NOAA Navigation Services

New England Report

Office of Coast Survey, Center for Operational Oceanographic Products & Services, National Geodetic Survey

August 2017

Contents

The New England Region

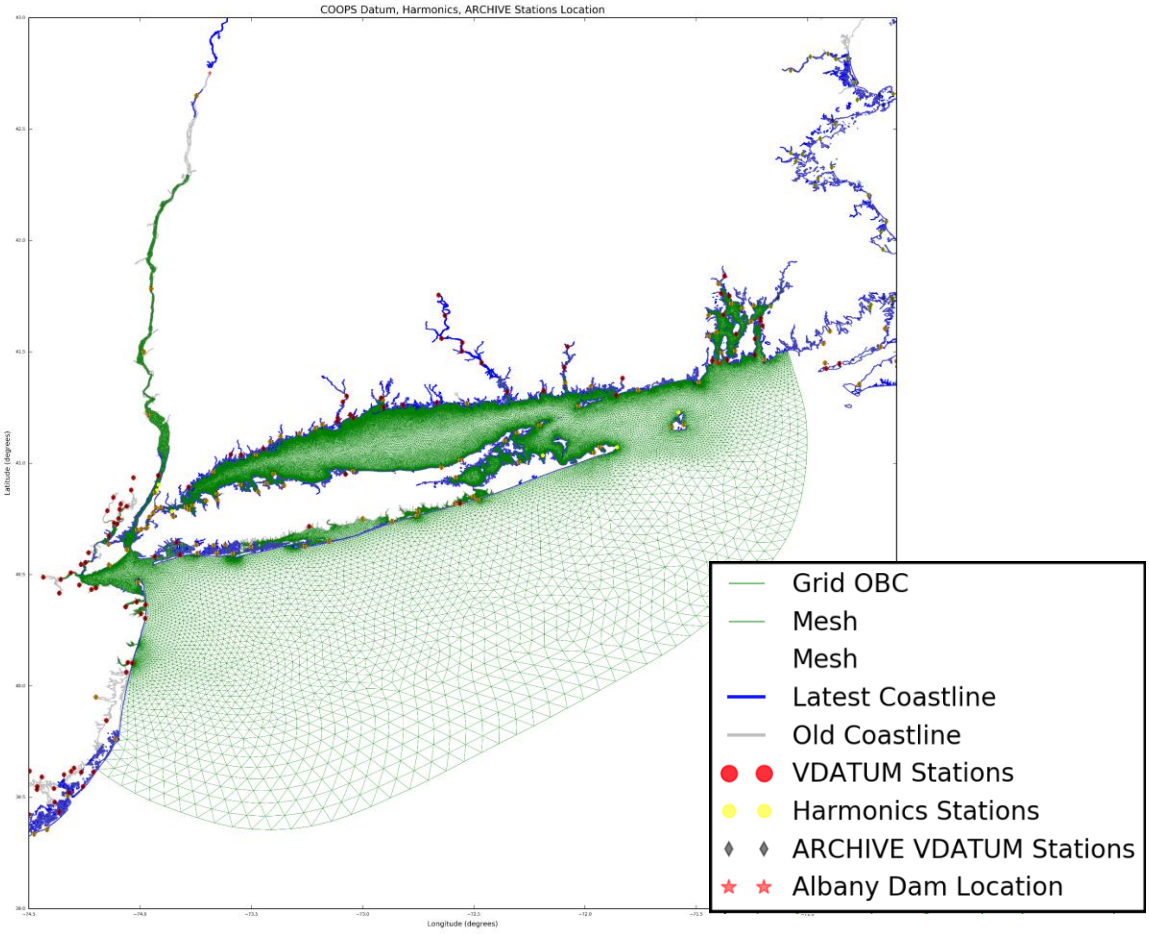
This report covers New England, the states of Maine, Vermont, New Hampshire, Massachusetts, Connecticut, and Rhode Island. New England is bordered to the west by New York, to the south by Long Island Sound, to the north and northeast by the Canadian provinces of New Brunswick and Quebec, and to the east by the Atlantic Ocean. Its largest city is Boston, but New Your City also has a strong influence on New England's economy and transportation networks.

This U.S. Coast and Geodetic Survey launch was involved in the wire drag survey off Block Island, 1917.

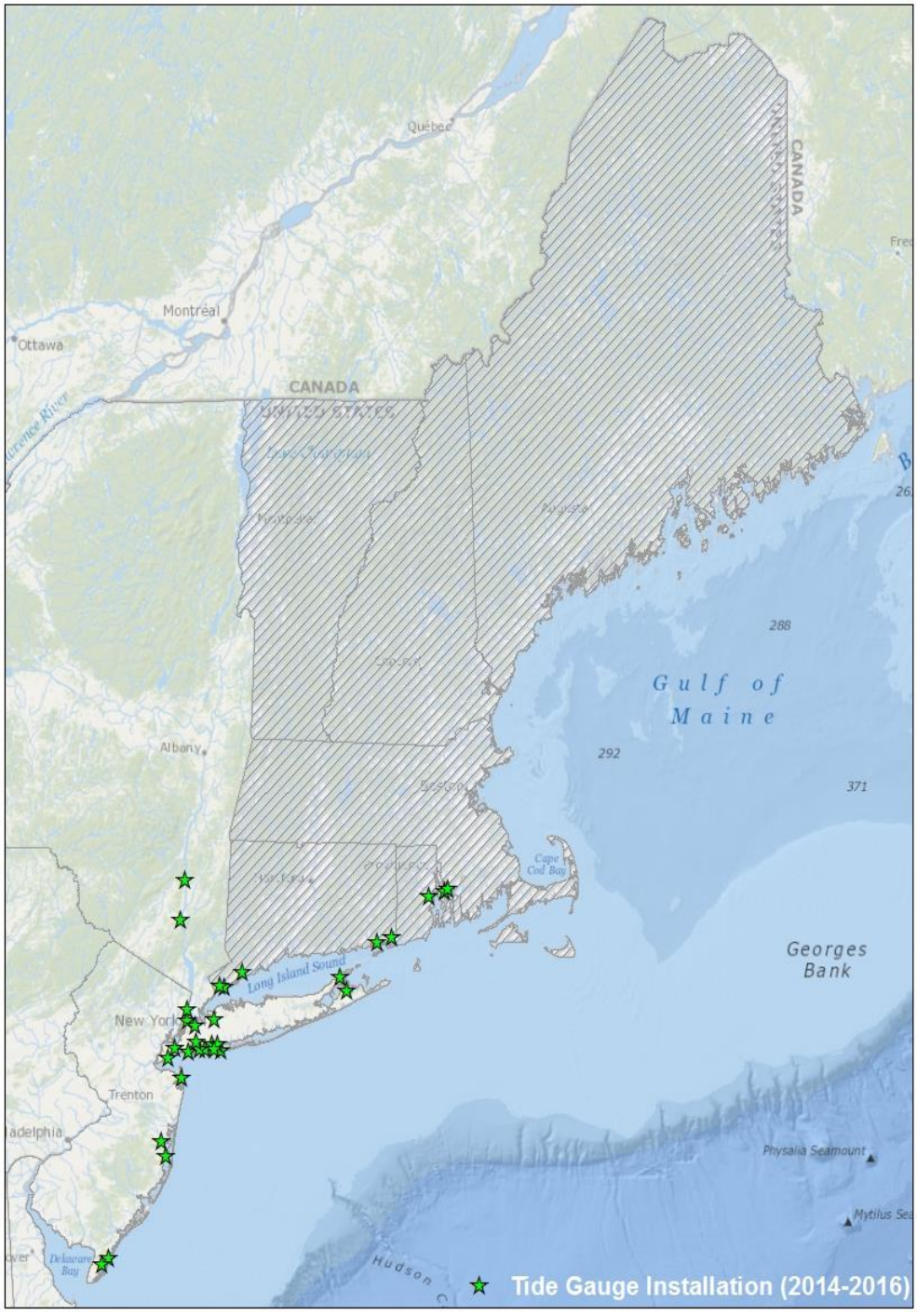
NGS, CO-OPS, and OCS "Tri-Office" Activities

VDatum grid updates for the Northeast

VDatum is a tool that transforms geospatial data among a variety of tidal, orthometric, and ellipsoidal vertical datums. NOAA is in the process of updating model grids around the country to lower the uncertainty within the models for broader usage. In line with those efforts, there is a current project in the National Ocean Service to update VDatum in the New York Bight and Long Island Sound in FY19. Below are two images illustrating the regional model being updated and the tide gauge installation campaign from FY14-16 to capture foundational data for incorporation of updated tidal datum fields in the model. Spatially varying uncertainty will also be developed, as part of the process of blending the modeled and observed tidal datums. Coverage will also be extended further into several rivers and estuaries in the region, including the Hudson River, Connecticut River, and Narragansett Bay. In FY15, eight water level stations were installed in Connecticut and Rhode Island to collect data to add to the VDatum models.



Geographic extent (in green) of VDatum model being updated for the New York Bight region.



Tide gauge installation campaign to capture foundational data for incorporation into the VDatum model update.

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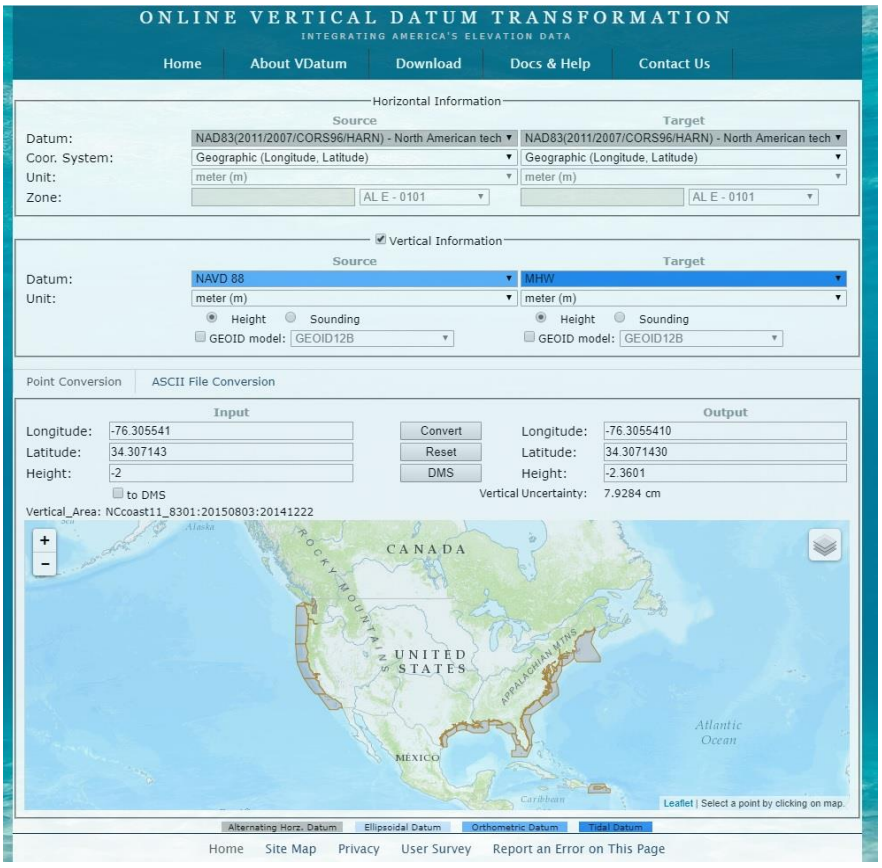
Upgraded VDatum tool

In an effort to make the VDatum tool (vdatum.noaa.gov)more readily accessible to users, without the need to download software and install it on a computer, the VDatum team has released an initial online version. The online version provides a similar user interface and transformation functionality as the standalone application, but has reduced input/output format capabilities since it is web-based. In addition, an updated standalone version (3.7) is being released in the fall 2017 timeframe with the following updates and improvements:

- GeoTIFF input/output format support
- HTDP incorporation
- Regional model grid versioning and reporting
- xGEOID16b support
- South Florida regional model update
- Bug fixes: (3D shapefile fix, IGLD85 grid point fix, exit code implementation)



Online version of the VDatum tool provides a similar user interface and transformation functionality as the standalone application.

Office of Coast Survey

Personnel and products in the New England Region

Coast Survey regional navigation managers

Coast Survey's navigation managers, stationed strategically in port areas along U.S. coasts and Great Lakes, work directly with the U.S. Coast Guard, pilots, mariners, port authorities, and recreational boaters. They help identify navigational challenges facing the marine transportation system, and provide the resources and services that promote safe and efficient navigation. Coast Survey has one navigation manager in New England.

Region	Navigation manager (base of operations)	Contact information
Northeast Atlantic	Lt. David Vejar David.Vejar@noaa.gov New London, CT	Phone: 401-782-3252 Fax: 401-782-3292

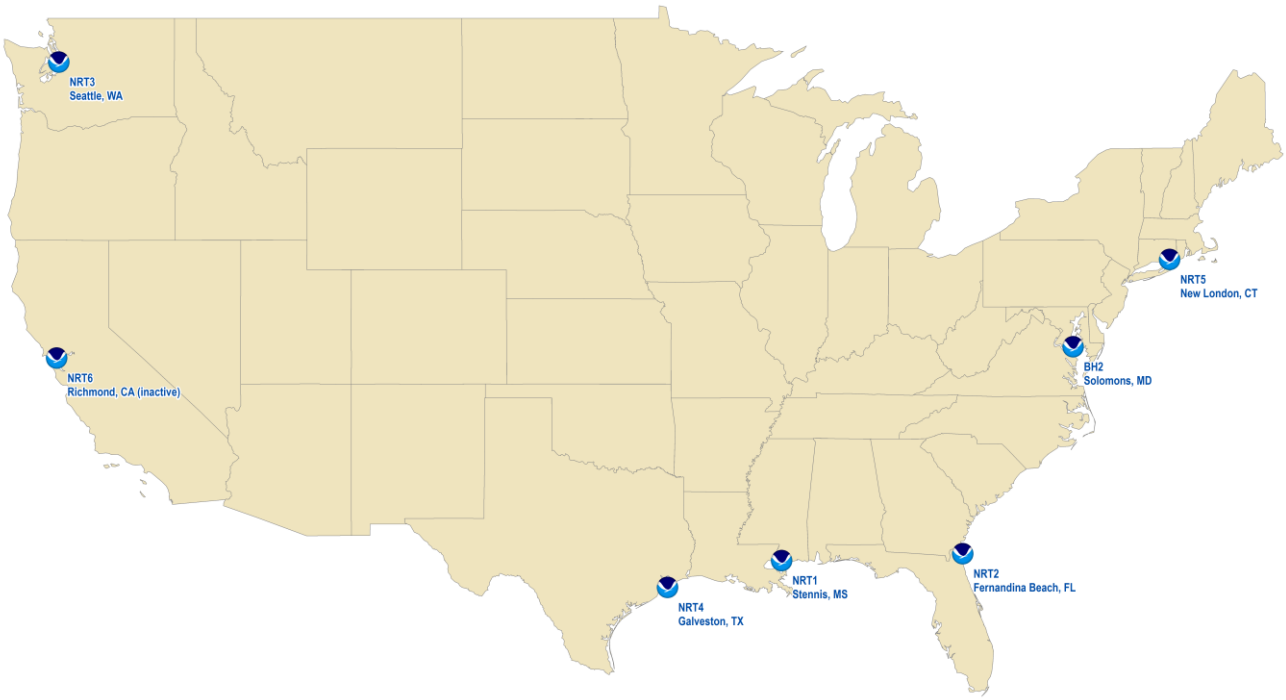
Navigation response and mobile integrated survey teams

Coast Survey's highly mobile navigation response teams (NRT) provide both routine and rapid response hydrographic surveys, helping to protect life and property from underwater dangers to navigation. During emergencies, such as following a hurricane or maritime accident, NRT surveys speed the reopening of our nation's ports allowing shipping to resume and critical supplies to reach affected areas. Outside of emergencies, NRTs serve the maritime economy by identifying critical chart discrepancies and investigating emerging navigational concerns for 175 major ports within the U.S. marine transportation system.

The NRTs are strategically homeported around the U.S. coast and equipped with trailer-able survey launches and state-of-the-art hydrographic equipment to determine water depths and acquire high-resolution imagery of the seafloor. Coast Survey is currently updating and upgrading NRT equipment. Lake Assault Boats of Superior, Wisconsin, built and delivered five new survey boats specifically designed for hydrographic surveying. Two of the five boats are fully outfitted and survey-ready. The remaining three boats will be coming online over the next few months. All five vessels are expected to be survey-ready with side scan and new Kongsberg multibeam sonars by spring of 2018. Additionally, the NRTs will begin incorporating unmanned systems into their suite of equipment this fall, including a Remus 100 autonomous underwater vehicle (AUV) and a small autonomous surface vehicle (ASV) that will support shallow water investigations.

NRT5 is homeported in New London, CT, and supports the entire Northeast Atlantic region. NRT5's new boat was delivered and will be prepared for survey operations this fall. Recently, NRT5 coordinated with the *Bay Hydro II* to survey the Hudson River. Preliminary plans have them surveying Long Island Sound, Cape Cod,

Sakonnet River, and Woods Hole over the next five years (although these plans may change based on new or emerging requirements).

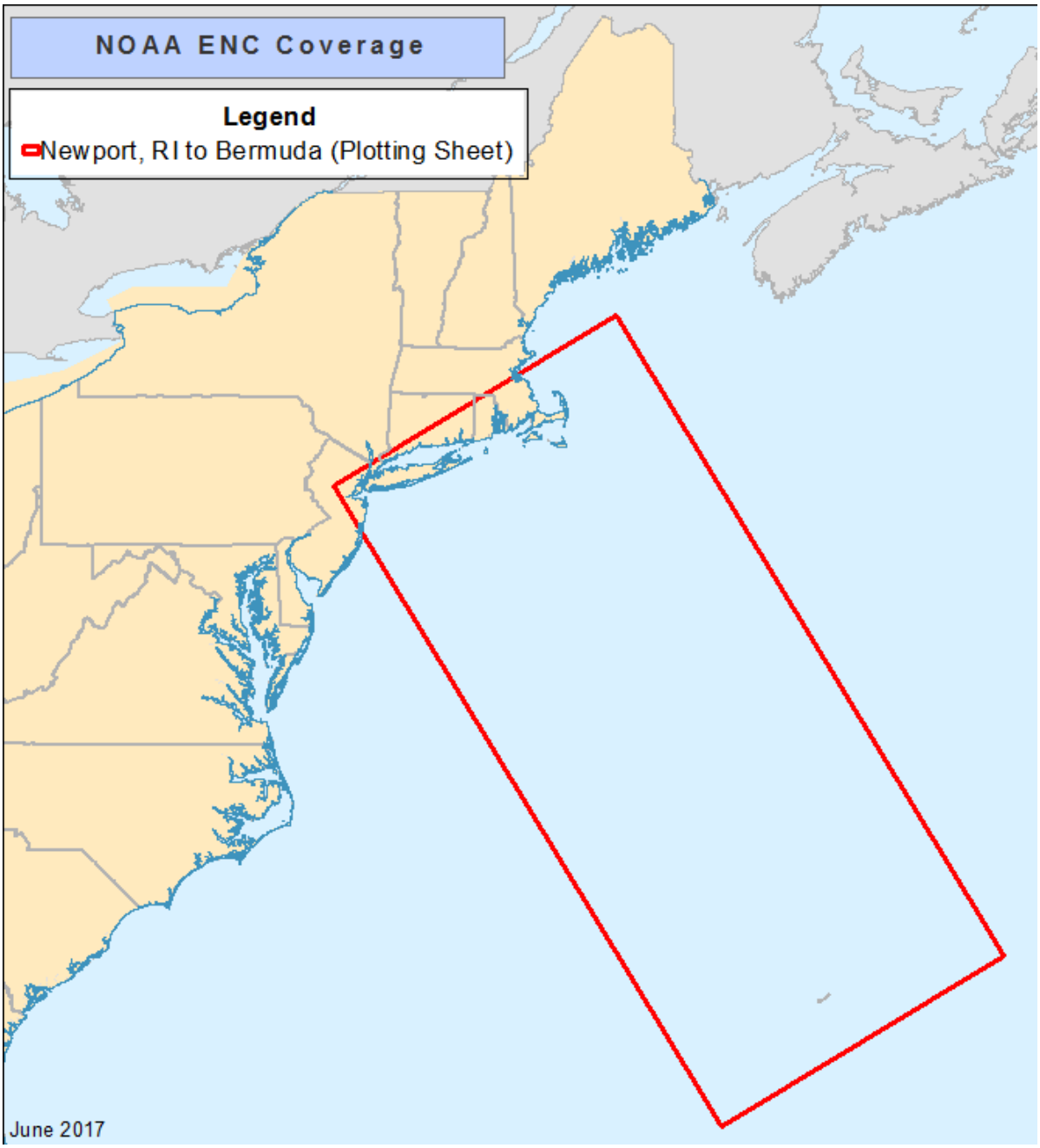


Location of navigation response teams across the country.

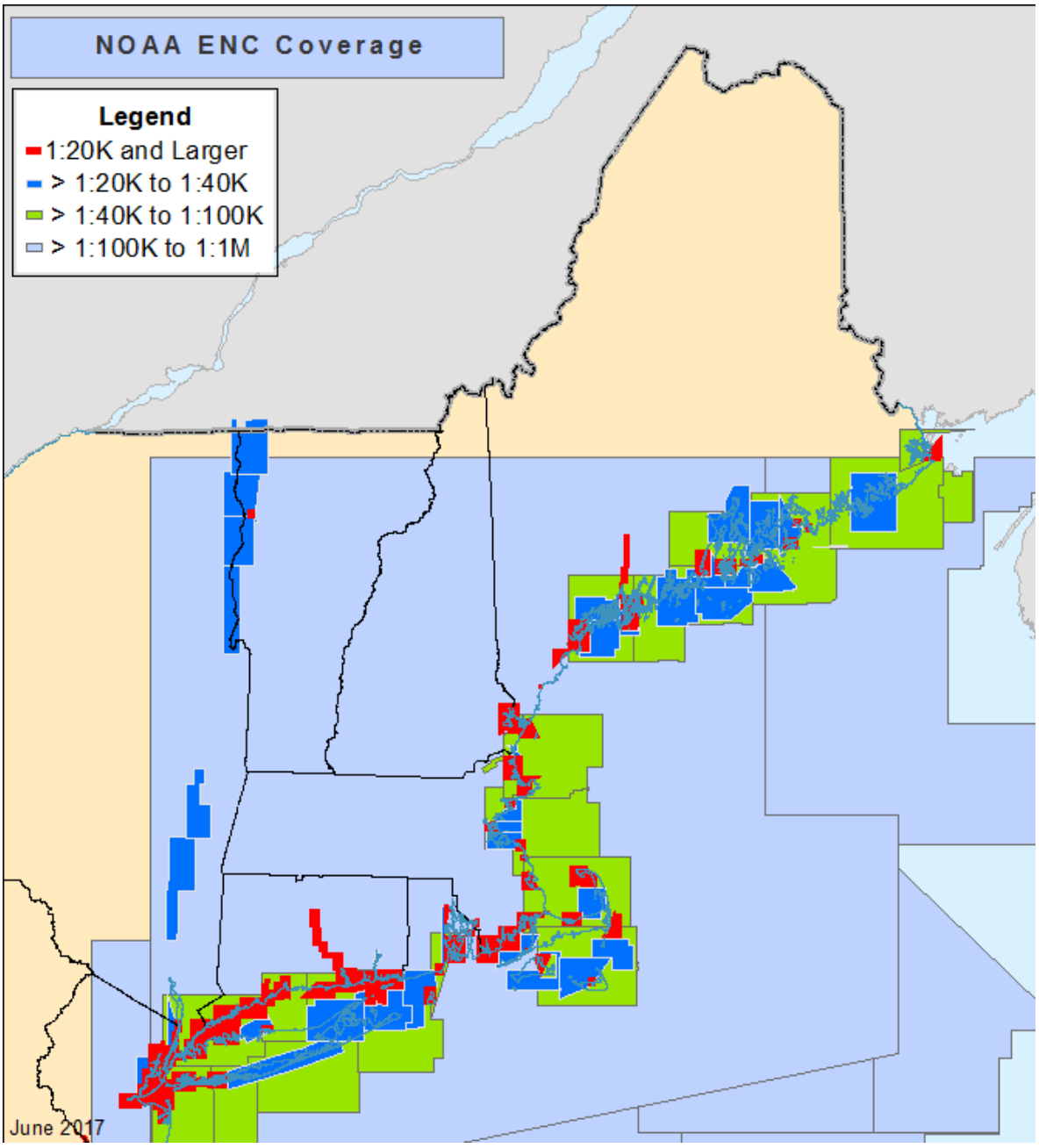
Chart coverage

Coast Survey is transitioning nautical chart production into a single database—the Nautical Information System (NIS) database from the two databases that were built separately to create raster (paper) nautical charts (RNC) and electronic navigational charts (ENC). The transition allows faster simultaneous updates for all NOAA chart products. As cartographers receive new source information, they update the affected ENC and RNC products and release the updated products to the public weekly. This allows Coast Survey to keep both the ENC and RNC in agreement and provide the mariner with the most up-to-date products. With improvements in the chart production system, the raster charts are in a continual maintenance status, meaning that mariners will see shoreline and hydrographic updates more quickly, without having to wait years for a new edition.

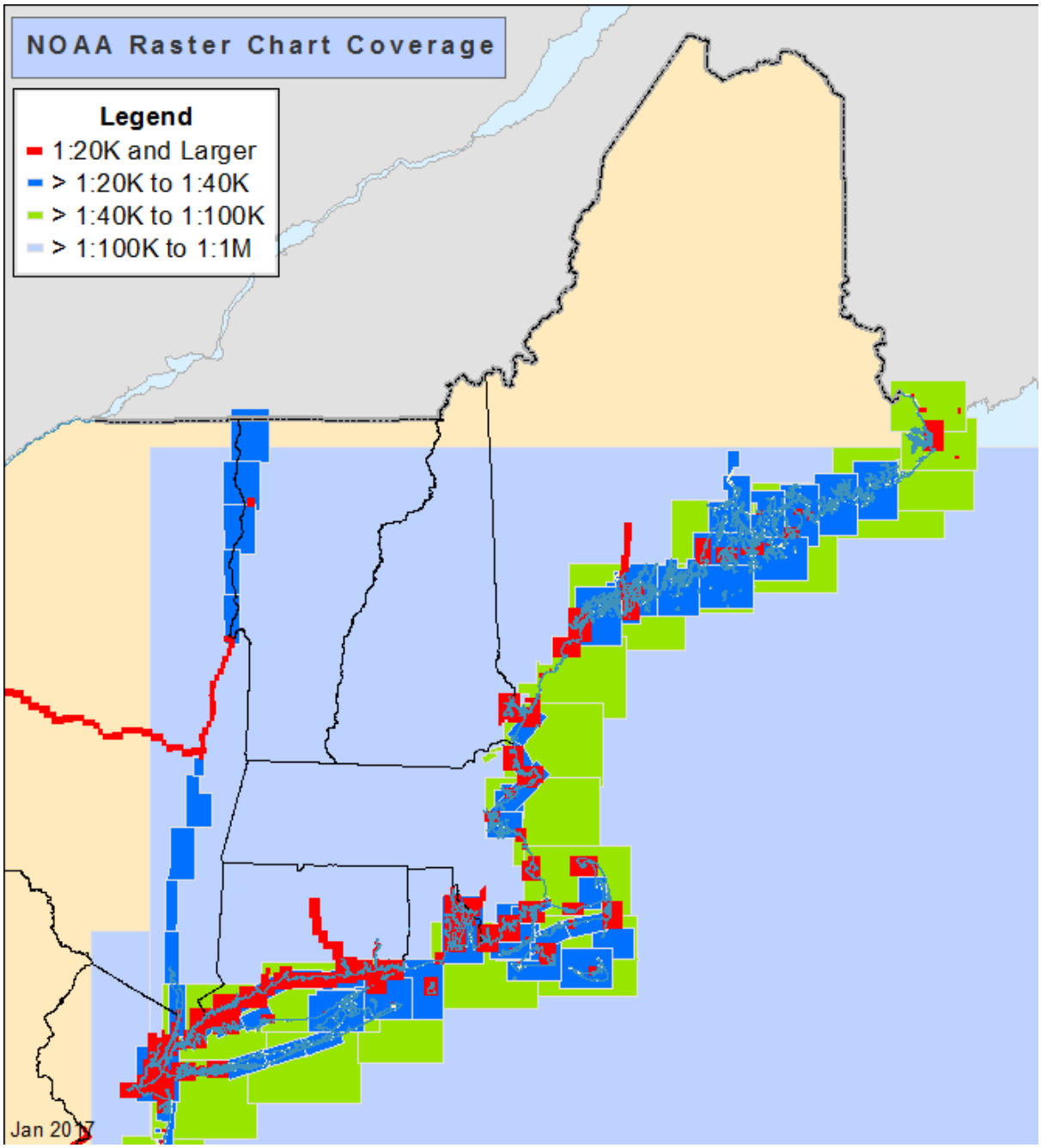
Over 95 percent of NOAA nautical chart data is loaded into the NIS database. The remaining four dozen charts will be loaded by the end of October 2017.



ENC coverage for New England.

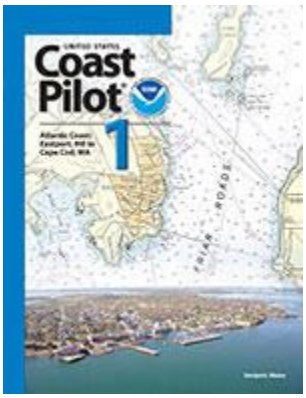


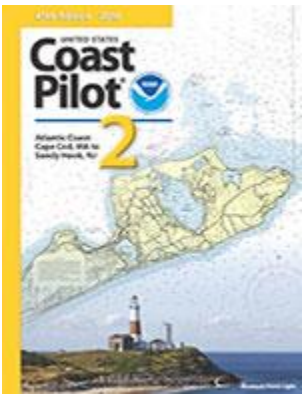
ENC coverage for New England.



RNC coverage for New England.

United States Coast Pilot®





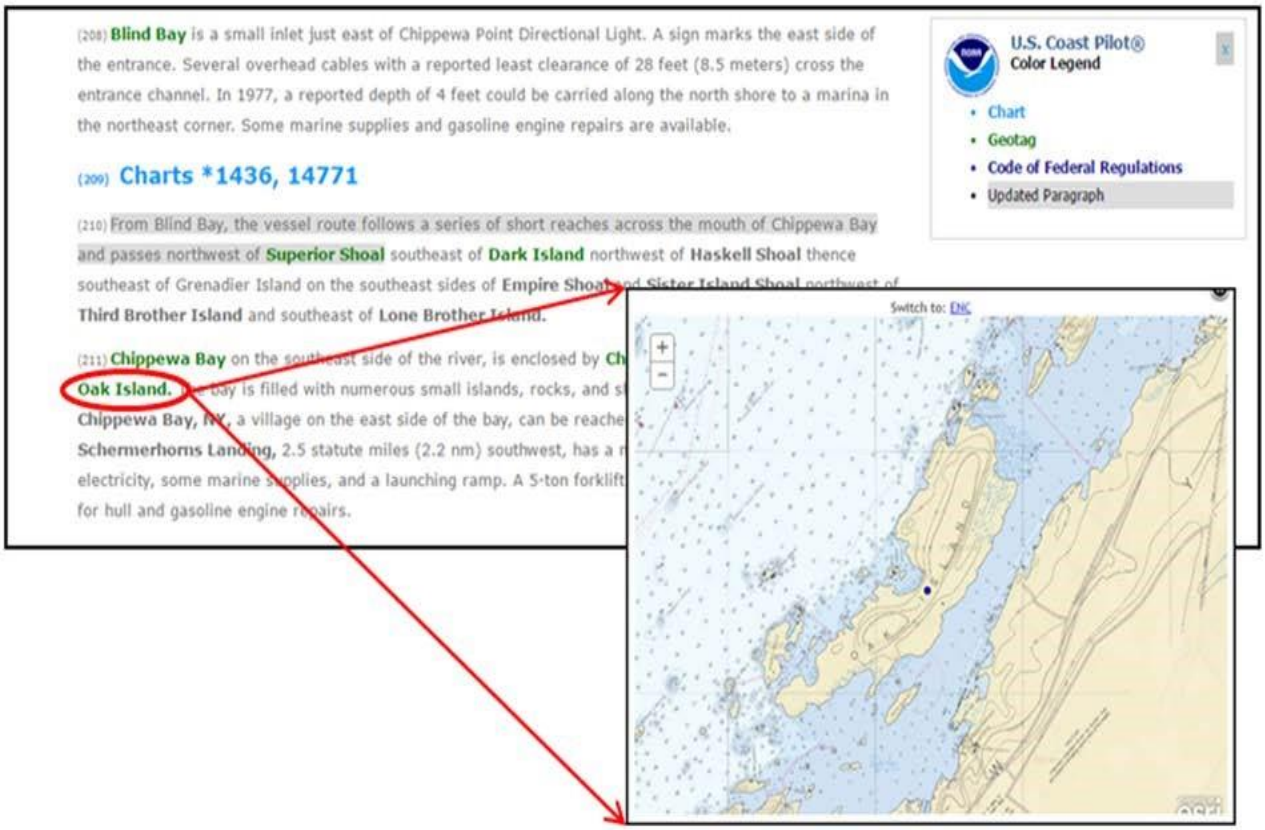
The *United States Coast Pilot* ® provides information important to navigators of coastal and intracoastal waters and contains supplemental information that is difficult to portray on a nautical chart. Topics in the *Coast Pilot* include channel descriptions, anchorages, bridge and cable clearances, currents, tide and water levels, prominent features, pilotage, towage, weather, ice conditions, wharf descriptions, dangers, routes, traffic separation schemes, small-craft facilities, and federal regulations applicable to navigation.

Coast Pilot 1 (47th Edition) covers the coasts of Maine, New Hampshire, and part of Massachusetts, from Eastport, ME, to Provincetown, MA. *Coast Pilot 2 (46th Edition)* covers the Atlantic coast from Cape Cod, MA, to Sandy Hook, NJ, including the coasts of Rhode Island, Connecticut, and New York. All nine volumes of the *Coast Pilot* are updated and available for download weekly, and can be used on mobile devices such as smart phones and tablets.

The digital version of *Coast Pilot* provides geotagged reference points that assist mariners with landmark positions and displays the associated nautical chart inset. (A geotag is a geographical location information assigned to a type of media.) In the online xml versions of *Coast Pilot*, certain place names and objects, (highlighted in green) are now viewable on a nautical chart and linked to entries in the official U.S. Geographic Names database.

Other features include:

- images that become larger when clicked
- an interactive table of contents for each book
- links to raster nautical chart, highlighted in light blue
- weekly changes, highlighted in gray, which are retained until the next annual version is published



Clicking on the geotagged place name in the online xml versions of Coast Pilot, launches a chartlet of the area.

Recent Activities

Northeast Atlantic stakeholder engagement

One of the ways that Coast Survey engages stakeholders and partners is through interactions at industry events. The Northeast navigation manager routinely meets with stakeholders in the region, including the U.S. Coast Guard (USCG), U.S. Army Corps of Engineers (USACE), pilots associations, recreational boaters and commercial fishermen, state and local governments, and academia. Some of the activities in which the Northeast navigation manager has participated over the past year include the following:

Summer 2016

- Attended newly-formed Connecticut Port Authority meeting, which was created after the Connecticut Maritime Commission was dissolved.
- Attended Boston Port Operators Group meeting where the harbor deepening and maintenance dredging project was discussed.
- Visited Fugro Inc., USA, to discuss the status of the ongoing Penobscot Bay survey.

- Participated on Northeastern Regional Association of Coastal Ocean Observing Systems (NERACOOS) buoy cruise to meet with area stakeholders and partners.

Fall 2016

- Presented at the Connecticut State Port Authority board meeting, highlighting Coast Survey's activities in the area, our resources, and our survey and emergency response capabilities.
- Met with USCG Sector Long Island Sound to provide a chartlet, which would help locate the deep-water outlet outside of the federal channel. Also presented on Coast Survey's resources and capabilities and discussed the need for current surveys in the highly dynamic secondary waterways throughout Long Island Sound.
- Attended the annual Connecticut Port Authority public hearing.
- Attended the Rhode Island Port Safety Forum and provided an update on Coast Survey's weekly update website and survey overview.
- Attended Southeast Massachusetts Port Safety Forum and provided an update on Coast Survey's new weekly update website as well as the possibility of using satellite-derived bathymetry or lidar for updating the 'changeable area' in Chatham.
- Attended Boston Port Operators Group meeting, where concerns were raised from ship captains entering the Port of Boston, about to the ECDIS zone of confidence listed as "unassessed" for this area.
- Attended the Maine/New Hampshire Port Safety Forum and presented on the weekly chart update website and Penobscot Bay survey status.

Winter 2017

- Attended the Northeast Pilots meeting, where issues with the Cape Cod Canal current predictions were discussed.
- Staffed a booth at the Providence Boat Show, which provided the opportunity to inform recreational boaters about Coast Survey and CO-OPS products.
- Visited the University of New Hampshire Center for Coastal and Ocean Mapping. Discussed the data pipeline for Maine and Bureau of Ocean Energy Management (BOEM) data, the status of Maine/New Hampshire coastal mapping efforts, and the backscatter request from Maine.
- Met with the state of Maine to discuss the need for stakeholder outreach concerning the upcoming Penobscot Bay survey and Maine's request to receive backscatter from this survey.
- Attended the Penobscot Bay Pilot meeting to discuss the upcoming survey season and other hot topics.

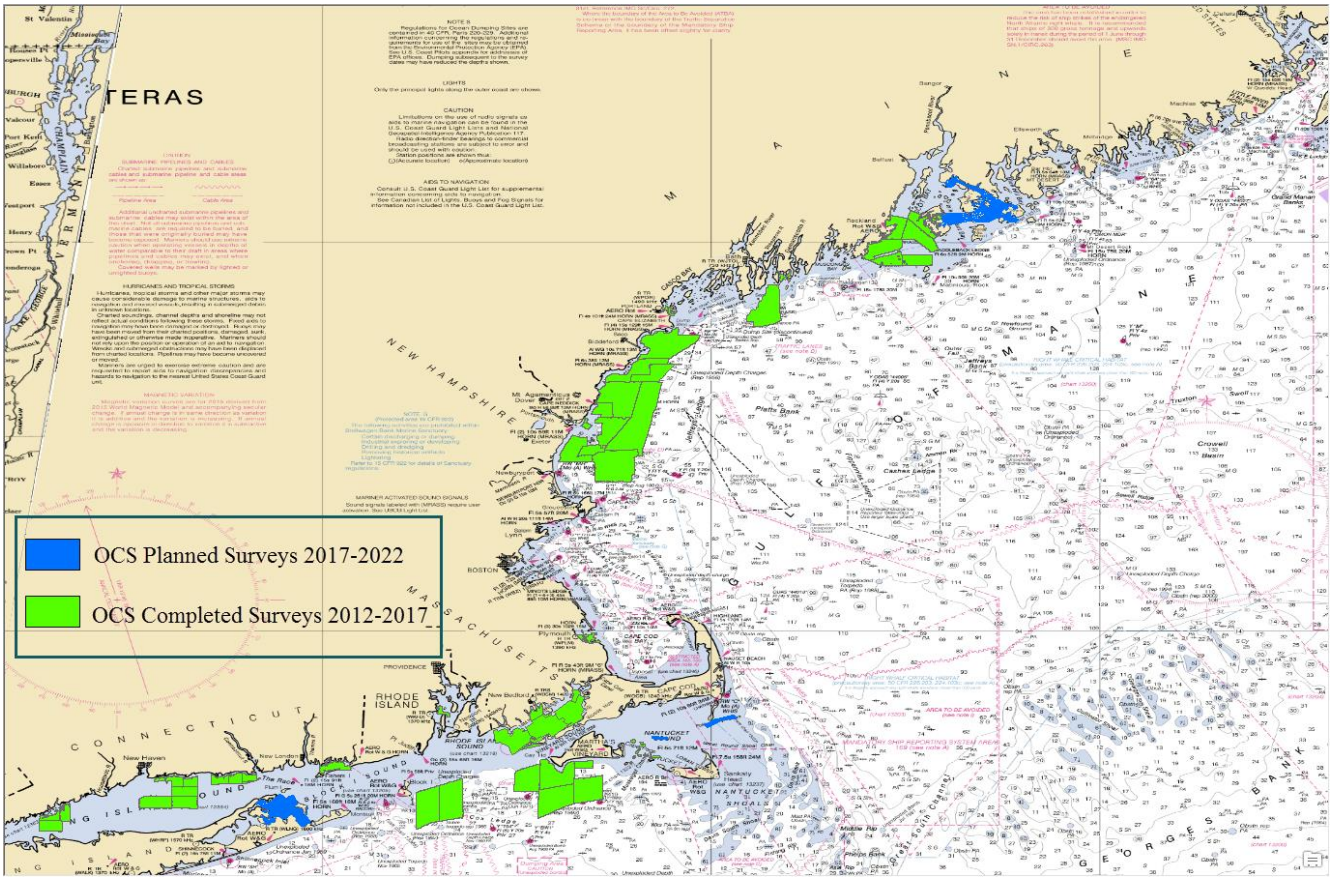
Spring 2017

- Accompanied Rear Adm. Smith to meet with staff from Senator Chris Murphy (D-CT) and Senator Richard Blumenthal's (D-CT) offices.
- Attended the Rhode Island Port Safety Forum, where discussions were held with representatives from DONG Energy regarding the possibility of sharing bathymetric data collected during the work on the wind farm off Martha's Vineyard.

- Attended Maine Lobstermen's Association and Fugro pre-survey meeting to discuss the upcoming Penobscot Bay survey, including operations plan, communications plan, and resulting products.
- Presented on the National Charting Plan and announced the upcoming HSRP meeting and membership call at the Southeast Massachusetts Port Safety Forum, Massachusetts Bay Harbor Safety Committee annual meeting, and Boston Port Operators Group meetings.

Survey operations in the New England in the past five years

NOAA ships *Thomas Jefferson* and *Ferdinand R. Hassler* have conducted 28 surveys in New England. This is in addition to 13 NRT surveys, six surveys by Coast Survey contractors, and eight processed external source surveys totaling 1491 square nautical miles, all in the past five years.

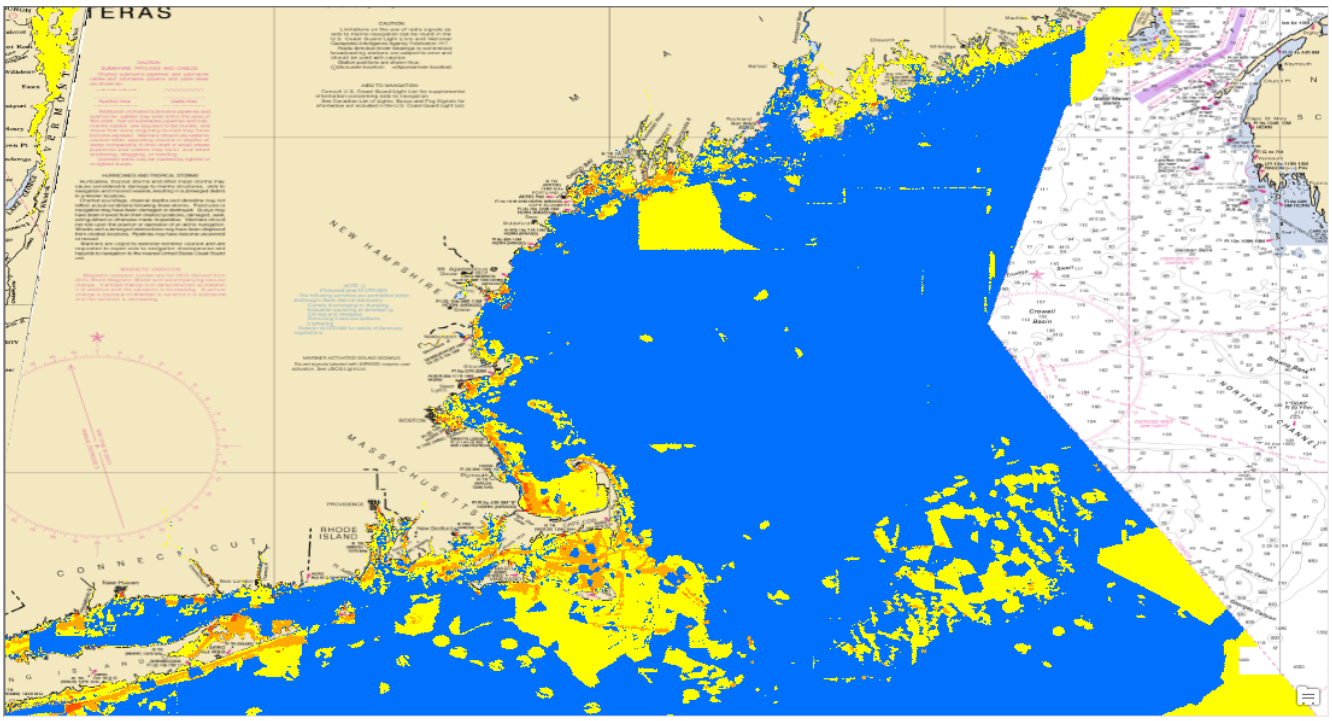


Map of completed and planned surveys for the New England area.

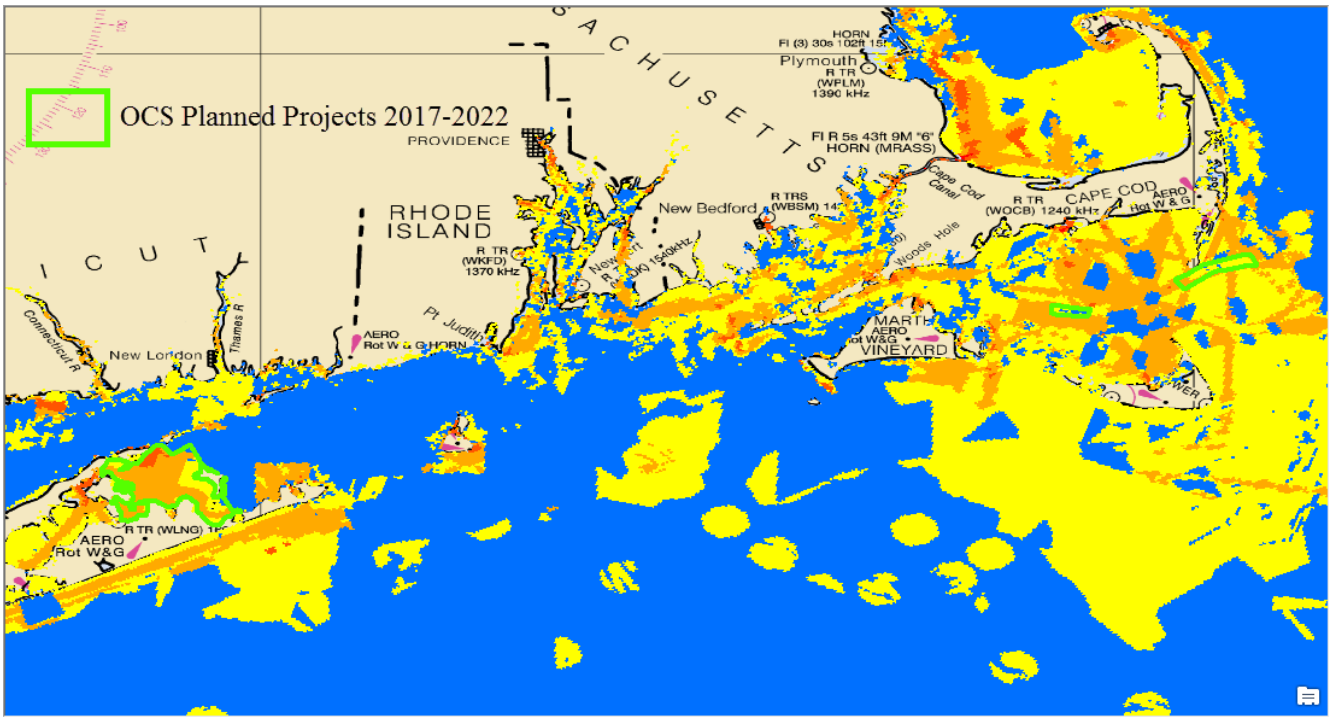
New England survey priorities

Coast Survey has three survey areas planned for the near future in New England: 1) Penobscot Bay, ME; 2) Nantucket Sound, MA; and 3) Gardiners Bay, NY.

It is important to note that Coast Survey is in the process of developing new methodology for evaluating survey priorities, by modeling the "hydrographic health" for a given survey area. With the completion of the initial run of the Hydro Health model, Coast Survey will have better tools to assess the urgency of navigational needs in an area. This new model is still being quality controlled and having its input datasets verified, so any conclusions should be reached only with consultation with the Hydro Health team. The following two images are samples of one potential visualization option applied to the New England region and a better scale image of the project areas for Gardiner's Bay and Nantucket Sound.



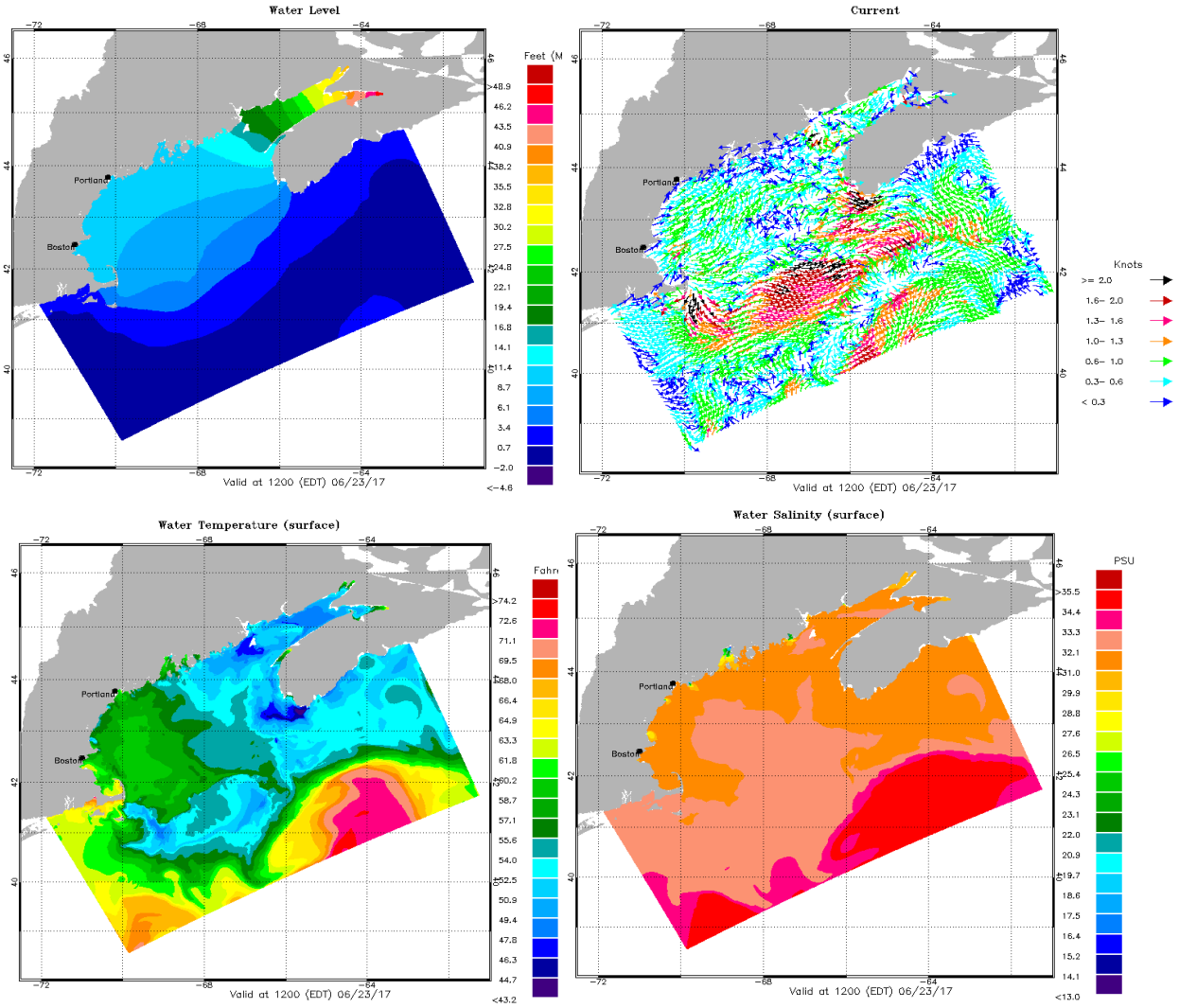
Visualization option applied to New England offered by the Hydro Health model.



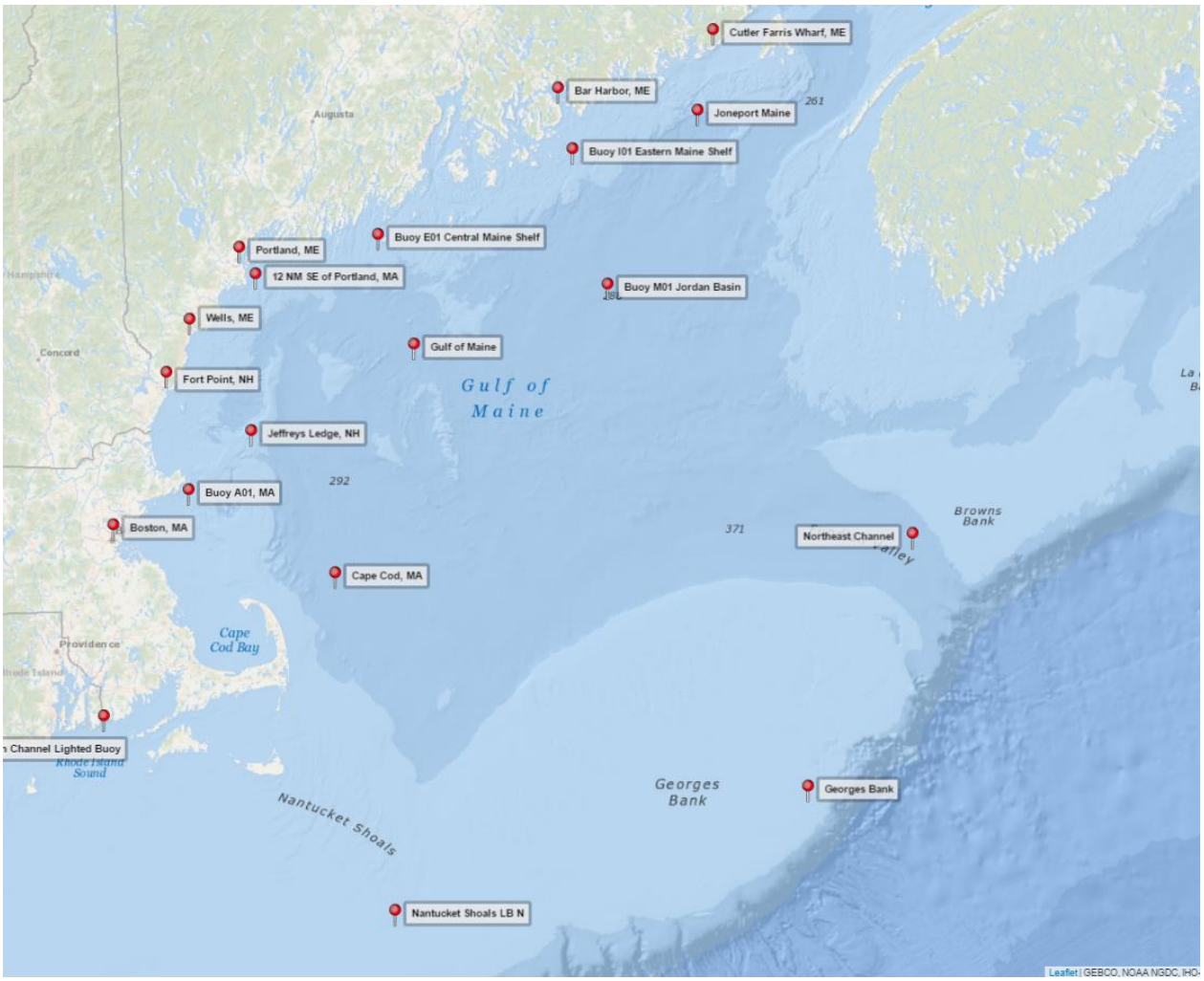
Visualization option offered by the Hydro Health model zoomed into Gardiners Bay and Nantucket Sound. Planned Coast Survey projects are outlined in green.

Gulf of Maine Operational Forecast System (GoMOFS)

NOAA's National Ocean Service is in the final stages of developing a Gulf of Maine Operational Forecast System. GoMOFS is based on the three-dimensional Regional Ocean Model System (ROMS) model and runs on NOAA's high performance computers. GoMOFS provides water level, currents, water temperature, and salinity nowcast and forecast guidance. GoMOFS will run four times per day and generate six-hour nowcasts and 72-hour forecast guidance. GoMOFS products include time series graphics at several station locations, aerial animations, and grid file output of the Gulf of Maine for all five parameters (wind, water level, currents, temperature, and salinity). The GoMOFS is expected to become operational in September 2017. Work is also in progress by the National Centers for Coastal Ocean Science (NCCOS) to test and implement a Harmful Algal Bloom (HAB) model that will be linked to GoMOFS in the future.



Gulf of Maine Operational Forecast System forecast grids of water level, surface current, sea surface temperature, and salinity.



GoMOFS time series plot station locations.

Unmanned systems for maritime mapping: AUVs and USVs

Coast Survey is continuing to adopt unmanned systems as complementary technology to its maritime mapping capabilities, where the unmanned systems can provide a meaningful benefit by either expanding capabilities or making more effective use of manned resources.

Small, man-portable AUVs and unmanned surface vehicles (USVs) have both been put to operational use for Coast Survey's mapping requirements. Small AUVs have been integrated with Coast Survey's navigation response capability, and small USVs are used aboard NOAA Ship *Thomas Jefferson* to meet very shallow water mapping requirements. *Thomas Jefferson* used the small AUVs to investigate shoals and rocks in Buzzards Bay and Vineyard Sound in Massachusetts, and for a small survey project in Newport, Rhode Island.

Coast Survey completed evaluations of a large, deep-diving AUV and a large, long-endurance USV. Coast Survey determined that large AUVs are not well suited for coastal hydrographic surveys, but can meet the high-resolution, deep-water mapping requirements of other NOAA offices, so is evaluating alternatives for operational transition. Long-endurance USVs, as evidenced by a successful operational demonstration of a leased USV in September 2016 aboard NOAA Ship *Nancy Foster*, do have the potential to enhance the capabilities and effectiveness of the hydrographic survey fleet.

Based on the lessons learned during the demonstration, Coast Survey is pursuing the conversion of an existing survey launch to operate in both manned and unmanned modes.

NOAA-University of New Hampshire Joint Hydrographic Center and the UNH Center for Coastal and Ocean Mapping

The Joint Hydrographic Center (JHC) is a research and educational partnership between NOAA and the University of New Hampshire (UNH) located on the university's main campus in Durham, NH, and funded by a competitively-awarded NOAA cooperative agreement. The Center for Coastal and Ocean Mapping (CCOM), a complementary university center, expands the scope of ocean mapping interaction and collaboration to the private sector, NGOs, other government agencies, and universities. With over 70 researchers, staff, and graduate students, the center is a world leader in hydrographic and ocean mapping research and education.

Major research themes of the center include:

- improved technology for the acquisition and processing of acoustic and lidar bathymetry
- autonomous vessels and systems for hydrography and ocean mapping
- innovative approaches to managing hydrographic data and transforming those data to electronic navigational charts
- new concepts in electronic charts and other tools supporting enhanced situational awareness in navigation
- enhanced techniques in the visualization, presentation, and display of mapping data

- advancements in the planning, acquisition, understanding, and interpretation of the continental shelf, slope, and rise seafloor mapping data
- development and delivery of advanced curricula in hydrographic and ocean mapping science and engineering

Acoustic test tank for echo sounder research and calibration.

UNH's Judd Gregg Marine Facility in New Castle, NH, is the home for the center's two dedicated survey research vessels, the 46-ft R/V *Gulf Surveyor* and the 39-ft R/V *Cocheco*. These versatile vessels are outfitted to support a full range of seafloor mapping research missions and can be configured with a wide variety of state-of-the-art echo sounding systems. The UNH marine facility is also the home port of NOAA's most modern hydrographic survey ship, the NOAA Ship *Ferdinand Hassler*.

CCOM/JHC's dedicated survey research vessel R/V Gulf Surveyor.

NOAA Ship Ferdinand R. Hassler *at its homeport at the UNH marine facility.*

Co-directors from NOAA and UNH manage JHC. Twelve NOAA employees representing Coast Survey, CO-OPS, and Ocean Exploration are based at JHC and work in partnership with the UNH research team.

NOAA's Integrated Ocean and Coastal Mapping Program

NOAA's Integrated Ocean and Coastal Mapping (IOCM) program is actively engaged in the New England region, particularly through the Northeast Regional Ocean Council (NROC) Habitat Subcommittee (HCOM). NROC is a state and federal partnership that facilitates the New England states, federal agencies, regional organizations, and other interested regional groups in addressing ocean and coastal issues that benefit from a regional response. NROC's HCOM coordinates using the IOCM federal mapping coordination SeaSketch site, and IOCM has closely followed the development of the Northeast Region Ocean Action Plan for opportunities to insert IOCM commitments into planning. IOCM held its first "mini" regional stakeholder mapping summit in the Northeast in 2014. Plans are underway to host a larger summit in 2018 to which a wider range of stakeholders will be invited (similar to the successful Great Lakes Summit held in Chicago in April 2017).

NOAA's IOCM Center, a pilot effort based at the NOAA-UNH JHC and funded initially by the Hurricane Sandy Response Fund, has worked on a wide range of projects since 2014. Major efforts in New England include:

- **Marine debris** – IOCM is working with NOAA's Office of Response and Restoration, National Geodetic Survey (NGS) Remote Sensing Division (RSD), and state partners to assess post-Sandy lidar and side scan sonar surveys in the Northeast for marine debris and to develop best practices for locating and tracking the charting and removal of marine debris from regional waterways.
- **Airborne lidar data with NGS RSD and academic partners** - In partnership with NGS RSD, IOCM is developing lidar reflectance/intensity maps and documenting procedures for processing bathymetry and reflectance from the latest generation of modern shallow-water airborne lidar systems.
- **New England external source data** -- The IOCM Center has been instrumental in locating available external source data and assessing and re-processing it for NOAA charting use:
    - U.S. Geological Survey (USGS) interferometric sonar data – the center assessed and re-processed USGS seabed surveys in Massachusetts to prepare these surveys for NOAA charting.
    - State of Maine hydrographic surveys – The center supported the state in developing and deploying a hydrographic survey program and has quality-assured the resulting surveys for application to the nautical chart.
- **Coastal and Marine Ecological Classification System (CMECS)** – IOCM is working on the collection and archival of bottom photos into Coast Survey hydrographic workflow and cross-walking Coast Survey bottom descriptions with the CMECS system widely used in habitat mapping.
- **Tidal zoning products** – IOCM is working in partnership with NOS's CO-OPS Services, advancing the availability of regional tidal zoning products to the public.

Other IOCM updates

NOAA, BOEM, and USGS have just begun drafting a memorandum of agreement (MOA) to facilitate cooperation on survey acquisition using NOAA fleet and/or NOAA contract vehicles. The first partnership effort under the MOA will be joint survey work off the coast of California in November 2017. The multibeam data acquired will support USGS and BOEM environmental research efforts. It will also provide data for NOAA nautical chart updates and the Seabed 2030 initiative.

National Enhanced Elevation Assessment and Oceans and Coasts (NEEA- Oceans and Coasts)

Coast Survey and the USGS National Geospatial Program plan to conduct a follow-on study to the NEEA white paper finalized in 2012 (NEEA overview can be found at https://pubs.usgs.gov/fs/2012/3088/). NOAA, USGS and partner mapping agencies are working to improve the technology, systems, data, and services that provide information about 3D data and related applications within the United States. By learning more about business uses and associated benefits that would be realized from improved 3D data, the agencies will be able to prioritize and direct investments that will best serve user needs. A comprehensive study of requirements and benefits for improved elevation data that covers the geographic scope as defined by the 3D Nation vision will help federal mapping agencies to develop and refine future program alternatives for enhanced 3D data to meet many federal, state, and other national business needs. The level of effort and quality for this work is expected to be comparable to and build upon the original USGS NEEA study and results.

The proposed name of the study, the 3D Nation Requirements and Benefits Study, is derived from the 3D Nation concept, which unites terrestrial and coastal/ocean mapping efforts from the highest mountains to the deepest oceans to ensure public access to an accurate, authoritative national elevation dataset.

Center for Operational Oceanographic Products & Services

Personnel and products in the New England Region

CO-OPS personnel

CO-OPS has a Northeast field team located out of Chesapeake, VA, that is responsible for the operations and maintenance of the New England portion of the National Water Level Observation Network (NWLON) for the collection, analysis, and dissemination of water level observations and long-term sea level trends. There are two field crews deployed to ensure operations of these sensors. NWLON is nationally composed of 210 primary and long-term control tide stations that provide basic tidal data for U.S. coastal and marine boundaries and for charting data. Other uses range from storm surge warnings to commercial and recreational vessel navigation to global climate change and tectonic studies. CO-OPS also has one employee stationed at the UNH's JHC. This employee is part of the CO-OPS Coastal and Estuarine Circulation and Analysis Team, measuring tidal currents. This employee also sits on the International Hydrographic Organization Tides, Water Level, and Currents Working Group.

National Water Level Observation Network

CO-OPS operates and maintains the NWLON, which is a network of 210 continuously operating water-level stations throughout the U.S., including its island possessions and territories. NWLON is the "go to" source for government and commercial sector navigation, recreation, and coastal ecosystem management. The NWLON provides the national standards for tide and water level reference datums used for nautical charting, coastal engineering, international treaty regulation, and boundary determination. NWLON supports storm surge and tsunami warnings and provides relative sea level trends. Approximately one quarter of the NWLON is located in the Great Lakes (non-tidal), providing water level data for the international management of those water resources. The NWLON is also widely recognized as the key federal component of the Integrated Ocean Observing System (IOOS).

There are 11 NWLON stations in New England. Water level stations contain the water level sensors and data collection platforms. Real-time data are transmitted every six minutes via geostationary orbiting environmental satellite. Telephone modems or cellular gateways are installed as back up communications at most locations. In addition to a primary and back-up water level sensor, most stations also acquire meteorological data including wind speed and direction, air temperature, and water temperature.

CO-OPS operates the following NWLONs in New England:

- four in Maine: Eastport, Cutler Ferris Wharf, Bar Harbor, and Portland
- three in Massachusetts: Boston, Woods Hole, and Nantucket Island
- two in Rhode Island: Newport and Providence
- two in Connecticut: New London and Bridgeport

Upgrade in water level technology

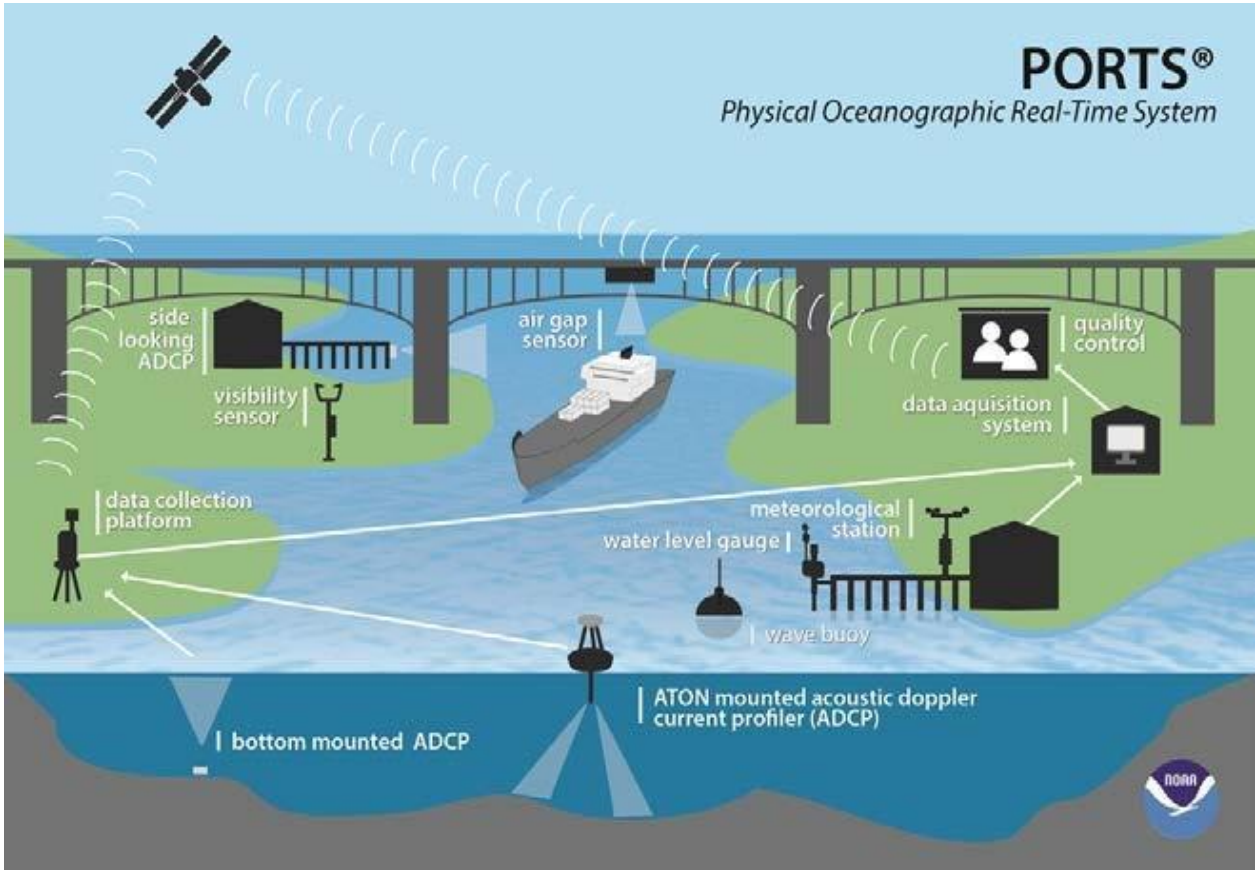
CO-OPS is upgrading the NWLON using microwave water level sensors (MWWL) instead of traditional acoustic sensors. With a MWWL system, the sensors sit up out of the water, meaning less maintenance is needed, resulting in lower costs. It is also more accurate in high-energy conditions and has the potential to provide information on waves. In order to ensure accuracy of the data, CO-OPS leaves both the MWWL and acoustic sensors in place for one year for comparison. To date, CO-OPS has installed MWWL sensors at 49 NWLON stations across the country, and 18 of those stations have been fully transitioned to using MWWL as the primary sensor as of FY17. MWWL has been installed at 27 non-NWLON locations (PORTS, etc.), 23 of which are fully operational. In New England, Bridgeport, MA, and Boston have MWWL already installed and operating as the primary sensor, with Newport, RI, slated for FY18 install. New London and New Haven in Connecticut have MWWL's installed but not transitioned to primary yet.

Partner stations in New England

CO-OPS works with other federal entities to assist with collecting water level to NOAA standards. Recently, CO-OPS and the National Park Service (NMS) signed a MOA. The NPS will be operating and maintaining a station in Chatham, MA, that is in an NWLON gap, but is not presently funded as the data benefits both agencies. A water level station in Wells, ME, is installed in partnership with the National Estuarine Research Reserve. CO-OPS has also recently been working with USACE to provide tidal datums for their coastal projects. CO-OPS worked with the New England District recently to provide technical assistance for installing a gauge, but also for the computation of tidal datums in New Hampshire.

Physical Oceanographic Real-Time System (PORTS®)

PORTS® is a decision-support tool that improves the safety and efficiency of maritime commerce and coastal resource management through the integration of real-time environmental observations, forecasts, and other geospatial information. PORTS® measures and disseminates observations and predictions of water levels, currents, salinity, waves, and meteorological parameters (e.g., winds, atmospheric pressure, visibility, and air and water temperatures) that mariners need to navigate safely. NOS operates 29 PORTS®, four of which operate in New England: Cape Cod, MA; Narragansett Bay, RI; New Haven, CT; and New London, CT.



Cape Cod PORTS®

A PORTS®- is operated cooperatively with the Northeastern Regional Association of Coastal Ocean Observing Systems (NERACOOS) and provides real-time data quality-controlled and disseminated to local users for safe and efficient navigation. Real-time wave data is available from one wave buoy.

Narragansett Bay PORTS®

A PORTS®- is operated cooperatively with the State of Rhode Island, Department of Environmental Management at which real-time data are quality-controlled and disseminated to local users for safe and efficient navigation. Real-time data are available from five water level stations with meteorological data from the same five stations, three current meter stations, and three visibility sensors.

New Haven PORTS®

A PORTS®- is operated cooperatively with the State of Connecticut and provides real-time data quality-controlled and disseminated to local users for safe and efficient navigation. Real-time data is available for a water level station with meteorological data.

New London PORTS®

A PORTS®- is operated cooperatively with U.S. Department of the Navy, Port Operations, Commander Navy Region Mid-Atlantic and provides real-time data quality-controlled and disseminated to local users for safe and

efficient navigation. Real-time data is available for a water level station with meteorological data and a current meter.

Current surveys in Casco Bay

During the summer of 2014, CO-OPS collected tidal current information in Casco Bay with the deployment of 24 current meter stations. With the improvements in measurement and computing technology available today, the accuracy of these modern predictions are significantly improved from past observations. Data and predictions are available to partners, stakeholders, and the public in the NOAA Tidal Current Tables and through NOAA Current Predictions website and has also been used to support the development of a new operational forecast model for the Gulf of Maine.

Operational forecast systems

Operational nowcast and forecast hydrodynamic model systems support NOAA's mission goals and priorities by providing automated integration of observing system data streams, hydrodynamic model predictions, product dissemination**,** and continuous quality-control monitoring. State-of-the-art numerical hydrodynamic models driven by real-time data and meteorological, oceanographic, and/or river flow rate forecasts, form the core of these end-to-end systems. The OFS will perform nowcast and short-term (0 hr. – 48 hr.) forecast guidance of pertinent parameters (e.g., water levels, currents, salinity, temperature, waves) and disseminate them to users.

Ecological Forecasting

Extensive shellfish resources in the Gulf of Maine are frequently contaminated with toxins produced by the red tide dinoflagellate *Alexandrium fundyense*. Shellfish harvesting must be closed to protect public health. Near shore areas are monitored and shellfish harvesting is regulated by states in the region. In federal waters where routine monitoring is not feasible, large areas have been permanently or temporarily closed to shellfish harvesting.

To minimize economic disruption, NCCOS has funded a project to develop models to predict toxic blooms and understand the transfer of toxins to shellfish in order to provide early warning. It is currently in demonstration mode and is scheduled to be the next region in the HAB operational forecast system that is maintained operated out of CO-OPS.

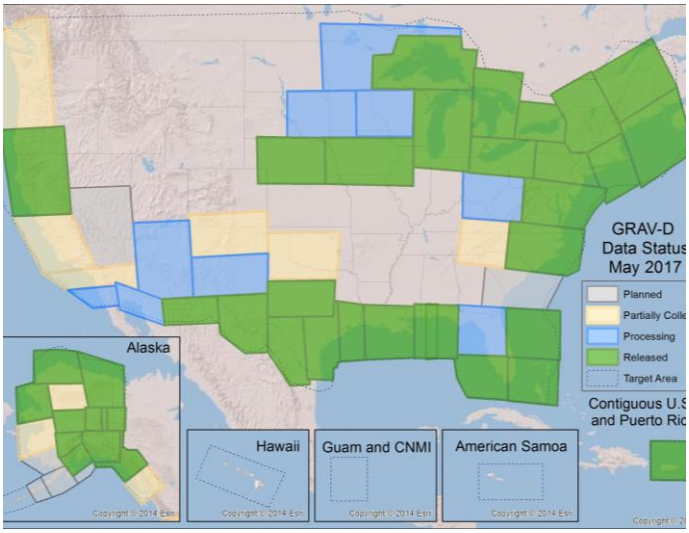
National Geodetic Survey (NGS)

Regional mission summary

NGS supports a wide variety of programs and activities in the Northeast Atlantic focused on monitoring elevation changes, improving accuracy of the National Spatial Reference System (NSRS), and producing a gravity-based vertical datum. This is accomplished with the help of the NGS regional geodetic advisor, who improves coordination between NGS and our partners. The regional value of implementing these programs and activities essentially provides accurate geodetic and water level products that ultimately improves the NSRS and activities between Canada and the United States.

Activities in the New England Region

GRAV-D update for the Northeast Atlantic Region



The Gravity for the Redefinition of the American Vertical Datum (GRAV-D) program is producing a gravity-based vertical datum that will be accurate at the ~2 cm level where possible. GRAV-D flights in the Northeast Atlantic are complete. This new information will be included in revised gravity models for the region and will culminate in a new national vertical reference system. This system will result in an estimated $522 million in nationwide annual economic benefits once implemented, allowing users to determine more precise elevations using the Global Positioning System (GPS), with approximately $240 million saved from improved floodplain management alone. For more information go to the NGS GRAV-D web page or contact Monica Youngman at monica.youngman@noaa.gov.

Geodetic activities in the Northeast Atlantic Region

Maine

The Maine Department of Transportation (MEDOT) operates and maintains a global navigation satellite system (GNSS) real-time network that currently consists of 13 stations and covers the southern third of the state. MEDOT is working to expand the network statewide. For more information, contact Harold Nelson, continually Operating Reference Station (CORS) Project Manager at mail to: Harold.Nelson@maine.gov.

New Hampshire

The New Hampshire Department of Transportation (NHDOT) has operated a GNSS CORS for a number of years. The station is currently down for repair/replacement. NHDOT is an active contributor to the NGS database that houses the Shared OPUS Solutions. For more information, contact Brian Easler at beasler@dot.state.nh.us.

Vermont

The Vermont Agency of Transportation (VTrans) operates and maintains a 19 station GNSS real-time network (VECTOR) that provides statewide coverage. VTrans is a fervent contributor to Shared OPUS Solutions. They are actively collecting GNSS data on published NAVD 88 benchmarks for the purpose of providing data to aid in the creation of NGS's vertical transformation tool. For more information, contact Brad Herring at brad.herring@vermont.gov.

Massachusetts

The Massachusetts Department of Transportation (MassDOT) operates and maintains an 18 station real-time network (MaCORS) which provides near-statewide coverage. Currently they have agreements in place to add stations on Nantucket and in Chatham. Similar to Vermont, Massachusetts has implemented a program for observing GNSS on NAVD 88 benchmarks. They have identified a network of 34 stations that they intend to observe annually. For more information, contact Evanson Browne at evanson.browne@ma.state.us.

Connecticut

Connecticut Department of Transportation (ConnDOT) has formed a committee to standardize GNSS work at all four district survey offices as well as for consultants. The group is in the process of creating new standards/specifications for all GNSS work in the state, with a view to eventually share with the Connecticut Association of Land Surveyors. The current guidelines, while still useful, are outdated, as methods and technology have evolved rapidly over the last number of years. This document also covers RTK /RTN work suitable for ConnDOT project use. Connecticut is also aggressively performing GNSS observations on NAVD 88 benchmarks and sharing the OPUS solutions. For more information, contact Robert J. Baron, Manager of Survey Operations at Robert.baron@ct.gov. ConnDOT owns and operates 12 GNSS base stations within the state, and works in agreement with the University of Connecticut, who manages the real-time network (ACORN) derived from these stations. ACORN provides statewide coverage within Connecticut. For more information contact Thomas Myer, Ph.D, thomas.meyer@uconn.edu.

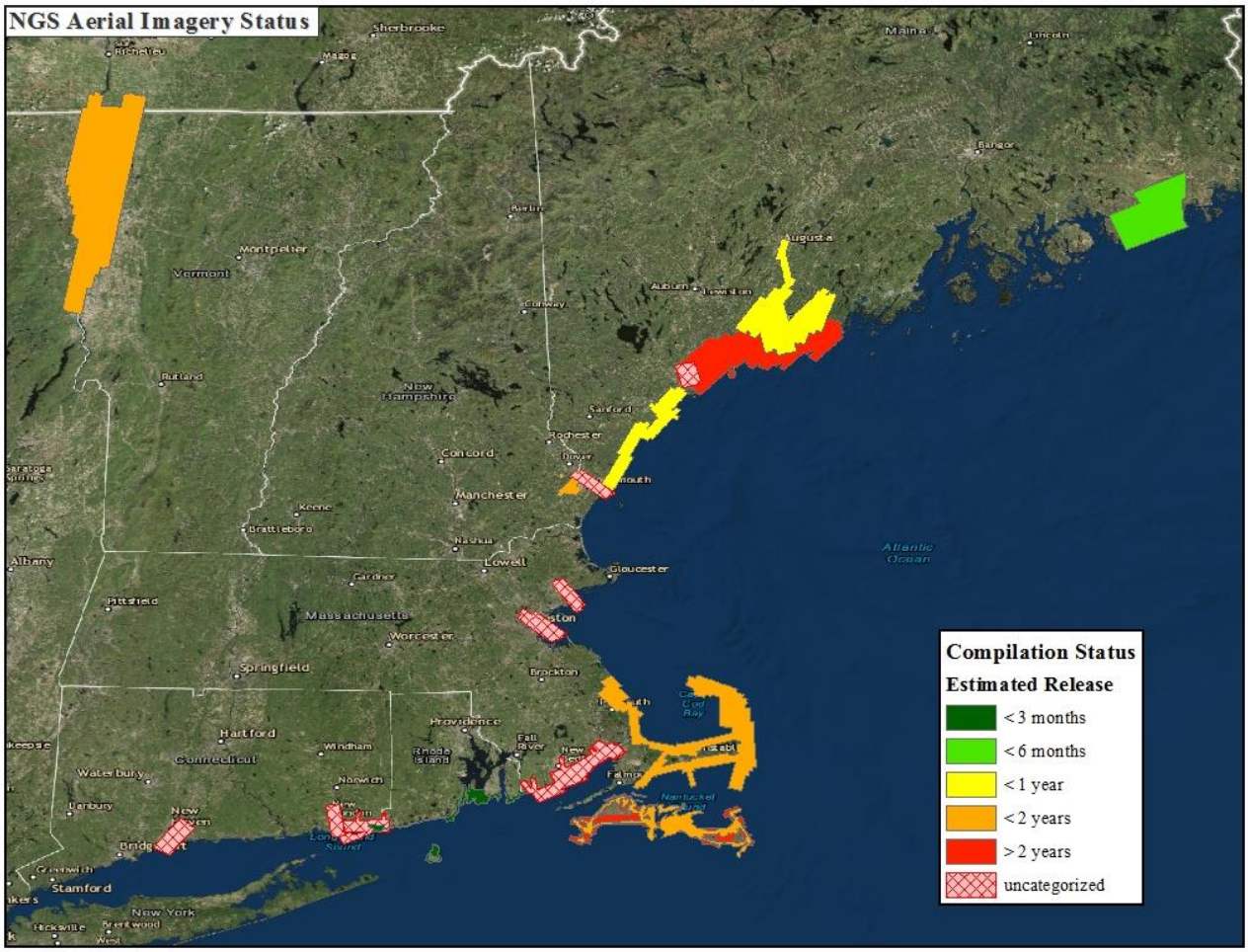
Rhode Island

Rhode Island Department of Transportation (RIDOT) is preparing to advertise for a survey supervisor, who will officially have the responsibilities of the Rhode Island geodetic coordinator, who will work closely with the Northeast regional geodetic advisor to support the geodetic needs for Rhode Island. The state does not

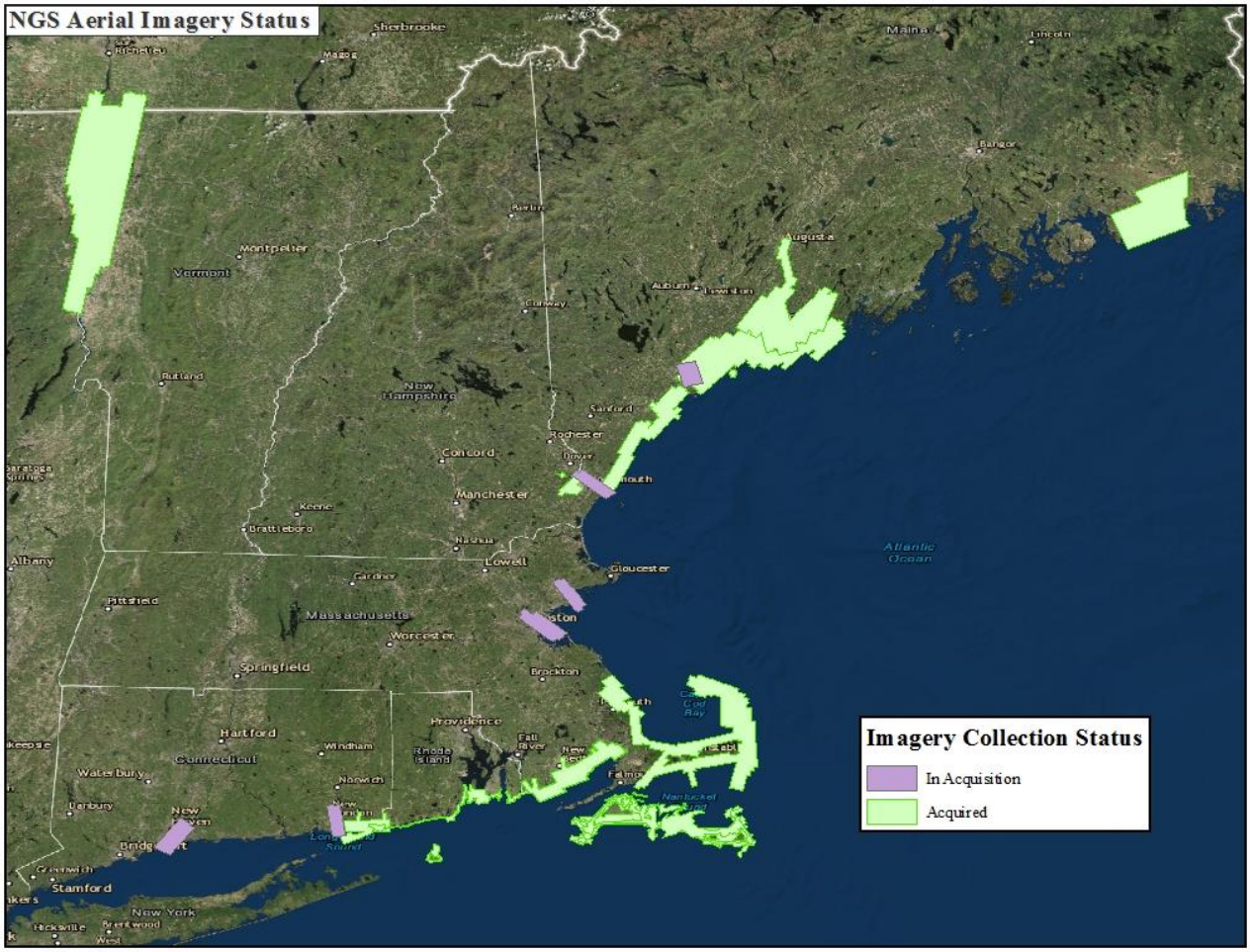
currently operate a real-time network, as they can take advantage of a number of the Connecticut and Massachusetts stations. RIDOT is considering adding a station or two within the state, and adding those stations to ACORN. For more information, contact Michael Gaston, PLS, Manager of Survey Operations at michael.gaston@dot.ri.gov

Shoreline coverages for the Northeast Atlantic Region

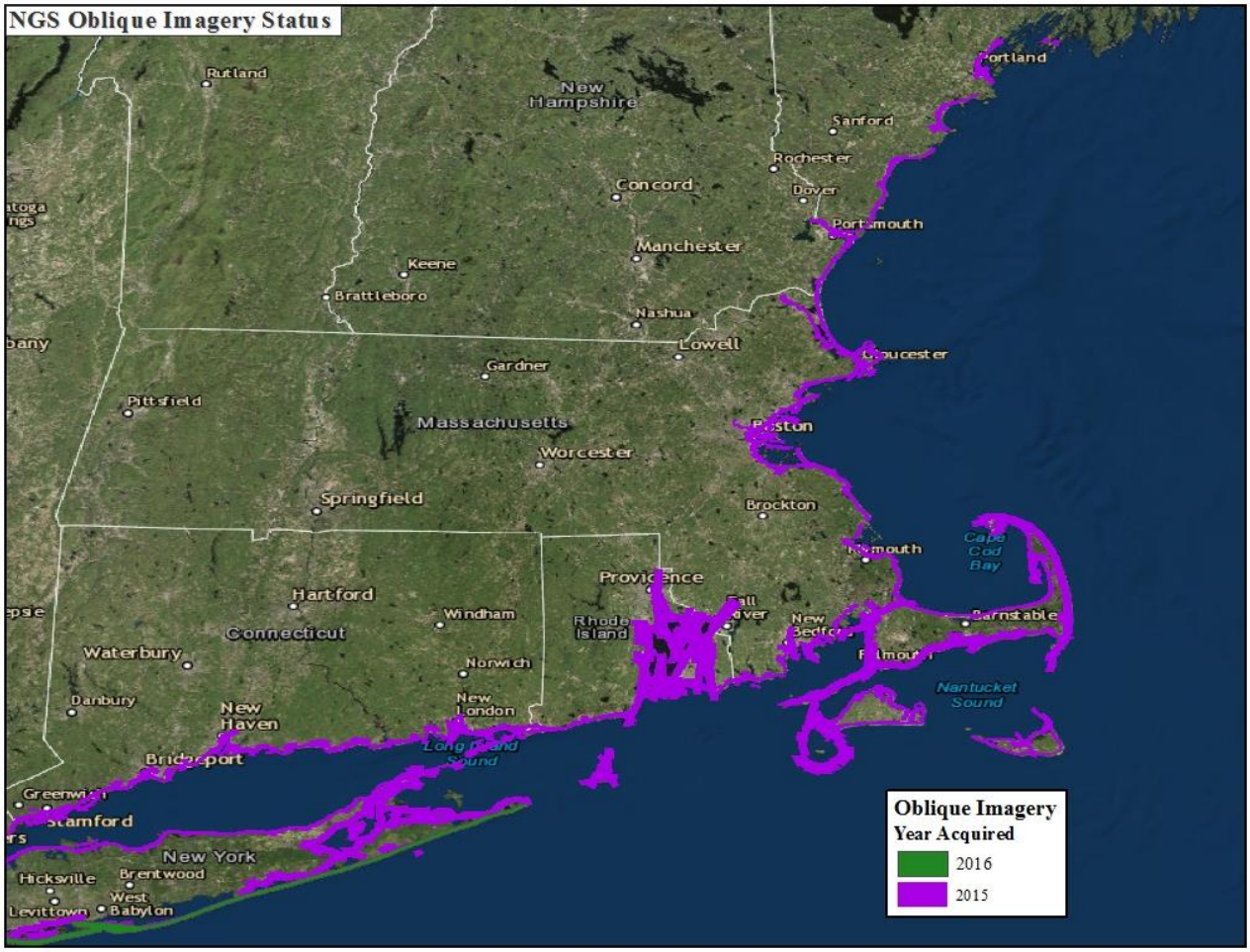
NOAA continues to acquire and compile the national shoreline for the Northeast Atlantic. NOAA plans to collect RGB aerial imagery for six Coast and Shoreline Change Analysis Program Ports in FY17. The ports that will be surveyed are New Haven, CT; New London/Groton, CT; Boston, MA; Salem, MA; Portsmouth, NH; and Portland, ME.



Compilation of NGS aerial imagery status.

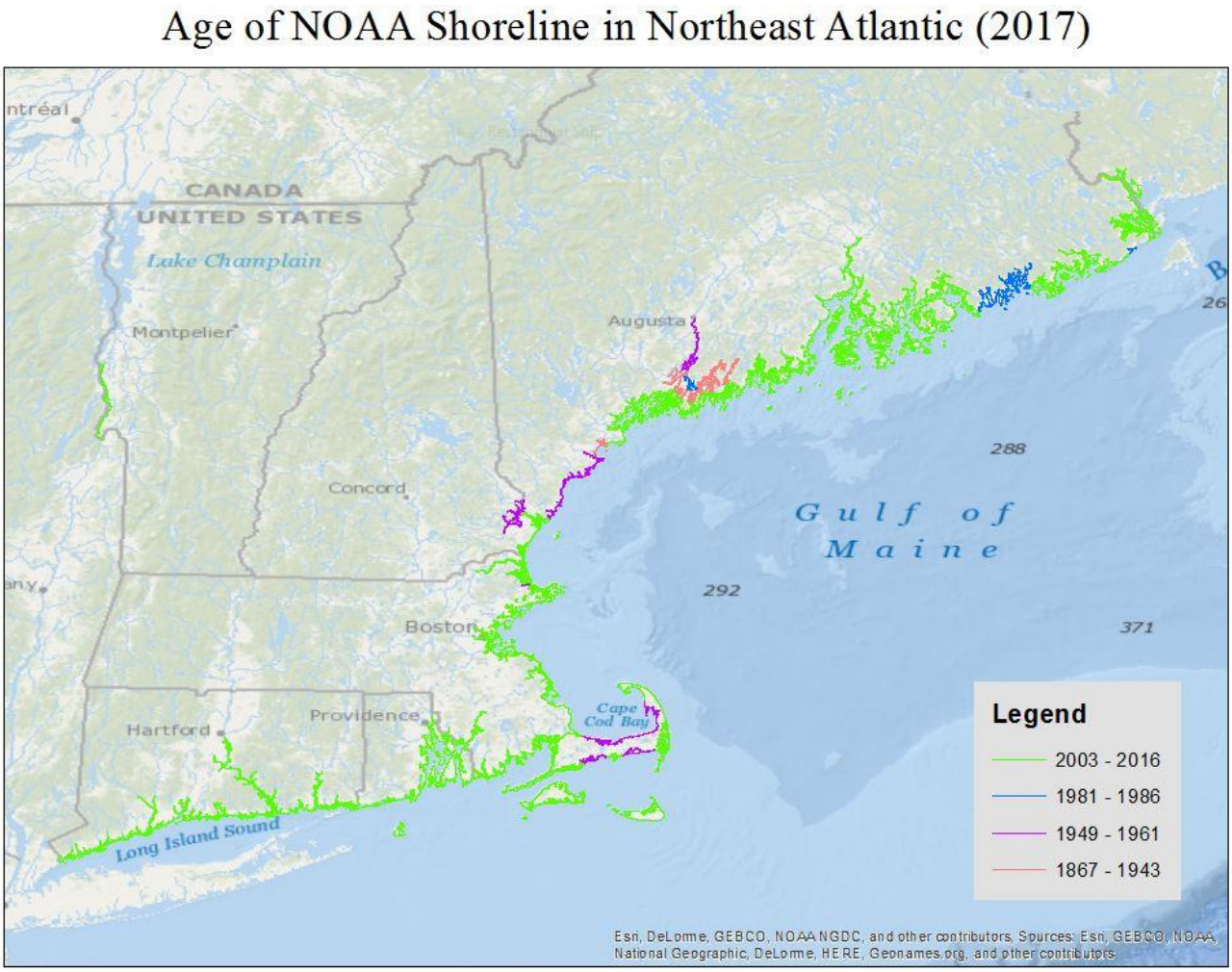


NGS aerial imagery acquisition status.



NGS oblique imagery collection status.

NOAA's continually updated shoreline product (CUSP) provides the most current shoreline representation of the U.S. and its territories. CUSP is built upon NGS national shoreline data and uses both NOAA and non-NOAA contemporary sources to replace vintage shoreline areas. The goal of CUSP is to represent the dynamic interface between land and water; therefore, CUSP is designed to deliver continuous shoreline with frequent updates.



CUSP coverage in the Northeast.

Emergency response imagery

NGS conducts flights to collect imagery after natural (hurricane, earthquake, tsunami, flood, and tornado) and man-made (oil spill) disasters. The high-resolution, geo-referenced airborne imagery, which support NGS's coastal mapping program, also support homeland security and Federal Emergency Management Agency requirements, as well as state and local interests. NGS posts the images on the web, often within hours, to make them available to the public.

NGS has been called on to collect emergency response imagery following many different types of disasters, including the aftermath of the January 2015 Nor'easter that blanketed the region in snow and caused significant storm surge along the New England coast. NOAA imagery for this response covered coastal portions of Massachusetts. Below is all of NGS's 2015 aerial imagery collected in Northeast.

NGS has collected emergency response imagery for all major hurricanes since 2003. From the imagery, those in charge of response and restoration can determine the effect of disasters on the land; for example they can determine where flooding has wiped out parts of barrier islands and affected their formation.

In 2013, NGS enhanced its imagery collection by developing hardware, software, and processes to allow for the collection of oblique aerial imagery. In 2015, NGS began collecting pre-event imagery along most of the U.S. shoreline using oblique imagery. Currently, NGS has collected pre-event imagery for the majority of the contiguous United States outer coast.

NGS's 2015 aerial imagery collected in Northeast.