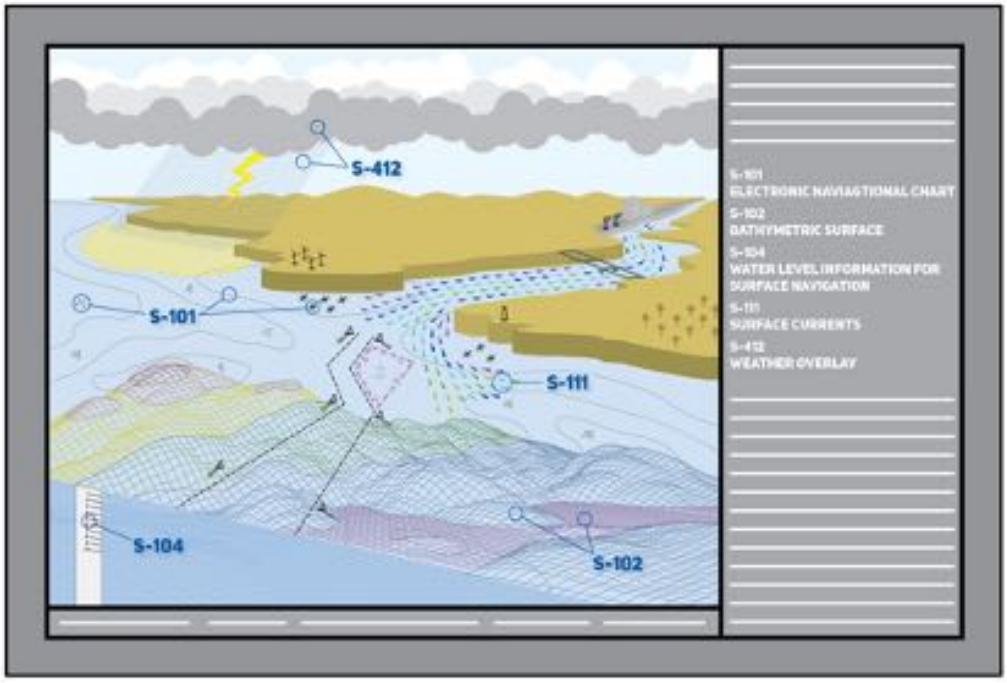
Office of Coast Survey

NOAA's Office of Coast Survey (OCS) maintains the nation's nautical charts and publications for U.S. coasts and the Great Lakes. OCS creates and maintains over a thousand charts covering 95,000 miles of shoreline and 3.4 million square nautical miles of water. OCS supports the 1.3 billion metric tons of cargo valued at $1.8 trillion that comes in and out of U.S. ports every year. In addition, OCS conducts hydrographic surveys to collect depth measurements for nautical charts, and to aid in navigation, provides regional navigation support, develops models for storm surge and hurricane prediction, and develops and tests new technologies to improve mapping efficiencies. Below are five highlighted scientific projects by OCS researchers and their partners.

Precision Marine Navigation Dissemination



Integrated multi-source information available through the OCS-developed Precision Marine Navigation System. Image credit: NOAA OCS.

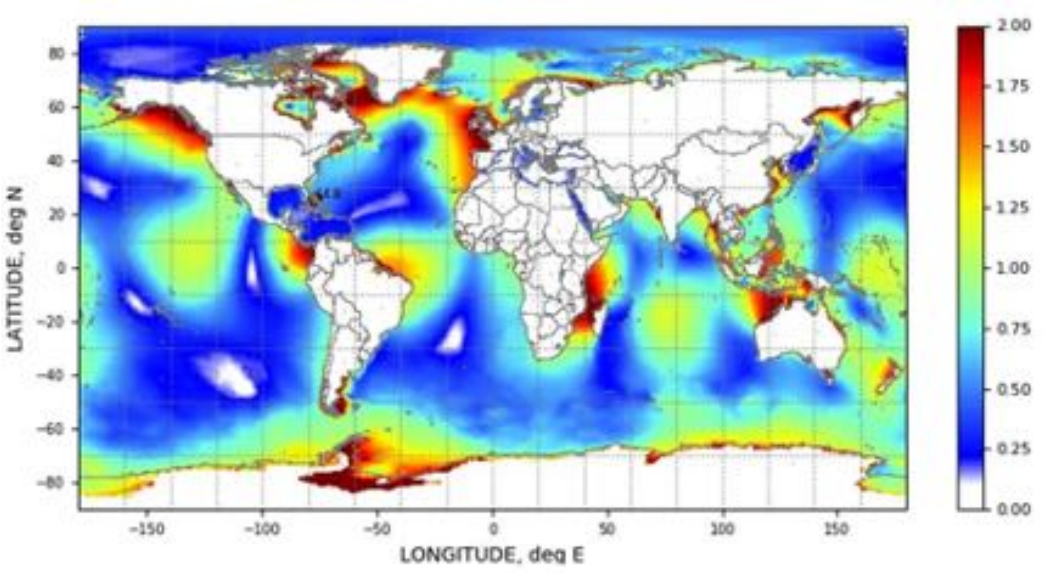
OCS is creating new online navigation services that will enable mariners to access critical marine navigation data in one convenient place. The Data Processing and Dissemination System uses cloud technology to enable machine-to-machine dissemination of integrated datasets, allowing mariners to make decisions efficiently when planning, transiting, and approaching ports. This new system was developed and deployed on Amazon Web Services (AWS) using open source software. It allows mariners' existing navigation software to automatically discover if NOAA has made new data available and ingest the data directly into their system. NOAA is working closely with industry partners to ensure that the service NOAA develops effectively disseminates navigation data. In September 2020, NOAA hosted a workshop with navigation equipment and navigation system manufacturers, pilots, and other federal agencies to collect feedback on the new online services. In July 2020, NOAA NOS released a new reformatted data service for surface water current forecasts. These data are now available for

companies to test using different types of navigation software. The S-100 compliant NOAA datasets will be made available to manufacturers of Portable Pilot Units and Electronic Charting Systems to integrate these datasets into their navigational systems. The integrated datasets will reduce the number of websites a mariner visits when planning, transiting, and approaching a port, allowing them to make decisions efficiently.

FY20 Accomplishment(s): NOAA's Office of Coast Survey targeted a beta release of the dissemination system in July 2020 with a goal for initial operations by late 2020.

Project URL:
https://nauticalcharts.noaa.gov/learn/precision-navigation.html

OCS Expands the Extratropical Surge and Tide Operational Forecast Systems



An example of maximum forecast water levels (m MSL) from a forecast cycle of Global ESTOFS. Image credit: NOAA OCS.

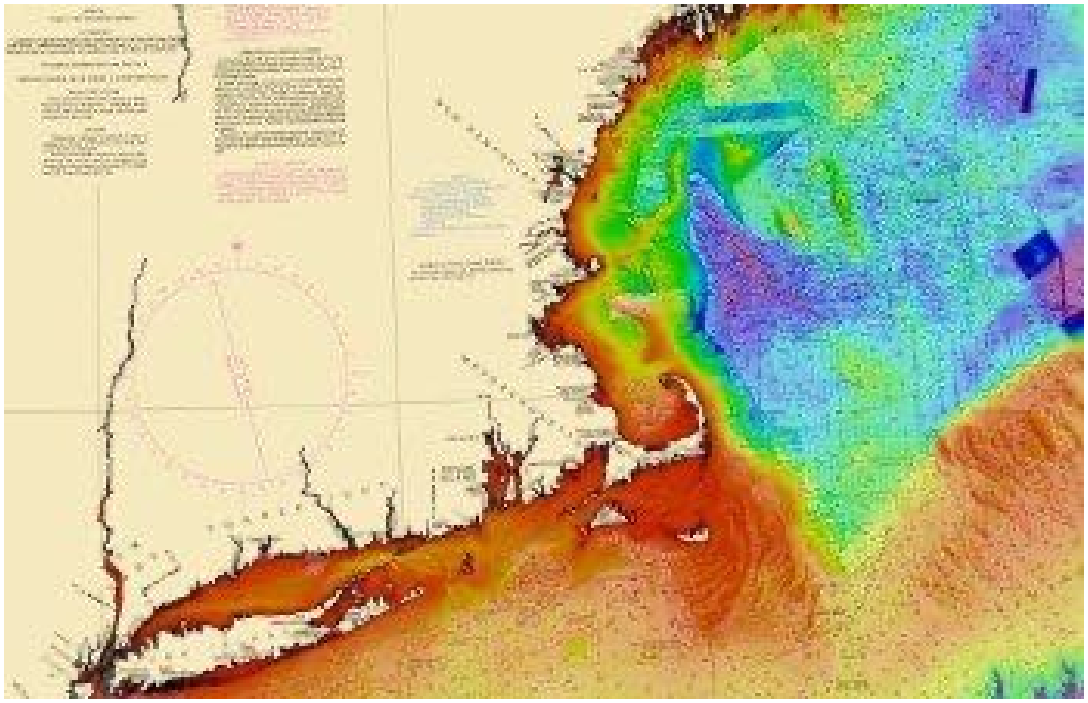
OCS is transitioning a global version of the Extratropical Surge and Tide Operational Forecast System (ESTOFS) into operations in fiscal year 2020-2021. Global ESTOFS will replace the existing regional ESTOFS-Atlantic, ESTOFS-Pacific, and ESTOFS-Micronesia systems and add enhancements to ESTOFS capabilities. Expected benefits include extending the system to cover all OCONUS (outside contiguous United States) territories, providing boundary and initial conditions for nearshore wave models, and improving spatial resolution for the U.S. coastal regions. Global ESTOFS will improve NOAA capabilities in coastal inundation prediction and open the doors for new applications, including precision navigation, risk assessment analysis, and on-demand coastal inundation prediction systems on a global scale.

FY20 Accomplishment(s): Global ESTOFS is anticipated to be transitioned to operations in FY20 and will unify existing regional ESTOFS systems into a unified model with enhanced resolution.

Project URLs:
https://ocean.weather.gov/estofs/estofs_surge_info.php

https://nauticalcharts.noaa.gov/updates/model-upgrade-extratropical-surge-tide-operational-forecast-system-estofs-is-now-global/

National Bathymetric Source project



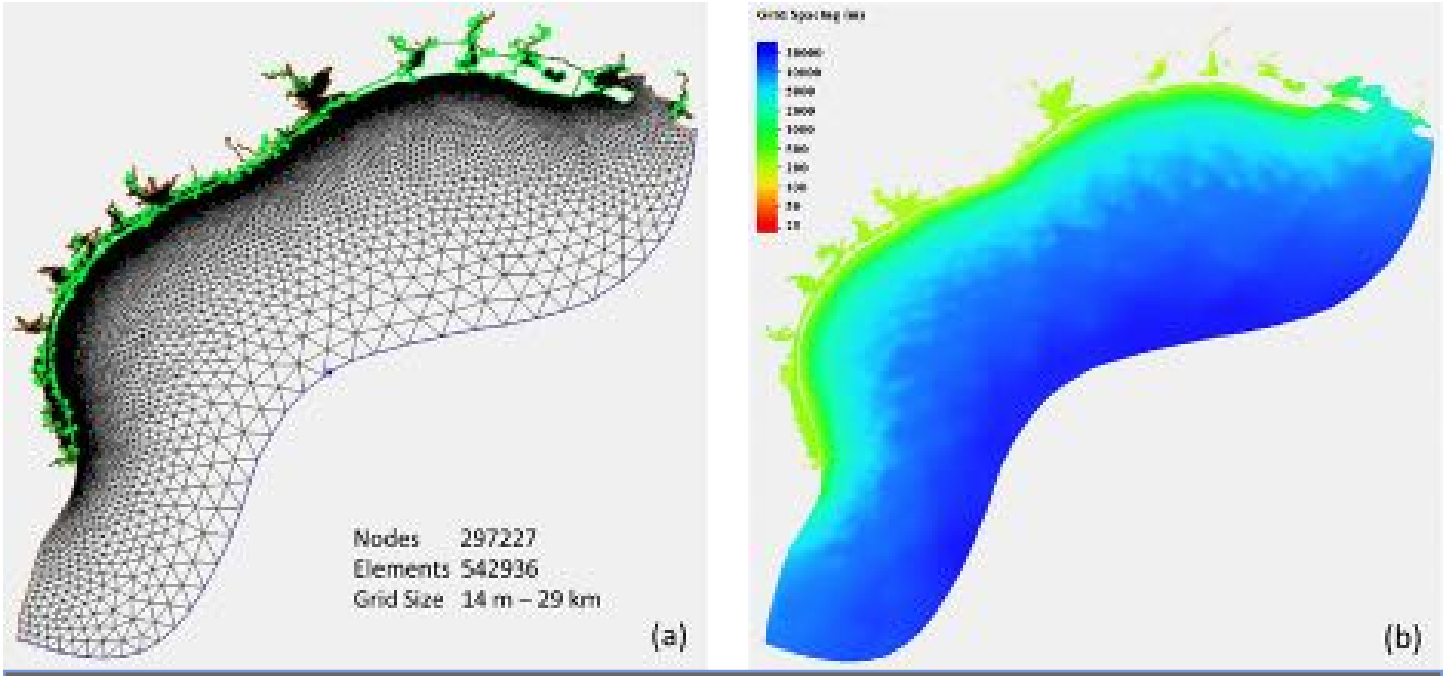
A preliminary build of the bathymetry for the New England region. Image Credit: NOAA OCS.

The National Bathymetric Source (NBS) project creates and maintains high-resolution bathymetry composed of the best available data. This project enables the creation of next-generation nautical charts while also providing support for modeling, industry, science, regulation, and public curiosity. Primary sources of bathymetry include NOAA and U.S. Army Corps of Engineers hydrographic surveys and topographic bathymetric (topo-bathy) lidar (light detection and ranging) data. Data submitted through the NOAA Office of Coast Survey's external source data process are also included, with gaps in deep water filled through Global Multi-Resolution Topography, a merged model of bathymetry. While there are other models of bathymetry for the United States, the NBS effort is unique because of the techniques used to combine the various sources into one nationwide model of the seafloor. These techniques are designed specifically to serve maritime navigation, but they are equally valuable to other oceanographic modelling and scientific endeavors. As new source data becomes available, OCS updates the national bathymetry for that immediate region. Automated processes all enable efficient inclusion of these new sources. With the completion of the New York region, OCS is expanding the national bathymetry throughout New England first. The NBS project also supports node selection for the Coast Survey modeling team as well as Precision Navigation efforts in major ports like Los Angeles and Long Beach, California. Overall, the resulting bathymetry directly supports the transition from product to data-driven workflows by increasing quality, accessibility, and timeliness of source data.

FY20 Accomplishment(s): A bathymetric buildout of the New England Region.

Project URL:
https://www.nauticalcharts.noaa.gov/updates/building-the-national-bathymetry/

Updated VDatum for the Coastal Waters of Texas and Western Louisiana: Modeled Tidal Datums and their Associated Spatially Varying Uncertainties



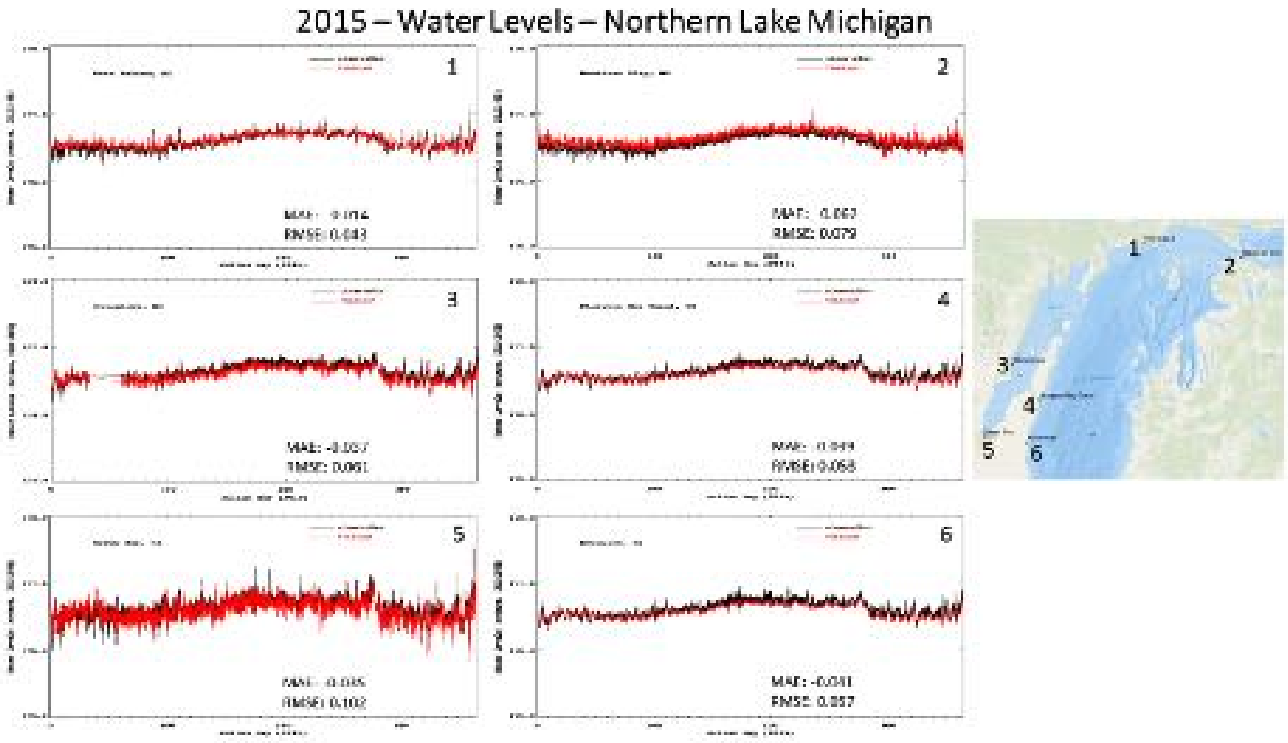
(a) The updated triangular model mesh grids for the TX and western LA coastal waters. Blue line denotes the model's open ocean boundary, brown line denotes land boundary, and green lines denote island boundaries. (b) The grid spacing in the model domain. Adapted from Wu et al. 2020, NOAA OCS.

This work by OCS updates the tide model and modeled tidal datums in Texas and western Louisiana coastal regions by using the most currently available shoreline, bathymetry, and tide station data and by using a two-dimensional depth-integrated barotropic version of the ADvanced CIRCulation (ADCIRC) hydrodynamic model (version 51.52.34, released in January 2016). Several techniques were used to reduce the errors in the modeled tidal datums for improving model performance. A Spatially Varying Uncertainty (SVU) statistical interpolation method was implemented for correcting the ADCIRC modeled tidal datums and computing associated uncertainties, and the existing non-tidal polygons in the coastal regions were upgraded by incorporating the modeled tidal datums for improving the quality of tidal datum marine grid population.

FY20 Accomplishment(s): A technical memorandum on updating the tide model and modeled tidal datums in Texas and western Louisiana coastal regions was successfully completed.

Technical Memorandum: Wu et al. 2020 *NOAA Tech Memo* NOS CS 43
https://repository.library.noaa.gov/view/noaa/24752

Upgrade of NOS Lake Michigan and Lake Huron Operational Forecast Systems to FVCOM: Model Development and Hindcast Skill Assessment



Time series plots of hourly hindcasts and operational nowcasts of water level (red) vs. observations (black) at CO-OPS National Water Level Observation Network (NWLON) gauges (1. Port Inland, MI, 2. Mackinaw City, MI, 3. Menominee, MI, 4. Sturgeon Bay Canal, WI, 5. Green Bay, WI, and 6. Kewaunee, WI) at northern Lake Michiganduring 2015. Mean Absolute Error (MAE; meters) and Root Mean Squared Error (RMSE; meters) at each station are shown individually on each panel.

NOAA GLERL and NOS have collaborated to upgrade the NOS Lake Michigan and Lake Huron Operational Forecast Systems to improve forecast guidance of water temperature, water levels, and currents by migrating to FVCOM and using a single model grid domain covering both lakes. Hindcasts from the new Lake Michigan and Huron Operational Forecast System were conducted for 2015, 2016, and 2017 and compared to observations from U.S. and Canadian observing networks using NOS skill assessment procedures. The results of the skill assessment of water level and surface water temperature hindcasts for 2015 and 2016 and evaluation of subsurface water temperature hindcasts for 2014-2017 were published in a NOS Technical Report.

FY20 Accomplishment(s): An evaluation of water levels and water temperature hindcasts for 2015, 2016 and 2017 from NOS' new Lake Michigan and Huron Operational Forecast System was completed and the results published in a NOS Technical Report.

Technical Memorandum URL: Kelley et al. 2020 *NOAA Tech Memo* CS 42: https://repository.library.noaa.gov/view/noaa/23891