



NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

## NOAA Navigation Services

# Gulf of Mexico Activities Report

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

March 2016



**Texas, Louisiana, Mississippi, Alabama, Florida**

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# The Gulf Region

The Gulf of Mexico region is home to coastal communities that are inextricably linked to the diverse natural resources supported by the Gulf of Mexico and its coastal habitats and wildlife. This link and the shared experience of recovery from the Deepwater Horizon oil spill and Hurricanes Katrina, Rita, and Ike have helped define the Gulf of Mexico as one region shared by five states and many vibrant coastal communities. Increasing recognition of interdependencies and advantages of regional partnerships is now bringing the region together on the path through recovery and restoration to emerge a stronger, more resilient region.

## Geography and Environment

The Gulf of Mexico is a 218,000 square mile semi-closed, oceanic basin that is connected to the Atlantic Ocean by the Straits of Florida and to the Caribbean Sea by the Yucatan Channel. The region experiences some of the most severe weather in the world, including major hurricanes, tornadoes and thunderstorms. The 17.2 million acres of marsh and nearly 30,000 miles of coastal tidal shoreline provide many opportunities for millions of tourists who flock to this beautiful area of the country. Watersheds from 33 of the 48 contiguous states drain into the Gulf of Mexico.

As the ninth largest body of water in the world, the Gulf of Mexico teems with sea life, from shrimp in the coastal estuaries to deep-water corals living thousands of feet below the surface. Coastal areas are home to a wide variety of living resources, including waterfowl, estuarine shellfish, sea turtles, and fish.

## Social and Economic Context

The Gulf of Mexico region is a vital economic engine for the nation, supplying trillions of dollars annually to the U.S. economy and providing jobs for millions of people. The Gulf is a proven ground for major marine industries such as commercial seafood, oil and gas production, and shipping. The gross domestic product (GDP) of the five states of the Gulf Coast region exceeded \$3 trillion in 2014, representing 17 percent of the nation's GDP (Bureau of Economic Analysis, 2014). The region is one of the most productive areas for natural resources in the country. Shipping and shipbuilding are also multi-billion dollar industries.

Ports in Louisiana and Texas are ranked first and second, respectively, in handling waterborne tonnage (by state), handling over a billion tons of cargo in 2014. The region also hosts a significant portion of the U.S. oil and gas industry, with its offshore drilling platforms, refineries, and pipelines. Roughly, two-thirds of all U.S. oil imports pass through the Gulf.

Abundant natural and living resources provide the basis for a thriving Gulf Coast economy. Industries such as tourism, commercial fishing, oil and gas, and shipping contribute significantly to the Gulf economy and employ millions of people region wide. However, significant economic benefits bring rising population, creating severe stress on the very same natural resources that provide the economic engine for the region. Therefore, it is imperative to realize that the health of the diverse ecosystems of the Gulf is the primary indicator of sustainable coastal economies.

## Challenges and Drivers

As a working coastline, the Gulf of Mexico maritime transportation sector faces many challenges. Its ports are expanding. Ships are getting larger, wider, and deeper. Anchorages are increasingly crowded. Multiple hurricanes result in dangers to navigation; and when submerged obstructions are located, they may remain on the charts even after they have degraded from the natural ocean movements. Marine pilots and tow companies are turning to the many advantages provided by digital navigation with portable pilot units and electronic charting systems. Maritime sectors call upon NOAA for updated charts, streaming real-time water levels, weather observations, and operational forecast systems, among other data.

The ecosystem faces many challenges, including the one of the world's largest areas of hypoxia, or "dead zone." Each year, the dead zone sharply affects the region's seafood production, illustrating the enormity and complexity of the threats facing the region's ecosystem and, subsequently the region's economy.

The Deepwater Horizon oil spill added to, and in many ways compounded, prior stresses on the Gulf of Mexico region's ecosystem and economy.

Sea level rise (SLR) is a growing concern. The amount of SLR happening around the Gulf varies because of differences in land subsidence, but tide gauge data shows that sea levels are already rising at rates from just over half a foot (Panama City, Florida) to just under three feet (Grand Isle, Louisiana) every 100 years. Moreover, science shows these rates are increasing. With uncertainty about how fast land-based glaciers may melt, scientists recommend communities use multiple scenarios when planning. Right now, science indicates the amount of global SLR over the next 100 years may range from one and a half feet to over six feet. Around the Gulf, SLR is already affecting infrastructure and natural resources; moving into the future, SLR will mean more frequent coastal flooding events and higher storm surges.

Growing coastal populations, extensive commercial and marine fisheries, traditional and emerging energy industry, and marine transportation both benefit and produce stressors for the region.

To address these challenges, regional collaboration and coordination will be increasingly important – and even more challenging. Priority challenges include integrating science and information to support the many new regional initiatives; coordinating among many governmental agencies, non-governmental organizations, and stakeholders; leveraging still limited resources to reduce duplication and prioritize actions; educating stakeholders on the importance of coastal ecosystems; and facilitating science-based management decisions and adaptive management approaches to understand progress toward achieving our shared goals.

By fully participating in region-wide and inter-agency activities and ensuring appropriate stakeholder engagement, NOAA can maximize its capabilities and efforts in the Gulf of Mexico. Fostering partnerships inside and outside of NOAA is a key part of addressing these regional challenges. NOAA has substantial assets within the Gulf region that are focused on addressing the challenges. This report focuses on the capabilities and assets of NOAA's navigation services.

# Office of Coast Survey

## Personnel & Products in the Gulf 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 navigation managers in the Gulf Region		
LOCATION	Navigation Manager (Base of Operations)	Phone/Fax
Western Gulf Coast (Texas)	<b>Alan Bunn</b> alan.bunn@noaa.gov (Galveston, TX)	Phone: 409-621-5151 x118 Cell: 979-676-2866 Fax: 409-621-1316
Central Gulf Coast (Mississippi, Alabama, Louisiana, Florida Panhandle)	<b>Tim Osborn</b> tim.osborn@noaa.gov (Lafayette, LA)	Phone: 337-291-2111 Cell: 337-254-5933 Fax: 337-291-3097
South Florida, Puerto Rico, U.S. Virgin Islands	<b>Michael Henderson</b> michael.henderson@noaa.gov (St. Petersburg, FL)	Phone: 727-824-5396 Cell: 727-772-3708 Fax: 727-824-5320

### Navigation Response Teams

Coast Survey’s highly mobile [navigation response teams](#) (NRTs) 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, NRTs speed the resumption of shipping that provides critical supplies to the affected area. Outside of emergencies, NRTs serve the maritime economy by identifying critical chart discrepancies and investigating emergent navigational concerns for 175 major ports within the U.S. marine transportation system.

#### *Keeping mariners safe and commerce flowing*

Coast Survey assets include six NRTs that conduct scheduled hydrographic projects in critical maritime areas. Working with NOAA’s regional navigation managers, NRTs search for shoaling waters and submerged dangers to navigation that could slow or halt ocean shipping. They provide time-sensitive information to the U.S. Coast Guard and port officials, and transmit data to NOAA cartographers for updating Coast Survey’s suite of navigational charts.

These agile hydrographic field units are equipped with trailer-able survey launches and mobile data processing trailers. The teams use state of the art hydrographic equipment to determine water depths and acquire high-

resolution imagery of the seafloor. All teams are equipped with side scan sonar and multibeam echo sounders to generate three-dimensional views of what lies below the surface.

***Initiating a NOAA navigation response***

While surveying, the teams remain available to respond to emergent needs in their region, and emergencies anywhere on the nation’s coasts. Requests for a NOAA navigation response team originate from the appropriate U.S. Coast Guard Captain of the Port, state pilot association, port authority, or U.S. Army Corps of Engineers office. Requesters work with NOAA’s regional navigation managers to identify mission objectives and define the deliverable products.

Coast Survey currently has two navigation response teams located in the Gulf of Mexico region.

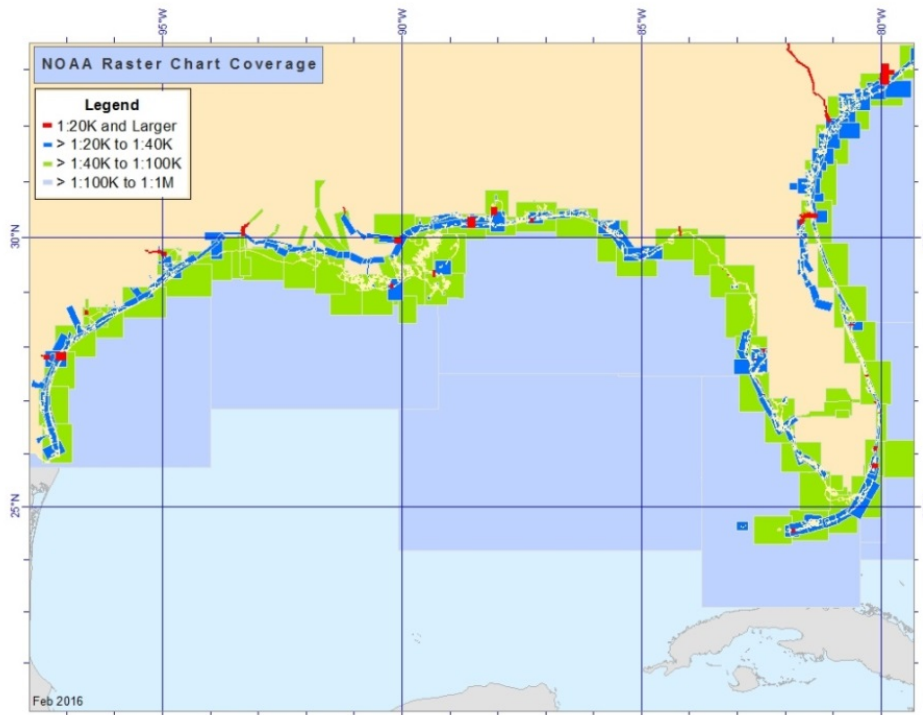
***New small survey boats for hard working navigation response teams***

Recognizing the value that NRTs bring to our survey and charting responsibilities – not to mention their essential work in locating underwater debris after hurricanes – NOAA is “recapitalizing” the NRT fleet, building new small boats specifically designed for hydrographic surveying. The first two boats, built by Lake Assault Boats of Superior, Wisconsin, were delivered in September 2015 to navigation response teams surveying ports in California and the eastern Gulf of Mexico.





## Chart Coverage – Gulf Region



- **Texas:** Charts 11300 – 11343 cover the Texas coast.
- **Louisiana:** Charts 11344 – 11370 cover the state of Louisiana. NOAA coverage includes the Mississippi River from South Pass to Baton Rouge; beyond that, U.S. Army Corps of Engineers inland charts provide navigational data.
- **Mississippi, Alabama and the Florida panhandle:** Charts 11371 – 11404 cover the remainder of the jurisdiction of the 8th U.S. Coast Guard District.
- **Florida:** Charts 11405 – 11452 cover from the Florida panhandle to the Straits of Florida. This area is under the jurisdiction of the 7th U.S. Coast Guard District and U.S. Army Corps of Engineers Jacksonville.

## United States Coast Pilot

The *United States Coast Pilot* 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* now provides geotagged reference points. A geotag is simply geographical location information assigned to a type of media. In this case, a geotag conveniently assists mariners with landmark positions and displays the associated nautical chart inset in the HTML version of *Coast Pilot*. Approximately 80 percent of the nine *Coast Pilot* volumes have been geotagged, with more points available each week.

*Coast Pilot 5* covers the Gulf of Mexico from Key West, Florida, to the Rio Grande. This area is generally low and mostly sandy, presenting no marked natural features to the mariner approaching from seaward. *Coast Pilot 5* also covers Puerto Rico and the Virgin Islands. All nine volumes of the *United States Coast Pilot* are updated and available for download weekly, and can be used on mobile devices such as smart phones and tablets.

[nauticalcharts.noaa.gov/CoastPilot](http://nauticalcharts.noaa.gov/CoastPilot)

## Recent Activities

### Coast Survey helps communities prepare for the 2015 Atlantic hurricane season

Coast Survey’s navigation managers and response teams spread awareness and helped communities prepare for the 2015 Atlantic hurricane season. At the start of any season, we do not know exactly when and where a hurricane will strike or how extensive the damage will be, but we are aware of the threat and are prepared to respond.

Prior to the start of the 2015 Atlantic hurricane season, Coast Survey focused on local community preparedness meetings and outreach events.

In May, Coast Survey’s navigation manager for the central Gulf Coast, in partnership with The National Weather Service Lake Charles and the Port of Morgan City, Louisiana, conducted public preparedness forums in Lafayette, Lake Charles, and Morgan City. One meeting featured U.S. Representative Charles W. Boustany, Jr., as the speaker. Approximately 90 people attended, including the Congressman’s constituents, and local, state, and federal agencies and responders. The information provided was of vital interest given the upcoming start of hurricane season and the 10th anniversary of hurricanes Katrina and Rita.

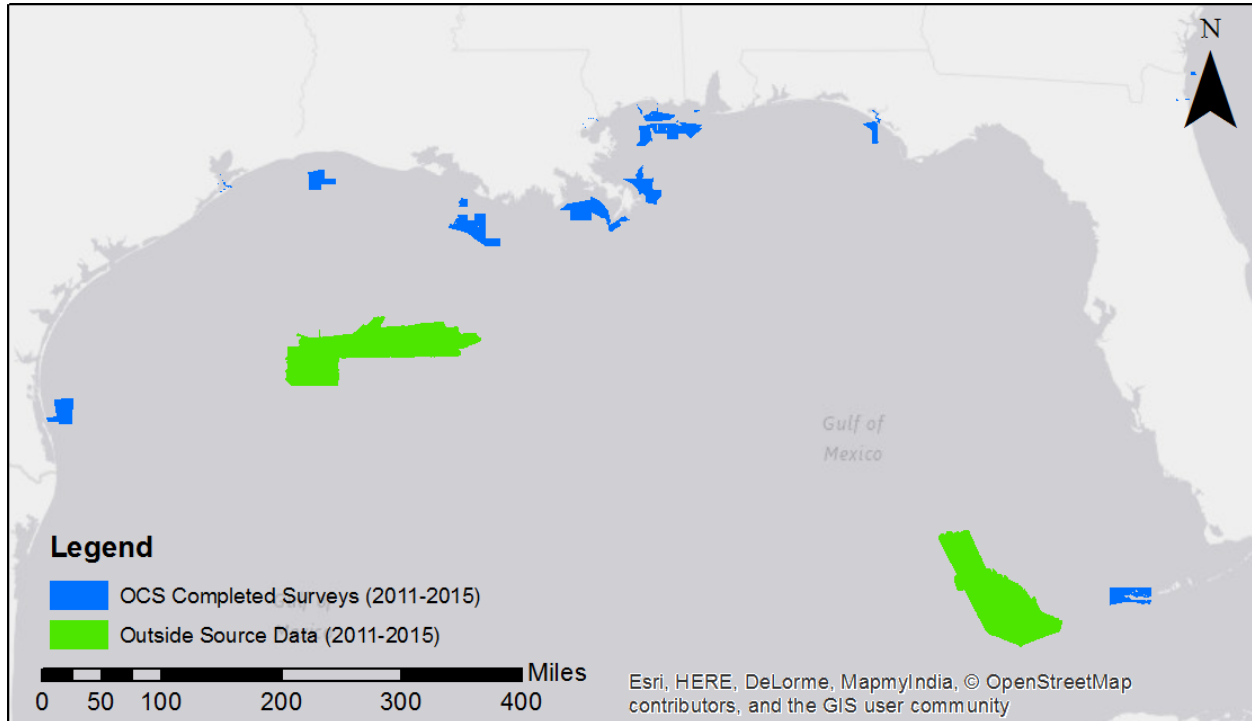
“As the 10th anniversary for Hurricanes Katrina and Rita approach, our coastal region is reminded of the need to be ever-ready for storms of every category,” said Joan Finley, district director for Rep. Boustany. “Our office appreciates the working relationship we have with NOAA, is reassured by the expertise of those working for NOAA, and is always available to provide assistance to ensure NOAA carries out its mission.”



*Public preparedness meeting at Port Morgan City, Louisiana*

## Survey operations in the Gulf of Mexico over the last five years

NOAA has issued 18 task orders to contractors for Gulf of Mexico hydrographic survey projects over the past five years (2011-2015). Usually, NOAA contractors have one or more task orders per year. Total awards for these task orders exceeded \$54,000,000. In total, contractors and NOAA vessels mapped over 2,600 square nautical miles (SNM) in the Gulf for charting. In addition, over 6,000 SNM of external data sources were assessed for charting.



Hydrographic surveys conducted by NOAA's Office of Coast Survey between 2011-2015 in the Gulf of Mexico (blue), in addition to outside data sources that were evaluated and applied to the chart (green).

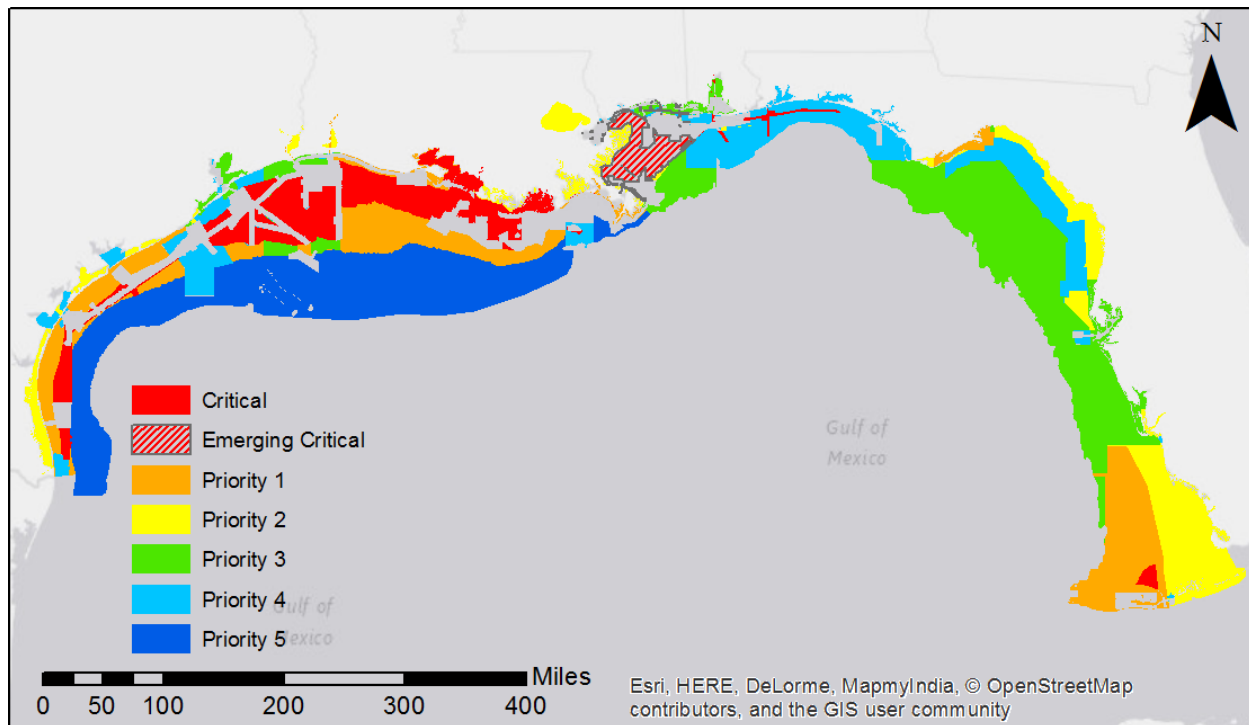
## Coast Survey Gulf-region survey priorities

Last published in 2012, the *NOAA Hydrographic Survey Priorities* (NHSP) document partitioned all U.S. waters based on the need for the acquisition of modern bathymetric coverage. Each partition was then assigned a survey priority rating from "critical" (most important) to "priority 5" (least important), based on the water depth, anticipated vessel traffic, and age/quality of the existing hydrographic holdings. A depiction of the remaining survey areas, based upon the 2012 edition of the NHSP, is shown in the figure below.

A full description of the NHSP is at [nauticalcharts.noaa.gov/hsd/NHSP.htm](http://nauticalcharts.noaa.gov/hsd/NHSP.htm).

The 2012 NHSP is a direct descendent of the original 1994 NHSP; as such, the document does not reflect modern knowledge regarding vessel traffic patterns and change in port usage from the past two decades. Further, the original NHSP did not meaningfully address the dynamics of the seafloor and the potential need for resurveying. The Office of Coast Survey is presently developing a new survey prioritization model based on a thorough risk analysis of all U.S. waters, which will incorporate, among many factors, modern vessel and port

usage data sets. Coast Survey will implement this risk-based model throughout 2016.



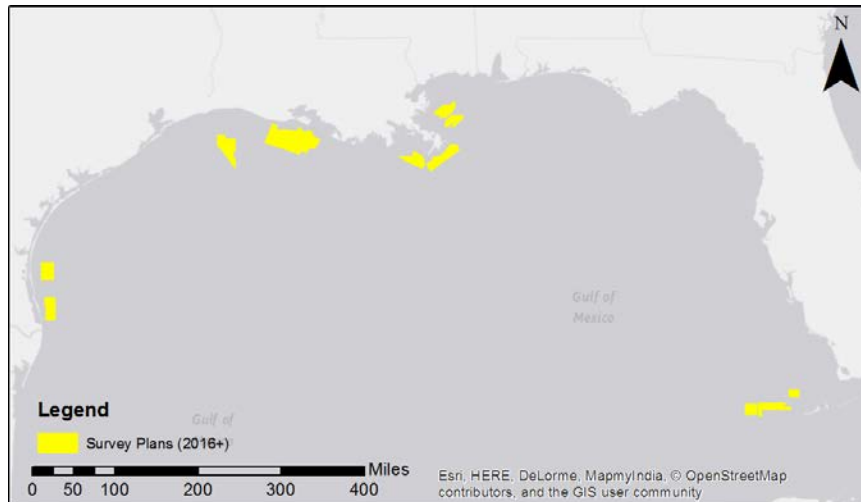
*Outstanding hydrographic survey priorities based upon the 2012 edition of the NHSP*

Area remaining of various categories of the 2012 NOAA Hydrographic Survey Priorities (in addition to the areas addressed in the past 5 years) within Gulf of Mexico:

- Critical – 7,225 SNM remaining (1,080 SNM addressed since 2011)
- Priority 1 – 10,601 SNM remaining (560 SNM addressed since 2011)
- Priority 2 – 7,960 SNM remaining (90 SNM addressed since 2011)
- Priority 3 – 14,270 SNM remaining (90 SNM addressed since 2011)
- Priority 4 – 8,506 SNM remaining (110 SNM addressed since 2011)
- Priority 5 – 14,279 SNM remaining (70 SNM addressed since 2011)
- TOTAL – 62,841 SNM remaining (2,010 SNM addressed since 2011)

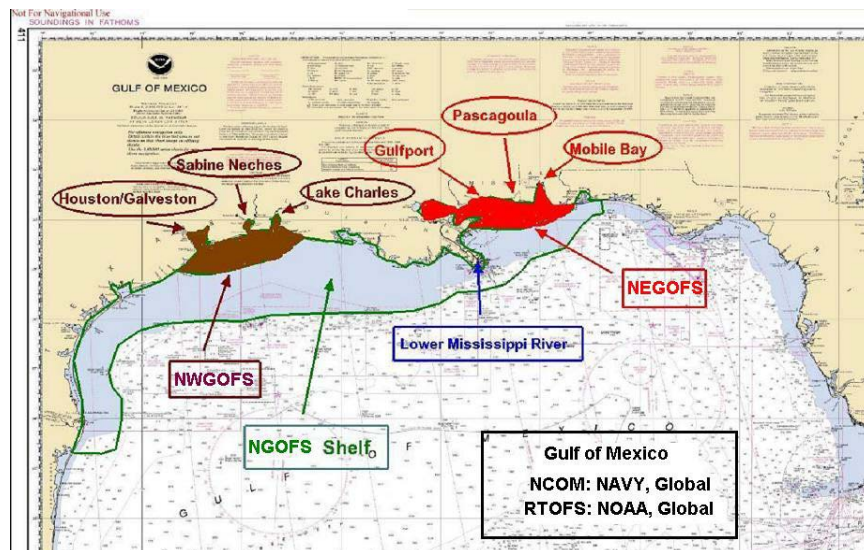
### **Survey plans for the near future in the Gulf region**

Over the next few years, approximately 3,500 SNM of surveys are tentatively planned for the Gulf of Mexico. The survey areas, shown below, are presently focused on regions previously identified as high priority by the 2012 edition of the NHSP; however, (as discussed in the previous section) these areas will be iteratively updated in 2016 as we implement the refined risk-based model for establishing survey priorities. The surveys will be a combination of either 200% side scan sonar in regions of critical underkeel clearance, or 100% side scan sonar surveys where there is a relaxed requirement for feature detection. These plans do not reflect emerging storm response work.



*Preliminary hydrographic survey plans of NOAA's Office of Coast Survey in the Gulf of Mexico.*

## Implementation of Northern Gulf of Mexico Operational Forecast System (NGOFS) Upgrades

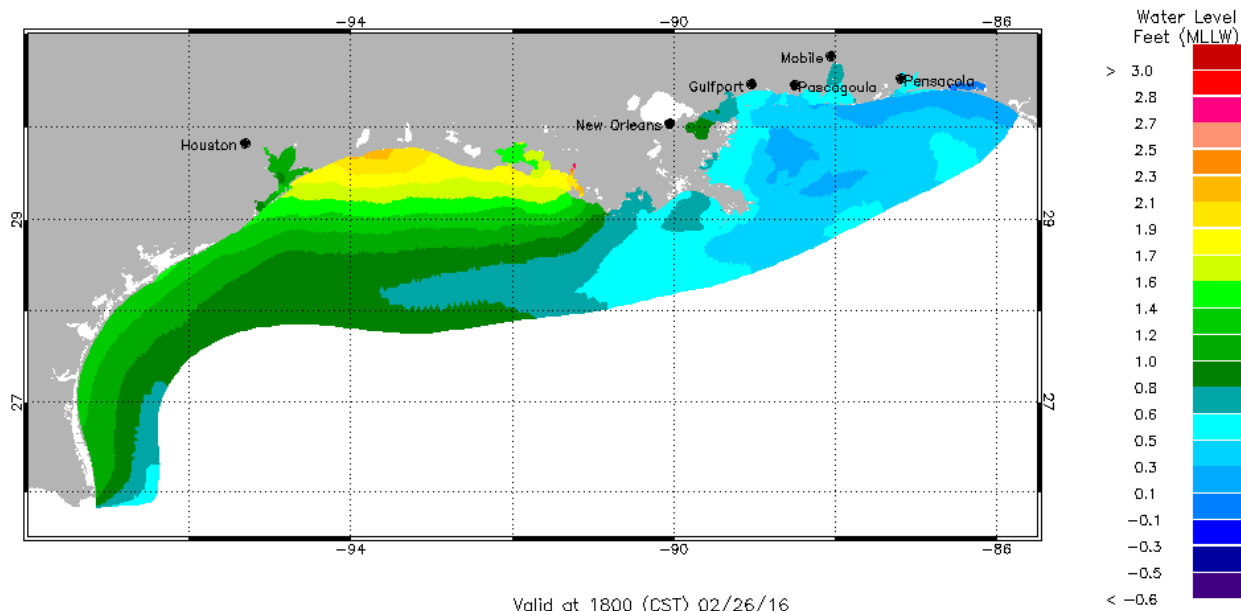


*NGOFS domain with high resolution NWGOFS and NEGOFs Nests*

Coast Survey has developed a series of high-resolution operational forecast systems (OFS) that provide two-day water level, current, temperature and salinity forecast guidance in northern Gulf coastal waters for marine navigation, emergency response and for ecological applications. Coast Survey develops and tests OFS models to ensure they are accurate and robust, and then delivers them to the Center for Operational Oceanographic Products and Services (CO-OPS) for operational application. Output and products from all OFS models are delivered routinely from CO-OPS' webpages, such as plots and graphics that are automatically updated. Coast Survey delivered NGOFS to CO-OPS to provide forecasts as time series at important points such as CO-OPS water level stations, as well as full field 3-D gridded forecasts over the entire shelf area from South St. Padre Island, Texas, to Panama City, Florida.

The NGOFS updates water level, current, temperature and salinity nowcast and forecast guidance four times per

day (every six hours). The forecast guidance is provided for 48 hours into the future. Animation maps of northern Gulf of Mexico as well as time series at particular stations or points of interest are available for 93 locations for surface winds, water levels, currents, temperature, and salinity. NGOFS covers CO-OPS PORTS® systems in Houston/Galveston, Sabine Neches, Lake Charles, Morgan City, Port Fourchon, Pascagoula, and Mobile Bay. Two high-resolution subgrid nests were implemented in NGOFS during 2014: the Northwest and Northeast Gulf of Mexico Operational Forecast Systems. They provide improved forecast guidance for important ports in the region: Lake Charles, Sabine Neches, Houston/Galveston Bay, Mobile Bay, Pascagoula and Morgan City.



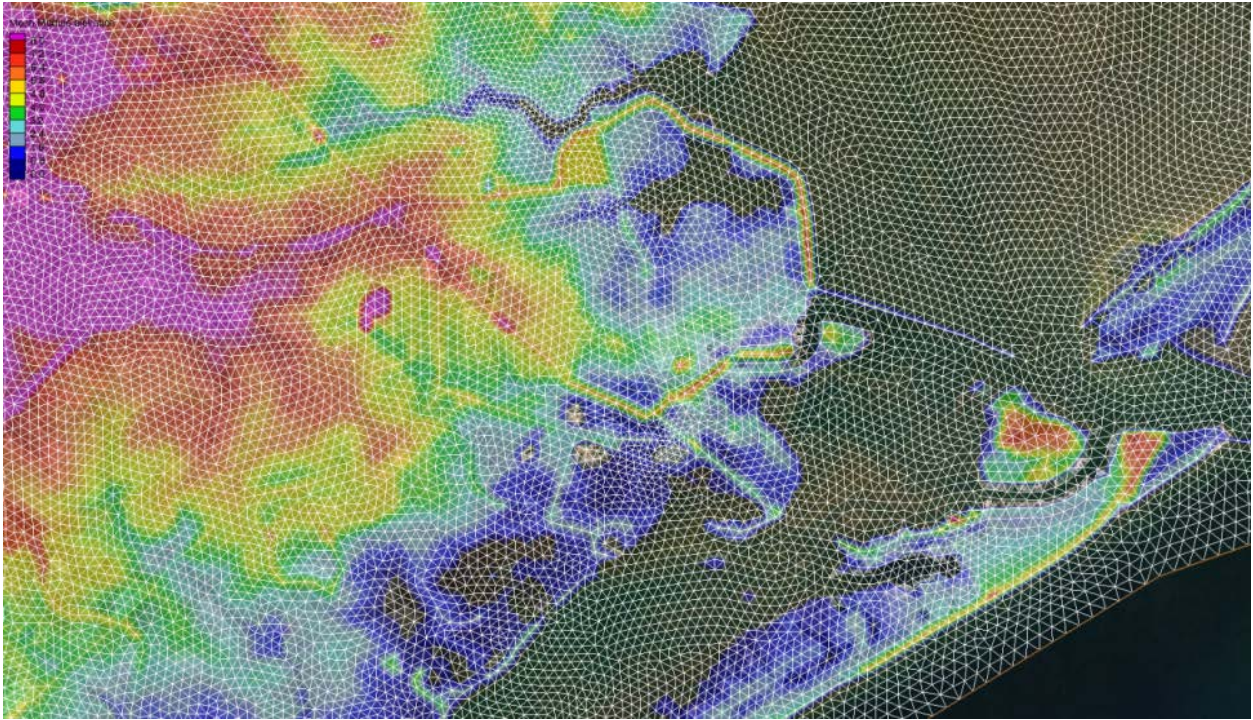
[tidesandcurrents.noaa.gov/ofs/ngofs/ngofs.html](http://tidesandcurrents.noaa.gov/ofs/ngofs/ngofs.html)

## Hurricane Surge on-Demand Forecast System

The Office of Coast Survey is developing a new hurricane storm surge model to support assessments of hurricane flooding conditions. The Hurricane Surge On-Demand Forecast System (HSOFS) is a complex and advanced storm surge model that is run on-demand as a storm makes landfall. The new model will produce more accurate flooding assessment for storm response and recovery. Coast Survey is using the advanced circulation (ADCIRC) coastal ocean model for HSOFS.

HSOFS simulates hurricanes as they track across the western Atlantic Ocean and Gulf of Mexico, and covers the coast from Texas to Maine, including Puerto Rico and the U.S. Virgin Islands. HSOFS has been validated by simulating significant historical storm surge events, such as 2005's Hurricane Katrina and 2008's Hurricane Ike, which had a severe impact across the Gulf coastline.

The HSOFS will be installed on NOAA's Weather and Climate Operational Supercomputing System ahead of the 2016 hurricane season.



*HSOFS Model Domain near Galveston, TX*

# Center for Operational Oceanographic Products & Services (CO- OPS)

## Personnel & Products in the Gulf Region

### CO-OPS Mobile, Alabama field office

CO-OPS maintains a field office in Mobile, located at the NOAA Disaster Response Center. The field office is responsible for maintenance and oversight of water level gauges located in the Gulf region. The field office was opened in 2014.

### National Water Level Observation Network

CO-OPS operates and maintains the National Water Level Observation Network (NWLON), which is a network of 210 continuously operating water-level stations throughout the U.S., including its island possessions and territories. Additionally, NWLON is the foundation for reference stations supporting NOAA's tide prediction products, and serves as control stations in determining tidal datum for all short-term water-level station. NWLON provides relative sea level trends and is capable of producing real-time data for storm surge warnings. NWLON data-collection platforms collect meteorological data in addition to water level data.

Currently, there are 31 NWLON stations in the Gulf from Naples, Florida, to Port Isabel, Texas. Since the evolution of NWLON's data collection capability, several water level data applications have emerged. For instance, the NWLON is a key part of the NOAA Tsunami Warning System and the NOAA Storm Surge Warning System. NWLON stations support PORTS in major ports and harbors. [tidesandcurrents.noaa.gov](http://tidesandcurrents.noaa.gov)

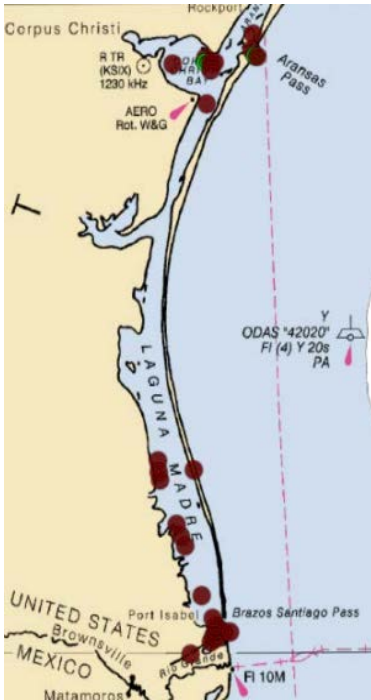
NOS operates the following NWLON in the Gulf of Mexico:

- Ten in western Florida, located at Key West, Naples, Fort Myers, St. Petersburg, Clearwater Beach, Cedar Key, Apalachicola, Panama City, Panama City Beach, and Pensacola
- Two in Alabama, located at Dauphin Island and Mobile State Docks
- Two in Mississippi, located at Pascagoula NOAA Lab and Bay Waveland Yacht Club. These stations were strengthened to deliver real-time storm tide data during severe coastal events.
- Ten in Louisiana, located at Pilots Station East, SW Pass; Shell Beach, Lake Borgne; Grand Isle; USCG New Canal Station; West Bank, Bayou Gauche; Berwick; LAWMA, Amerada Pass; Freshwater Canal Locks; Lake Charles; and Calcasieu Pass
- Seven in Texas, located at Sabine Pass, Galveston Bay Entrance (North Jetty), Galveston Pier 21, USCG Freeport, Rockport, Corpus Christi, and Port Isabel



## National Current Observation Program

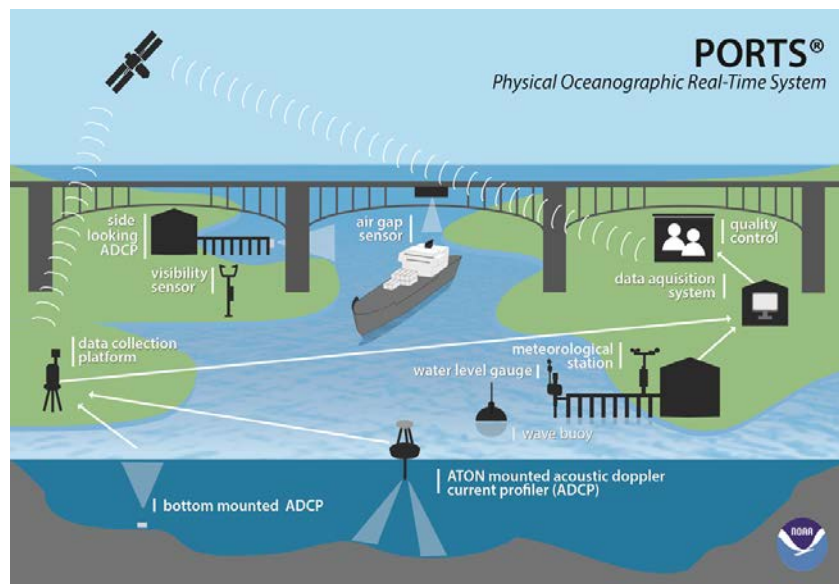
### *South Texas Current Survey*



CO-OPS intends to conduct a current survey of the inside waters of the southern Texas coast, from about Aransas Pass to Brazos Santiago Pass including the waters of Corpus Christi Bay and Laguna Madre in Spring-Summer 2017. The 20 planned stations will be predominantly inside or adjacent to navigational channels. Each station will be deployed for a minimum of 35 calendar days. Reference station(s) will be deployed for a minimum of 70 days. Data will be collected every six minutes and will vertically profile most of the water column. Data will be analyzed for the tidal components from which tidal current predictions are derived. This project will be used to create or update predictions found in NOAA's Tidal Current Tables, online at [tidesandcurrents.noaa.gov/noaacurrents/Regions](http://tidesandcurrents.noaa.gov/noaacurrents/Regions).

## 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 25 PORTS, nine of which are in the Gulf of Mexico.



### ***Tampa Bay PORTS®***

Real-time data are quality-controlled and disseminated to local users for safe and efficient navigation and include available for water level from four stations, currents from three stations, and meteorological data from eight locations. This PORTS also has incorporated visibility and a wave buoy. Tampa PORTS was the first PORTS and was developed because a catastrophic accident on the Sunshine Skyway Bridge in 1980, when a tanker collided with one of the bridge spans and it collapsed. It was determined that currents drove the tanker into the bridge and that if the captain of the tanker had access to real-time current information, the accident could have been avoided. [tidesandcurrents.noaa.gov/ports/index.shtml?port=tb](https://tidesandcurrents.noaa.gov/ports/index.shtml?port=tb)

### ***Mobile Bay PORTS®***

Real-time data are available for water levels data from six stations, currents from three stations and meteorological from five stations. The PORTS program integrated visibility sensors at Mobile Bay to help guide users in navigation-related decisions. The first PORTS visibility sensor was installed at Pinto Island, Alabama. A second sensor was installed at Middle Bay Port and completes the effort to equip the PORTS with visibility sensors and to integrate the new data type into CO-OPS systems. Visibility data in the Mobile Bay are critical, as the bay is susceptible to heavy fog beginning in the fall at the upper end of the bay and lasting into the winter months where the middle of the bay is especially affected. [tidesandcurrents.noaa.gov/ports/index.shtml?port=mb](https://tidesandcurrents.noaa.gov/ports/index.shtml?port=mb)

### ***Pascagoula PORTS®***

Real-time data are available for water levels data from two stations, currents from three stations and meteorological from three stations. [tidesandcurrents.noaa.gov/ports/index.shtml?port=ps](https://tidesandcurrents.noaa.gov/ports/index.shtml?port=ps)

### ***Lower Mississippi River PORTS®***

Real-time data are available for water levels at three station, currents from two stations, air gap data from two stations, and meteorological data from two stations. [tidesandcurrents.noaa.gov/ports/index.shtml?port=lm](https://tidesandcurrents.noaa.gov/ports/index.shtml?port=lm)

### ***Lake Charles PORTS®***

Real-time data are available for water level from three stations, for currents from three stations, for meteorological data from one location and an air gap system. [tidesandcurrents.noaa.gov/ports/index.shtml?port=lc](https://tidesandcurrents.noaa.gov/ports/index.shtml?port=lc)

### ***Port Fourchon PORTS®***

A Physical Oceanographic Real-Time System is operated cooperatively with Port Fourchon along the Gulf Coast where real-time data are quality-controlled and disseminated to local users for safe and efficient navigation. Real-time data are available for one water level for this PORTS. [tidesandcurrents.noaa.gov/ports/index.html?port=pf](https://tidesandcurrents.noaa.gov/ports/index.html?port=pf)

### ***Morgan City PORTS®***

A Physical Oceanographic Real-Time System (PORTS®) is operated cooperatively with the Port of Morgan City at the entrance and along the Atchafalaya River where real-time data are quality-controlled and disseminated to local users for safe and efficient navigation. Real-time data are available for water levels at three stations with meteorological sensors, currents from one station and salinity and relative humidity data at one location. [tidesandcurrents.noaa.gov/ports/index.html?port=mc](https://tidesandcurrents.noaa.gov/ports/index.html?port=mc)

### ***Sabine Neches PORTS®***

Real-time data are available for water level from two stations, for currents from six stations, for meteorological data from one location. [tidesandcurrents.noaa.gov/ports/index.shtml?port=sn](http://tidesandcurrents.noaa.gov/ports/index.shtml?port=sn)

### ***Houston/Galveston PORTS®***

Real-time data are available for water level from four stations, for currents from two stations, for meteorological data from four locations and for conductivity at two locations.

[tidesandcurrents.noaa.gov/ports/index.shtml?port=hg](http://tidesandcurrents.noaa.gov/ports/index.shtml?port=hg)

*NOTE: Gulfport PORTS® is no longer operational due to a lack of local funding.*

## **Partnerships**



### **Hydrographic and Shoreline Mapping Support**

Data collected by the NWLON support hydrographic and shoreline mapping activities. CO-OPS provides tidal zoning reports to Coast Survey and NGS. Both offices use the updated tidal zoning data for accurate tidal control in hydrographic surveys and shoreline mapping surveys. CO-OPS will provide support to Coast Survey in the following project areas in 2015-2016: Galveston Bay and vicinity; Sabine Pass (two projects); Mobile Bay; and Louisiana coast (offshore of LAWMA). CO-OPS will support NGS in the following areas for 2015-2016: St. Andrew Bay; Apalachicola Bay; Biscayne Bay; Cote Blanche Bay; Port Aransas; Matagorda Bay; Galveston Island; East Bay; Beaumont; Orange; Sabine Pass and Port Arthur.

### **Texas Coastal Ocean Observation Network (TCOON)**

The Texas Coastal Ocean Observation Network (TCOON), a network operated to NOAA standards that was begun in 1988 and numbers about 30 stations today, supplements NWLON in Texas. TCOON is supported by the Texas General Land Office, the Texas Water Development Board, and the U.S. Army Corps of Engineers, and is the nation's largest state/regional network of tide gauges operated to NOAA standards. CO-OPS has been a collaborating partner with TCOON, providing the standards and technical expertise needed to establish and operate TCOON to NOAA standards. CO-OPS has recently assumed a more active role by agreeing to operate TCOON for the supporting partners on a reimbursable basis.

## **Sentinel of the Coast Observing Systems**

Two Sentinels using NOAA design standards replaced TCOON water level stations in Texas that were destroyed or heavily damaged by Hurricane Ike in 2008. Elevated atop substantial single pile platforms, these stations are designed to withstand Category 4 hurricanes. Sentinels ensure data is available when most needed, i.e. storm surge from a hurricane is threatening our coastline and their communities. CO-OPS partnered with Texas A&M Division of Nearshore Research and the U.S. Corps of Engineers to establish these new Sentinels. These Sentinels are located off Houston-Galveston Bay and Sabine Pass.

More recently, the Texas General Land Office received a grant from the Coastal Impact Assistance Program (CIAP) to expand the Texas Coastal Ocean Observing Network through the addition of four new Sentinels at Freeport, the Matagorda Ship Channel, Port Aransas and South Padre Island, bringing the total number to six Sentinels off the coast of Texas, and ten in the Gulf.

### **Mobile Bay Storm Surge Monitoring Network**

CO-OPS partnered with Mobile County Commission, the Alabama Department of Transportation, and the National Weather Service to install five microwave sensors at various locations throughout Mobile Bay. This was the first time NOAA used this type of sensor, which withstands heavy storm- water levels while providing real-time storm surge data to Mobile County’s emergency managers, weather forecast offices, and others. Hurricane Isaac marked the first event captured by the network, providing information to emergency managers on the magnitude of flooding in the county, where water levels rose 3-4 feet above normal tide levels in many locations, from both storm surge and rain, causing substantial flooding in low-lying areas.



### **Support for NOAA's National Estuarine Research Reserves**

CO-OPS operates a water level station at the Weeks Bay National Estuarine Research Reserve, and partners with the Grand Bay National Estuarine Research Reserve to provide technical assistance in operation of a tide gauge. These gauges assist with monitoring both coastal hazards and climate change impacts on coastal ecosystems to help inform management action at NOAA Trust Resources and adjacent communities.

### **Recent Activities**

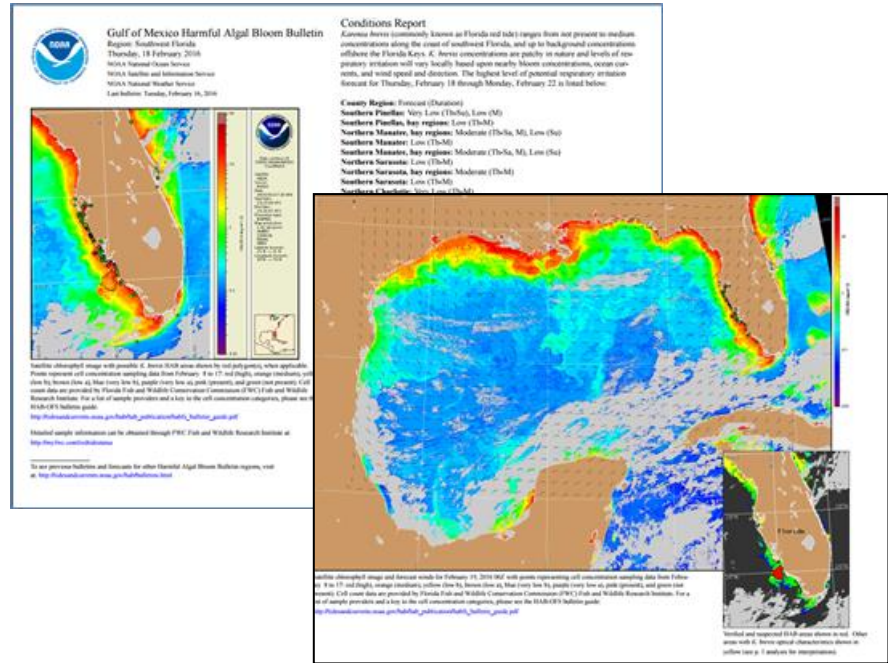
#### **Installation of I I-10 Bonnet Carre Floodway, LA - Station ID: 8762483**

This station was installed in partnership with the National Weather Service Southern Region and Slidell WFO. CO-OPS installed a new water level monitoring station and reestablished a meteorological station at Frenier Landing. This station went online in April 2015 and supports storm surge monitoring and other real-time monitoring requirements.

## Harmful Algal Bloom Forecasting

Advance warning of harmful algal blooms (HABs, commonly called “red tide”) increases the options for managing impacts resulting from these events. NOAA’s Harmful Algal Bloom Operational Forecast System (HAB-OFS) provides information on the location, extent, and potential for development or movement of harmful algal blooms in the Gulf of Mexico, specifically the west coast of Florida, east coast of Florida, Florida panhandle, and Texas.

[tidesandcurrents.noaa.gov/hab/](http://tidesandcurrents.noaa.gov/hab/)



# National Geodetic Survey (NGS)

## Products, Personnel & Projects in the Gulf Region

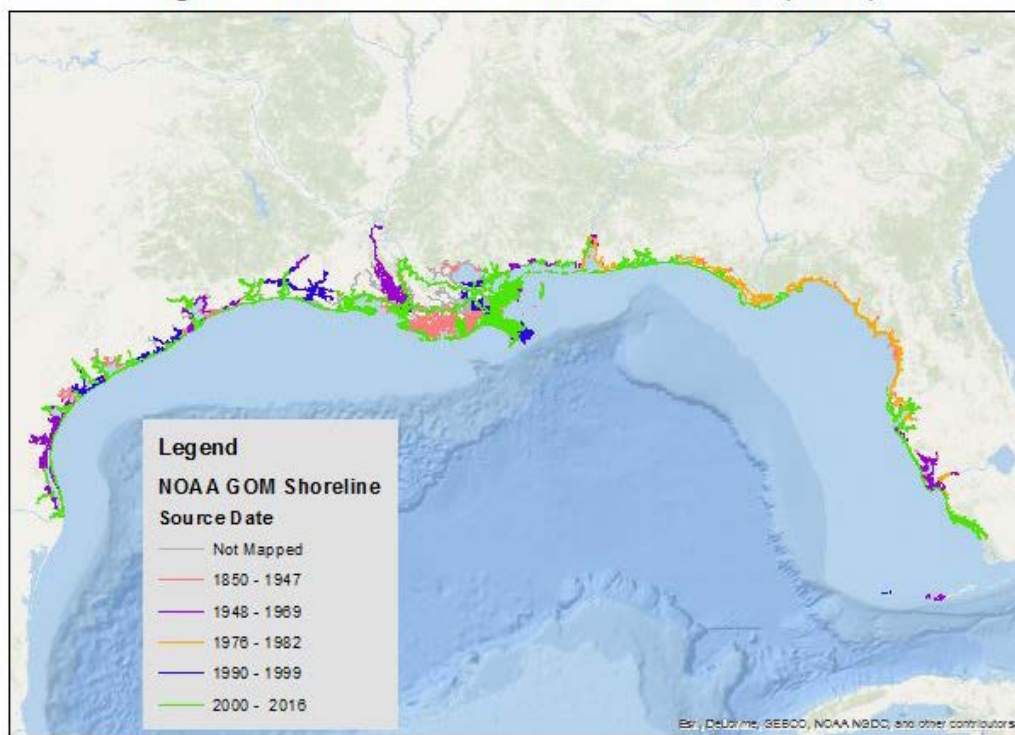
### Geodetic Advisor Program

The NGS state geodetic advisor program is a cost-sharing program that provides a liaison between NOAA and the host state, with a jointly funded NOAA employee residing in the state to guide and assist the state's geodetic and surveying programs. The program is transitioning away from state-based to a NGS-funded regional program scheduled to be fully operational on October 1, 2016.

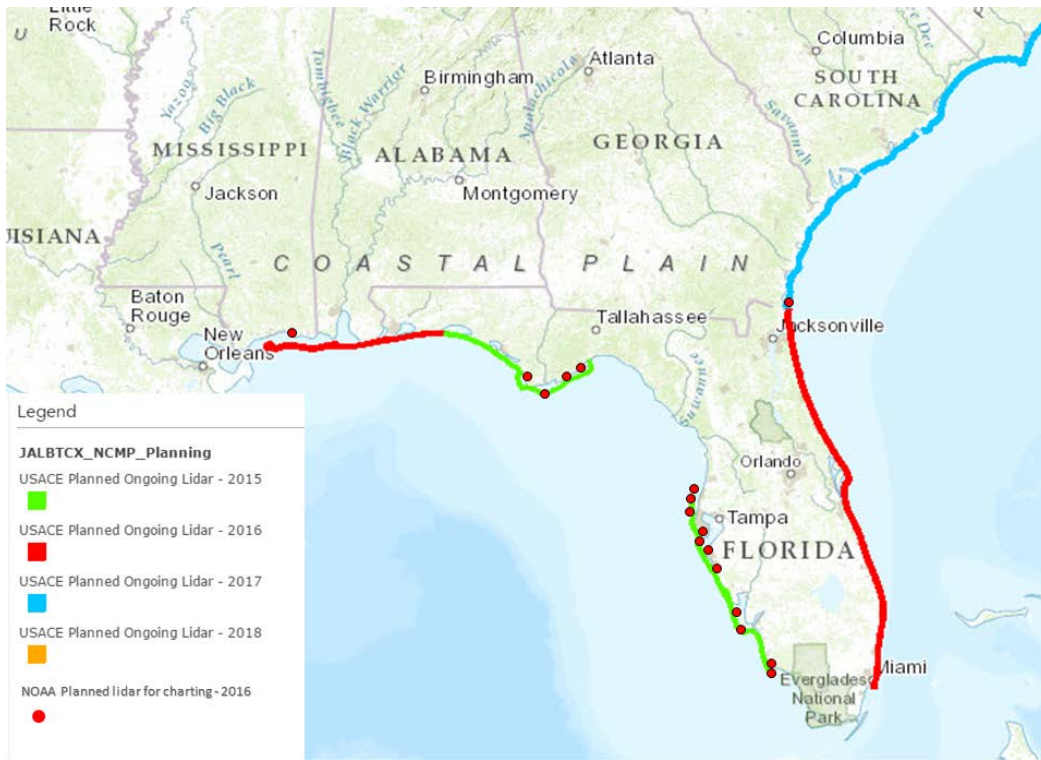
NGS has two Gulf Region advisors, in Texas and Mississippi, who are concurrently in state and regional roles. The Texas-based advisor serves Texas and Oklahoma, and the Mississippi-based advisor serves Alabama, Florida, Louisiana, and Mississippi. [geodesy.noaa.gov/ADVISORS/](http://geodesy.noaa.gov/ADVISORS/)

### Shoreline Coverage for the Gulf of Mexico

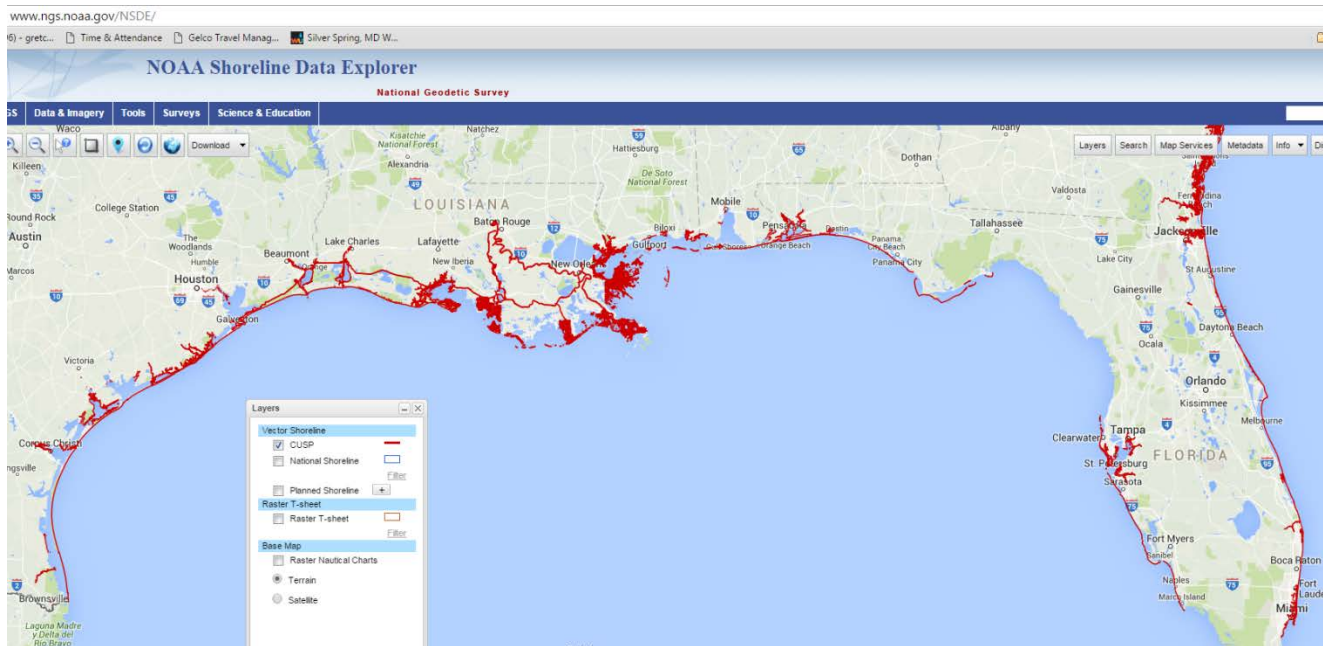
Age of NOAA Shoreline in Gulf Of Mexico (2016)



NOAA continues to map the Gulf of Mexico's ever-changing and complicated network of shoreline. JALBTCX and NOAA have been coordinating 2015-2016 lidar survey plans along the Gulf of Mexico as shown in the image below. NOAA will acquire bathymetric lidar data in discrete areas of the west coast of Florida to meet NOAA's charting requirements where additional information is needed.



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 has been designed to deliver continuous shoreline with frequent updates. The image below shows the available CUSP data for the Gulf of Mexico region.



## **Baseline Oblique Imagery**

NGS collects baseline oblique imagery that provides a geo-referenced GIS ready dataset to assess coastal change and quickly assess impacts from events both natural and manmade. In 2015, NGS collected 24,387 images over 106 days, covering over 90,000 miles of the U.S. coastline including large portions of the Gulf of Mexico.

[ngs-storm-viewer-web-testing.azurewebsites.net/coastal/index.html](https://ngs-storm-viewer-web-testing.azurewebsites.net/coastal/index.html)

## **Emergency Response Imagery**

NGS conducts flights to collect imagery after natural (hurricane, earthquake, tsunami, flood and tornado) and man-made (oil spill) disasters.

- To support Homeland Security and FEMA requirements
- High resolution, geo-referenced airborne imagery using NOAA aircraft that supports NGS' Coastal Mapping Program
- NGS posts images on the web, often within hours, to make these images available to the general public
- Imagery is used to determine impacts to NOAA as well as federal, state, local, and public interests

NGS has been called on to collect imagery following many different types of disasters, including the 2016 flooding in the Midwest, 2015 flooding on the East Coast due to a nor'easter and hurricane Joaquin, and all major hurricanes since 2003. Those in charge of response and restoration can use the imagery to 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. The oblique imagery data set provides an accurate snapshot of what the "normal" shoreline and its associated infrastructure look like prior to an event, making it easier to assess the extent of damage cause from a single event. [storms.ngs.noaa.gov/eri\\_page/index.html](https://storms.ngs.noaa.gov/eri_page/index.html)

### ***Gulf of Mexico Emergency Response Imagery***

The Midwest floods response: [storms.ngs.noaa.gov/storms/dec2015\\_midwestflood/index.html](https://storms.ngs.noaa.gov/storms/dec2015_midwestflood/index.html)

## **VDatum**

In 2010, NGS, CO-OPS and Coast Survey made available the first edition of NOAA's Vertical Datum Transformation (VDatum) tool for the entire contiguous United States. This online tool enables users to seamlessly transform geospatial data – based on different vertical reference systems – into one uniform surface or "datum."

Transforming data to a single vertical datum removes the most serious impediments to data sharing and is necessary to harmonize the differences between the vertical reference systems of land- and water-based spatial data.

VDatum is a free software tool jointly developed by NGS, CO-OPS and Coast Survey. It was first introduced to support a seamless bathymetric-topographic digital elevation model (DEM) for Florida's Tampa Bay region.



The DEM that resulted from the VDatum demonstration project has not only solved the problem of inconsistency among diverse datasets that causes difficulty in mapping coastal regions, but also provides standard geospatial data for multiple applications, such as inundation modeling, monitoring sea level change impacts, coastal management, and more. [vdatum.noaa.gov/](http://vdatum.noaa.gov/)

### ***VDatum Grid Updates for Gulf of Mexico***

We continue to collect geodetic and tidal data in the Gulf of Mexico, to update the VDatum model grid. At the end of 2018, we will begin GPS observations on our tidal benchmark campaign, and will begin foundational tidal data collection in 2019. Model development will begin in 2022 following the foundational geodetic and tidal data collection campaigns. By 2023, we expect to release an updated Gulf Coast model.

In addition to the Gulf of Mexico, we will release the following updated models:

- San Francisco Bay in 2016
- NY Bight/Long Island Sound in early FY18
- West Coast in FY19

### **New National Datums Planned for Release in 2022**

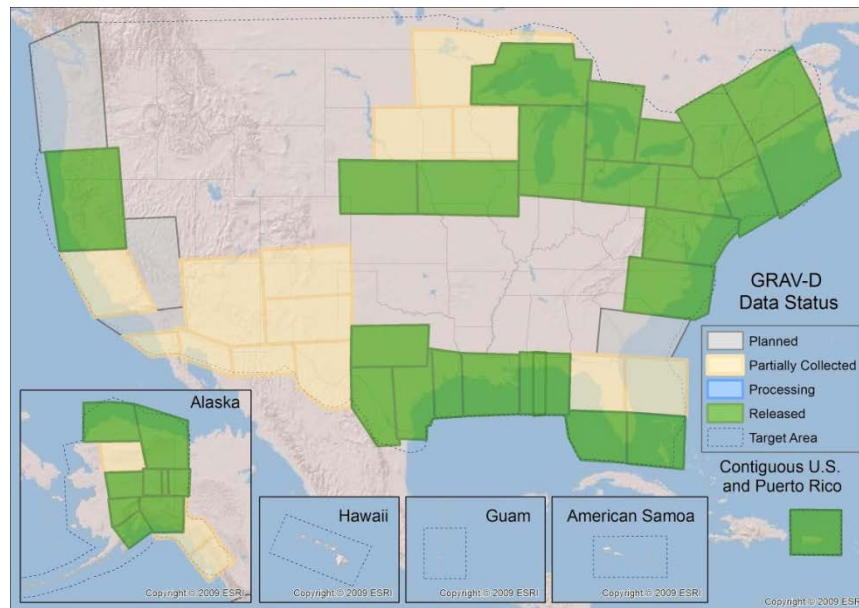
Congress (Coast and Geodetic Survey Act) requires National Geodetic Survey to maintain the national spatial reference system, which defines latitude, longitude, height, scale, gravity, and orientation throughout the U.S. Over time, systematic errors have accumulated in that reference system. To significantly improve that system and the quality of the data it produces, NGS plans to replace three fundamental system components in 2022:

- NAVD 88 - North American Vertical Datum of 1988: A new vertical datum realized through a combination of GNSS technology and gravity field modeling
- IGLD 85 – International Great Lakes Datum of 1985: A new dynamic height datum realized through a combination of GNSS technology and gravity field modeling
- NAD 83 - North American Datum of 1983: A new geometric datum fixed to Earth’s center of mass that accounts for motion in the Earth’s crust

As each of these three datums will be defined and realized through GNSS technology, the distinction between “vertical datum” and “geometric datum” will become unnecessary, with all of geodetic coordinates available in a single unified datum.

### **GRAV-D: Ongoing Project to Support the New Vertical Datum**

The data required for gravity field modeling is being collected under a project that is called Gravity for the Redefinition of the American Vertical Datum, or GRAV-D. The goal of this project is to update the American vertical datum by 2022.



*GRAV-D status update, as of February 3, 2016*

GRAV-D project consists of two main campaigns:

- a high-resolution “snapshot” of gravity in the U.S. This predominantly airborne campaign started in 2007, and is over 48% complete as of January 2016. [www.geodesy.noaa.gov/GRAV-D/data\\_products.shtml](http://www.geodesy.noaa.gov/GRAV-D/data_products.shtml)
- A low-resolution “movie” of gravity changes. This is primarily a terrestrial campaign to make repeated absolute gravity measurements in the same locations over time.

GRAV-D has collected airborne gravity data for most of the Gulf Coast and the final area in northern Florida is likely to be completed 2016. These data will be important for many applications, including inundation modeling, ecosystem modeling, coastal management, hydrographic surveys, and shoreline extraction from LIDAR. While the final geoid model will not be released until 2022, having continuous airborne gravity data through the Gulf Coast and soon connecting to the East Coast improves the accuracy of the experimental models that are released annually prior to 2022.

## **New Geoid Model Serves Surveying, Engineering, and Scientific Communities**

In 2012, NGS released a geoid model called GEOID12A – for the surveying, engineering, and scientific communities for whom water flow and heights above mean sea level are critically important. In 2015, NGS released a revised geoid model – GEOID12B – to correct errors in Puerto Rico and the Virgin Islands. GEOID12B is identical to GEOID12A, except for the corrections to the Puerto Rico and Virgin Island data. NGS’ geoid model is critical for transformations in NOAA’s VDatum tool to relate sea level with terrestrial elevations anywhere in the United States. Users have the ability to obtain a fast, three-dimensional, geometric solution using GPS technology and then convert the result using GEOID12B to achieve the more critical geophysical (orthometric) heights relative to sea level to determine where water will flow. By providing more accurate height measurements, GEOID12B greatly assists those involved in flood plain management, coastal and emergency management, port operations, and river/stream flow monitoring. NOAA’s new GEOID12B

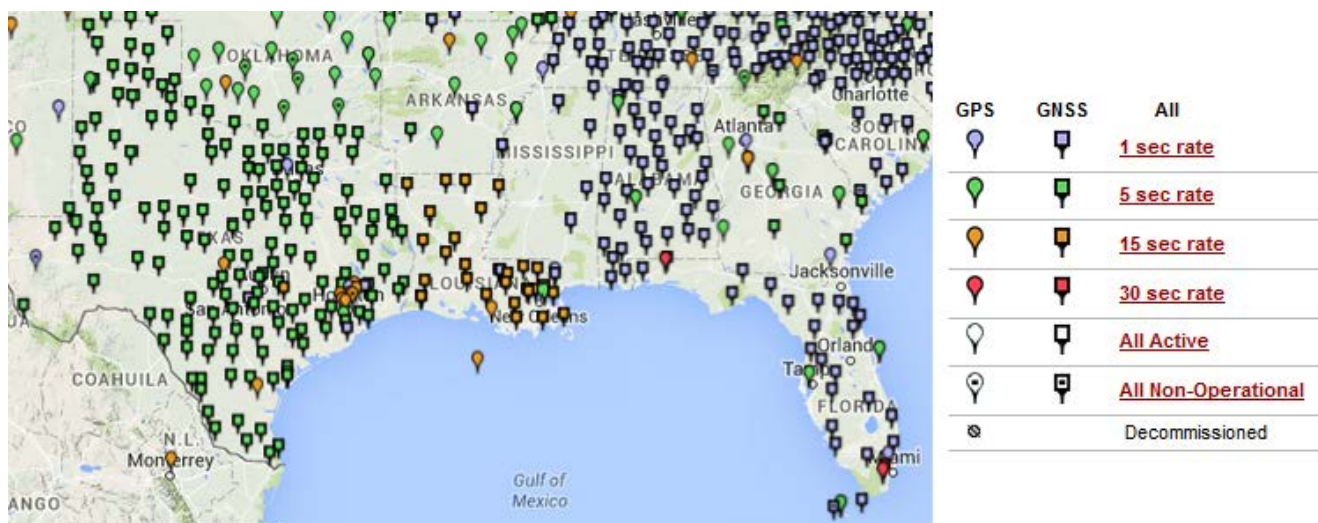
model has been implemented in GPS-manufacturer software to provide transformations to heights above the North American Vertical Datum of 1988 (NAVD 88) at the centimeter level of accuracy.

<http://www.ngs.noaa.gov/GEOID/geophysics.shtml>

## Continuously Operating Reference Stations (CORS)

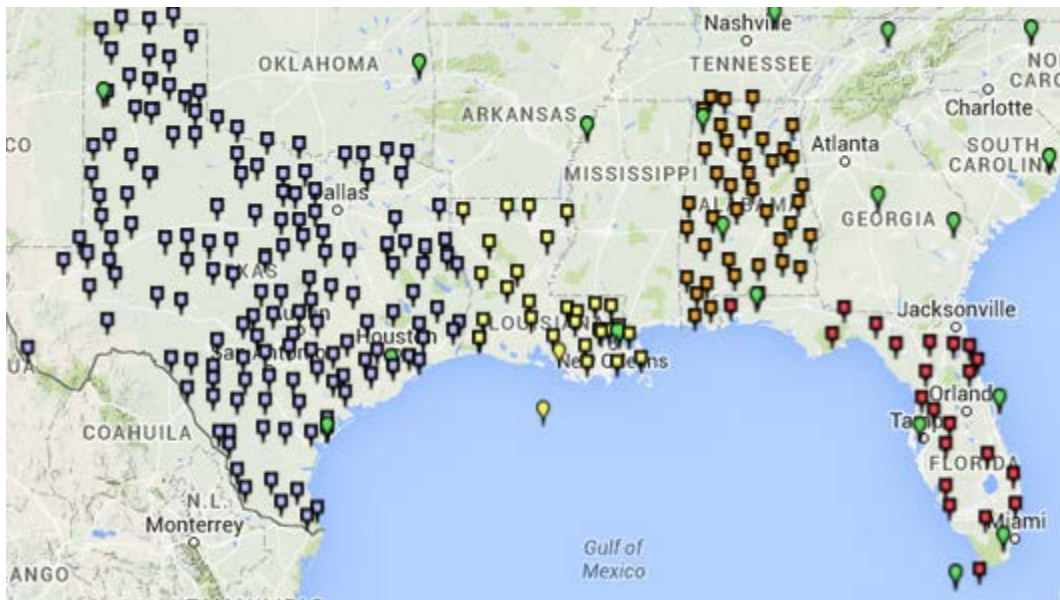
NGS manages a network of CORS that provides Global Navigation Satellite System data consisting of carrier phase and code range measurements in support of three dimensional positioning, meteorology, space weather and geophysical applications throughout the United States, its territories and a few foreign countries. The CORS network is a multi-purpose cooperative endeavor involving government, academic and private organizations. Currently, the CORS network contains over 2,000 stations. <http://www.ngs.noaa.gov/CORS/>

Each state bordering the Gulf of Mexico installed several regional CORS networks that are now included in the larger NGS CORS network.



*The location of all CORS in the Gulf region (Color-coded bubbles represent the sampling rate of the GPS/GNSS receiver at the site)*

There are five large regional CORS networks along the Gulf States. (See next image.) CORS from the Texas Department of Transportation (purple), the United States Coast Guard DGPS network (green), the Louisiana State University (yellow), the Alabama Department of Transportation (orange) and the Florida Department of Transportation (red) play a significant role in the surveying, GIS/LIS and research communities. Of particular interest along the Texas and Louisiana coasts is to use CORS to monitor subsidence and aid in estimating sea level change. Data from CORS, collected over many years, are used to better understand what geophysical phenomena takes place in these areas, especially where there is significant pumping, drilling and coastal engineering.



## National Geodetic Survey – Geospatial Modeling Grant

The University of Southern Mississippi – through the Mississippi Spatial Reference Center – leads a consortium of grant partners to enhance the National Spatial Reference System (NSRS) adjacent to the northern Coast of the Gulf of Mexico. The "Geospatial Modeling" grant includes partners from the Alabama Department of Transportation, Louisiana State University, and Texas A&M University-Corpus Christi. This project provides the foundation for geospatial modeling along that part of our nation’s coast, which provides the largest economic return on investment and which is most exposed to inundation from tropical storm surge. Specifically, this project enhances the NSRS by extending and modernizing the Continuously Operating Reference Station (CORS) network, expanding the number of CORS on tide gauges, establishing high-accuracy elevation data sets for monitoring marsh surface elevation trends, and acting as liaisons for geospatial consumers in the region. These activities result in accurate heights, which are critical for a variety of applications, such as planning evacuation routes, modeling storm surge and monitoring sea level rise.

## Recent Activities and Partners in the Gulf of Mexico

### Florida

NGS recently completed a project to assist the Apalachicola National Estuarine Research Reserve (NERR) in establishing vertical ties between reserve survey control marks and Surface Elevation Table (SET) control. Similar projects are ongoing at other Florida based NERRs. NGS continues working with the Florida Dept. of Environmental Protection Bureau of Surveying and Mapping on general geodetic leveling projects, as well as projects to make vertical ties to State tide and stream gauges. Future proposed efforts include re-leveling along the west coast of Florida from the St. Petersburg to Pensacola, leveling through existing tidal bench marks, co-location of GNSS CORS stations at tide stations, and submittal of GNSS observations on tidal bench marks to the NGS OPUS Shared Solutions database.

### Alabama

The Alabama Department of Transportation (ALDOT) is a partner of the NGS Geospatial Modeling grant. This

project provides the foundation for geospatial modeling along that part of our nation's coast, which provides the largest economic return on investment and which is most exposed to inundation from tropical storm surge. Among other activities, ALDOT contributes to the NGS Geospatial Modeling grant by performing GPS and leveling surveys at geographically sensitive areas throughout the state.

NGS has an ongoing project to assist the Weeks Bay NERR on establishing vertical ties between reserve survey control benchmarks and SET control marks. Efforts include leveling through existing tidal bench marks, co-location of GNSS CORS stations at tide stations, and submittal of GNSS observations on tidal bench marks to the NGS OPUS Shared Solutions database.

## **Mississippi**

The University of Southern Mississippi – through the Mississippi Spatial Reference Center (MSRC) – leads the NGS Geospatial Modeling grant. MSRC was established and became operational in 2007, and its mission is to provide coastal geoscience information, research, and applications that will benefit the public and private sectors of the communities we serve. Some recent accomplishments of the center include initiating remote sensing subsidence studies in LiDAR, densification of the Mississippi CORS Network, studying the accuracy of the vertical solutions obtained from RTK, and other geodetic activities. NGS is also working with the MSRC and the National Park Service in efforts to install CORS stations on two of the Mississippi barrier islands (Horn and Ship). A collaborative effort is being made between the MSRC, the Mississippi Dept. of Transportation and NGS (Advisor) to densify the number of published CORS throughout the state, improving Real-Time Network and OPUS positioning. [gcgusm.org/](http://gcgusm.org/)

## **Louisiana**

NGS is currently in the planning stages of a 2016 Southern Louisiana Control Update project. The project will update the heights of about 150 marks in the southern 27 parishes of Southern Louisiana, similar to past projects in 2004, 2006, and 2010. The project will provide update heights for the purposes of flood protection levee building and monitoring, coastal and coastal plain flood zone determination efforts by floodplain managers, and for continued marsh restoration project research. This project will include outreach efforts to involve voluntary participation by interested parties of the region (environmental research, surveying & engineering, etc.).

Louisiana State University (LSU) – through the Louisiana Spatial Reference Center (LSRC) – is a partner of the NGS Geospatial Modeling grant. LSRC is a non-profit organization affiliated with Center for GeoInformatics at LSU. The mission of the Center is to provide the necessary geodetic services to ensure the availability of accurate, consistent, and timely spatial referencing data for Louisiana. LSRC is building a statewide network of high precision Global Positioning System receivers, termed GULFNET, which will tie to the National Spatial Reference System, pinpoint the location of subsidence, and measure exactly how fast the coast is sinking. Additional activities include assisting NOAA in mapping the coastal regions of Louisiana and providing data for navigational charts; height modernization; assisting NOAA in developing specifications and guidelines for GPS surveys; and educating users about spatial referencing issues and applications.

## **Texas**

Texas A&M University - Corpus Christi (TAMUCC) – through the Texas Spatial Reference Center (TSRC) – is

a partner of the NGS Geospatial Modeling grant. The mission of TSRC is to conduct basic and applied research contributing to NGS's national Height Modernization program. TSRC is a repository for information used by researchers to develop improved understanding of elevation, geodetic and vertical datums in the state of Texas. The TSRC goal is to re-establish accurate elevations throughout Texas in cooperation with qualified geospatial scientists, professional engineers, and professional land surveyors. [tsrc.cbi.tamucc.edu/TSRC/HomePage](http://tsrc.cbi.tamucc.edu/TSRC/HomePage)