bathymetry, ROV dive locations and tracks, and ship tracks.

NOAA United States Bathymetry Gap Analysis 2019: NOAA's Geoplatform. Updated March 18, 2019:

<https://noaa.maps.arcgis.com/home/item.html?id=4d7d925fc96d47d9ace970dd5040df0a>. The United States Bathymetry Gap Analysis is a map service providing visual access to the local sounding density derived from all modern bathymetric data holdings at NOAA's [NCEI](#) and [Office for Coastal Management \(OCM\)](#). Underpinning the map service are seven principal layers of bathymetry. Actual soundings of multibeam data (raw), single beam data (1960 or later), NOS hydrographic surveys (1960 or later), and crowdsourced bathymetry are included. Coverage footprints of NOS BAG-formatted hydrography, bathymetric grids from the US extended continental shelf survey programme, and bathymetric Lidar data are also included.

US Maritime Limits and Boundaries: <https://nauticalcharts.noaa.gov/data/us-maritime-limits-and-boundaries.html#access-digital-data> - Maritime limits and boundaries for the United States are measured from the official US baseline, recognized as the low-water line along the coast as marked on the NOAA nautical charts in accordance with the articles of the Law of the Sea. The Office of Coast Survey depicts on its nautical charts the territorial sea (12 nautical miles), contiguous zone (24nm), and exclusive economic zone (200nm, plus maritime boundaries with adjacent/opposite countries).

Data submission to Seabed 2030 project: if you would like to submit any data sets for public archive you can officially submit and archive your mapping data with NOAA NCEI and Seabed 2030 regional data centers. [For more information see here](#).

Online General Bathymetric Chart of the Ocean (GEBCO): <https://seabed2030.gebco.net/>

<https://www.hydro-international.com/content/article/this-is-noaa-s-plan-for-deep-ocean-mapping-of-us-waters>
