



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**

*November 2012*



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

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# NOAA Navigation Services

## Gulf of Mexico Activities Report

### I. The Gulf Region

#### *Geography and Environment*

The Gulf of Mexico is a 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.

The U.S. portion of the Gulf of Mexico region extends from the Florida Keys westward to the southern tip of Texas, following the coastline of five states. The combined coastline of these states, Alabama, Florida, Louisiana, Mississippi, and Texas totals over 47,000 miles.

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 gross domestic product (GDP) of the five states of the Gulf Coast region was almost \$2.4 trillion in 2009, representing 17 percent of the nation's GDP (Bureau of Economic Analysis, 2011). The Gulf Coast region's economy is highly intertwined with its natural resource base, including oil and gas deposits, commercial and recreational fisheries, and waterways for ports and waterborne commerce.

The Gulf Coast is home to four of the ten largest commercial ports (by volume of foreign trade cargo) in the country. The ports of New Orleans and Houston-Galveston are the country's two largest port complexes by volume, handling over 520 million metric tons of cargo in foreign trade in 2011. The region also hosts a significant portion of the U.S. oil and gas industry, with its offshore drilling platforms, refineries, and pipelines. Almost 30% of America's supply of energy comes from the Gulf of Mexico. Roughly two-thirds of all U.S. oil imports pass through the Gulf.

Population in the Gulf Coast Region has increased by 109% since 1970, compared to a 52% increase in total U.S. population.

#### *Challenges and Drivers*

The Gulf of Mexico region provides the nation with valuable energy resources, abundant seafood, extraordinary beaches and leisure activities, and a rich cultural heritage. At the same time, the Gulf of Mexico has endured incredible natural and man-made catastrophes in the last decade, including the

most costly natural disaster in U.S. history – Hurricane Katrina in 2005 – and the largest accidental marine oil spill in U.S. history – Deepwater Horizon MC252 in 2010. All the while, coastal and ocean managers in the region continue to address complex ecosystem health and water quality and quantity challenges.

The well-being of the Gulf of Mexico region depends on a suite of benefits that flow from healthy coasts: food, clean water, jobs, recreation, and protection from hurricanes. But the ability of the Gulf Coast to deliver these benefits is being eroded by the extensive environmental alterations we have made to the region’s coastal ecosystems. In some cases, these benefits are being further eroded by changes in climate. Whatever the cause, these changes threaten to compromise the health and economic well-being of our coastal communities and the benefits that the Gulf region brings to the Nation.

Along the Gulf Coast, between Houston and Mobile, an estimated 2,400 miles of major roadway and 246 miles of freight rail lines are at risk of permanent flooding within 50 to 100 years if relative sea level rises four feet. The Gulf Coast is particularly at risk to service disruptions due to the interdependent nature of a transportation network that relies on minor roads and other low-lying infrastructure. Sea level rise could potentially affect commercial transportation activity valued in the hundreds of billions of dollars annually through inundation of area roads, railroads, airports, seaports, and pipelines (U.S. Global Change Research Program, 2009).

Since 2004, federal, state, and local partners have worked to increase regional collaboration at all levels, with the goal of improving the ecological and economic health of the Gulf region. NOAA continues as a proud partner in this collaborative approach, where shared scientific strengths are matched with shared management strengths.

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.

## **II. 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 has three navigation managers and one navigation specialist in the Gulf Region*

LOCATION	Navigation Manager (Base of Operations)	Phone/Fax
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
Central Gulf Coast (Mississippi, Alabama, Louisiana, Florida Panhandle)	<b>Tim Osborn</b> tim.osborn@noaa.gov (Lafayette, LA) <b>Patrick Fink (Contractor)</b> patrick.fink@noaa.gov (Mobile, AL)	Phone: 337-291-2111 Cell: 337-254-5933 Fax: 337-291-3097  Phone: 251-438-5690 Cell: 337-501-3097 Fax: 251-438-7957
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

## Navigation Response Teams

Coast Survey's highly mobile navigation response teams speed the resumption of shipping after storms, and help protect life and property from underwater dangers to navigation. When they are not [responding to emergencies](#), the teams respond to the needs of the maritime economy by conducting hydrographic surveys for critical chart updates for 175 major ports within the U.S. marine transportation system.

### Keeping mariners safe and commerce flowing

Coast Survey deploys six teams to conduct long-term hydrographic projects in critical maritime areas. While surveying, the teams remain available to respond to emergencies anywhere on the nation's coasts.

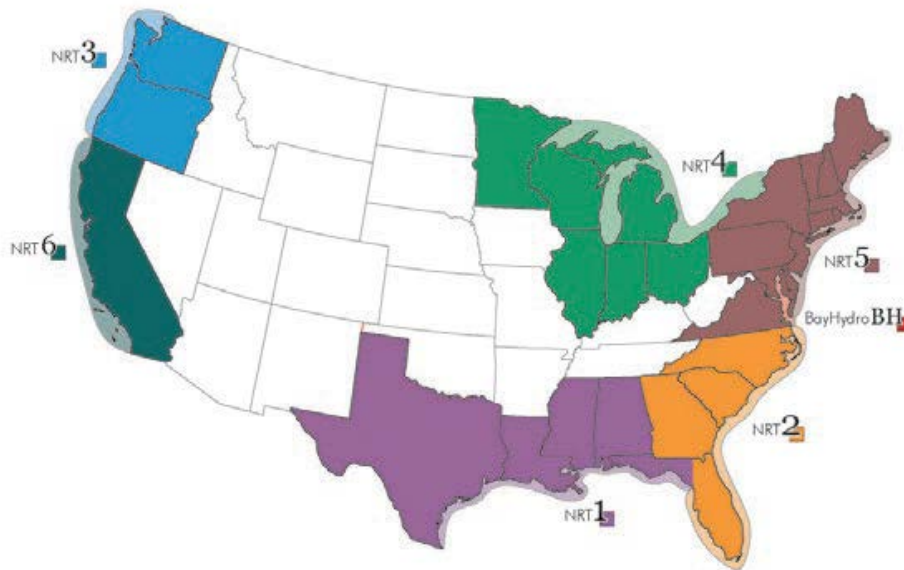
Working with NOAA's [regional navigation managers](#), the teams re-measure the depths of changing seafloors and search for underwater dangers to navigation that could slow down or halt ocean shipping. They provide time-sensitive information to the U.S. Coast Guard or port officials, and transmit data to NOAA cartographers for updating Coast Survey's suite of navigational charts.

These hydrographic field units are equipped with trailer-able survey launches. The teams use state of the art hydrographic equipment to gather photograph-like imagery of the entire sea floor. All teams have side-scan sonar and several teams have multibeam sonar to generate three-dimensional views of what lies below the surface.

## Initiating a NOAA navigation response

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 regional navigation managers to identify mission objectives and define the deliverable products.

Coast Survey NRT1 is located in the Gulf of Mexico region and, in 2012, NRT4 deployed to the Texas coast for a year of surveying.



## Chart Coverage – Gulf Region

Coast Survey electronic navigational charts (NOAA ENC®) provide complete coverage in the Gulf of Mexico.

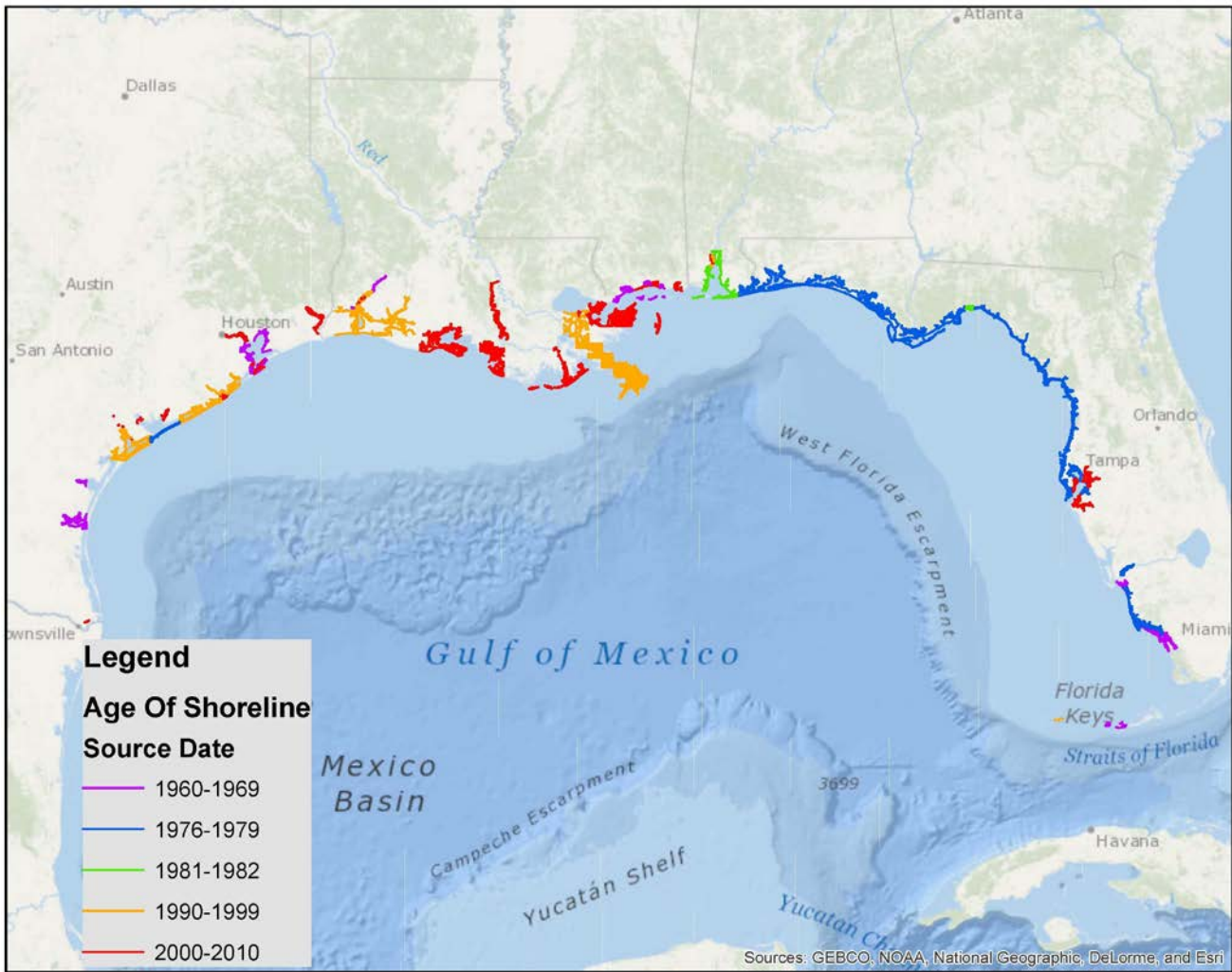
- **Texas:** Charts 11300 – 11343 cover the Texas coast.
- **Louisiana:** Charts 11344 – 11370 cover the state of Louisiana. NOAA coverage includes the Mississippi River from South Pass to Baton Rouge; beyond that, U.S. Army Corps of Engineers inland charts provide navigational data.
- **Mississippi, 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.

## Shoreline Coverage – Gulf Region

Shoreline in the Gulf varies significantly, as shown in the graphic that follows. Areas not identified in the legend predate 1960. Most of the contemporary shoreline has been added and published in port areas. Hurricane Katrina resulted in significant shoreline collection activities and publication in areas affected by that and other storms. Another significant project, which is partially complete, is shoreline in and around Tampa Bay.



Age of NOAA shoreline in the Gulf of Mexico







## *Recent Activities*

### Navigation Response speeds re-opening of Port Fourchon

When Tropical Storm Isaac started to approach the Gulf in late August, navigation managers mobilized from Florida to Texas as Coast Survey activated its rapid maritime response. Once it became clear that Isaac, which grew into a hurricane, was headed for Louisiana, Navigation Response Team 4 moved from its normal survey assignment in Galveston and positioned themselves in Lafayette. The day the hurricane started to move from the area, before flooded roads were even re-opened, NRT4 was heading to Port Fourchon, the single most important energy supply port in the Gulf, which had received a direct hit from Isaac. NRT4 was the first responder to reach the port and, by providing essential hydrographic reports quickly (and safely), was able to help the port resume critical energy support operations. Chett Chiasson, executive director of the Great Lafourche Port Commission, told NOAA Administrator Jane Lubchenco: “With a very large hurricane and coastal impacts we saw, you quickly find out who are the real responders and partners with the Port and the Gulf. For us, it is NOAA and the Office of Coast Survey. Our commendations and thanks to you and to the Office of Coast Survey. Their service to us and the Nation is truly exemplary.”

*The Coast Survey caravan, taking NRT4 to Port Fourchon, had to skirt downed utility lines as they traveled from Lafayette to Port Fourchon. They were escorted by the Port Fourchon Harbor Police.*

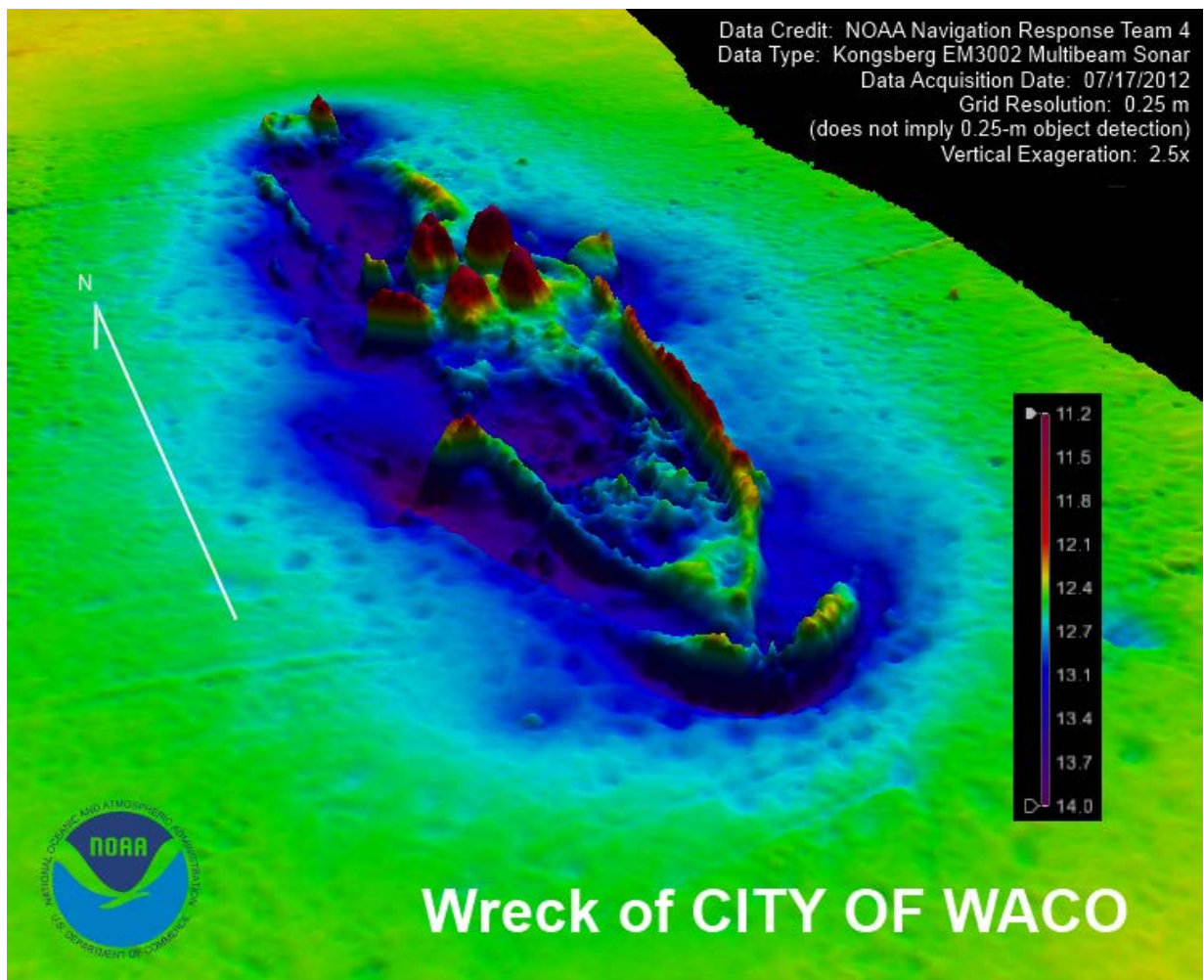




## Navigation Response Team captures history on the seafloor

While Navigation Response Team 4 conducted a year-long survey of the seafloor in the Port of Houston and Galveston Bay navigational areas, they took some time to assist federal and state partners who are adding to our understanding of ocean archeology. In collaboration with NOAA's Flower Garden Banks National Marine Sanctuary and the Texas Historical Commission's Marine Archeology Division, the navigation response team — with the State Marine Archeologist onboard — re-mapped the location of two historically significant wrecks. (With often-shifting sediment, there are periods of covering and uncovering, so archeologists like to periodically map historically significant wrecks to see what's changed.) The steamship *City of Waco* is one of the historical wrecks that NRT4 was asked to survey. The steamship burst into flames and sank on Nov. 8, 1875, and 56 people died. The sunken ship was ordered to be demolished in 1900, to protect navigation in the area.

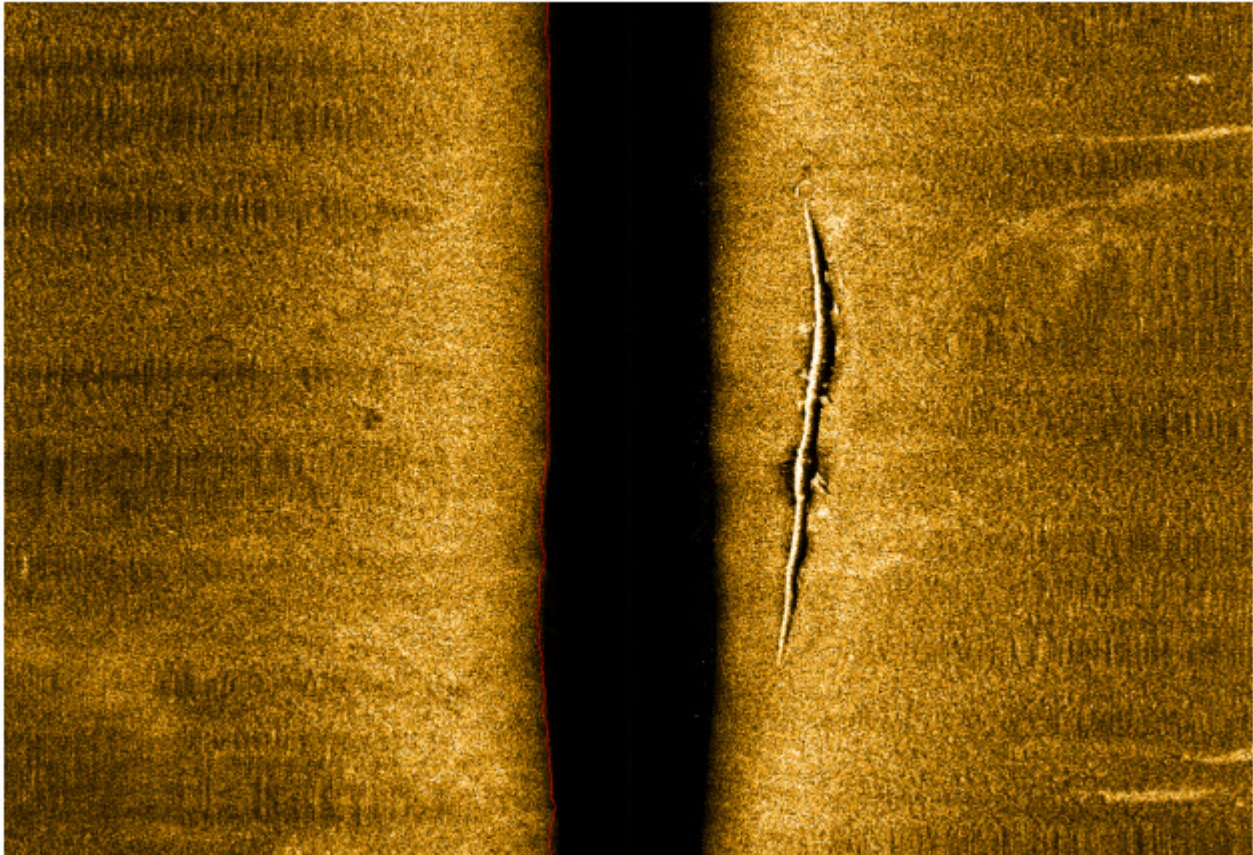
*NRT4 captured some fascinating images of the City of Waco, created from data they gathered during the hydrographic survey.*



## Survey discovers exposed natural gas pipeline south of Mobile Bay

Ocean floors are always changing. Coast Survey's hydrographic surveys are intended to find and measure those changes. Often, we need to do more than that, as shown by a survey of the seafloor in Alabama coastal waters. Coast Survey contractor David Evans and Associates found a large high-

pressure natural gas pipeline that had been uncovered and was lying exposed, as shown by this side scan sonar image. The exposed 36-inch diameter pipeline, pressured to 2,100 psi, posed a threat to navigation and the environment. A navigation manager worked in concert with the contractor to report the danger to the Department of Interior Bureau of Ocean Energy Management (BOERME), and to the U.S. Coast Guard District 8 Headquarters Waterways Section. Coast Survey and the contractor were able to provide precise positions, imagery, and other resources, so the Coast Guard could take appropriate actions to protect life and property.

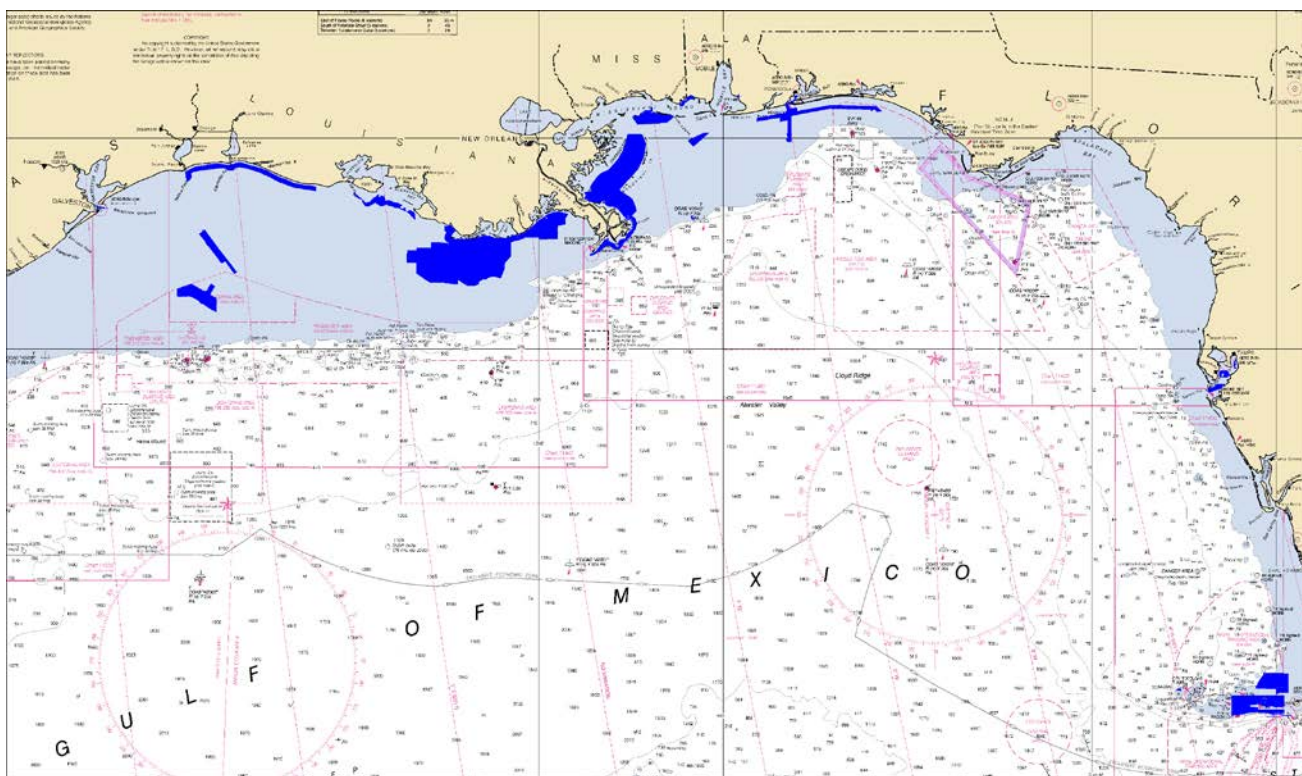


### Survey operations in the Gulf of Mexico over the last five years

NOAA has issued 16 task orders to contractors for Gulf of Mexico hydrographic survey projects over the past five years (2008-2012). Usually, NOAA contractors have one or more task orders per year. Total awards for these task orders were \$55,732,018, which includes \$21,119,090 for hurricane debris mapping projects. In total, contractors and NOAA vessels mapped 3,689 square nautical miles (SNM) in the Gulf for charting. Of this total, contractors acquired data for 3,507 SNM, and NOAA vessels acquired 183 SNM. NOAA ships used 46 days at sea (DAS) for acquisition.

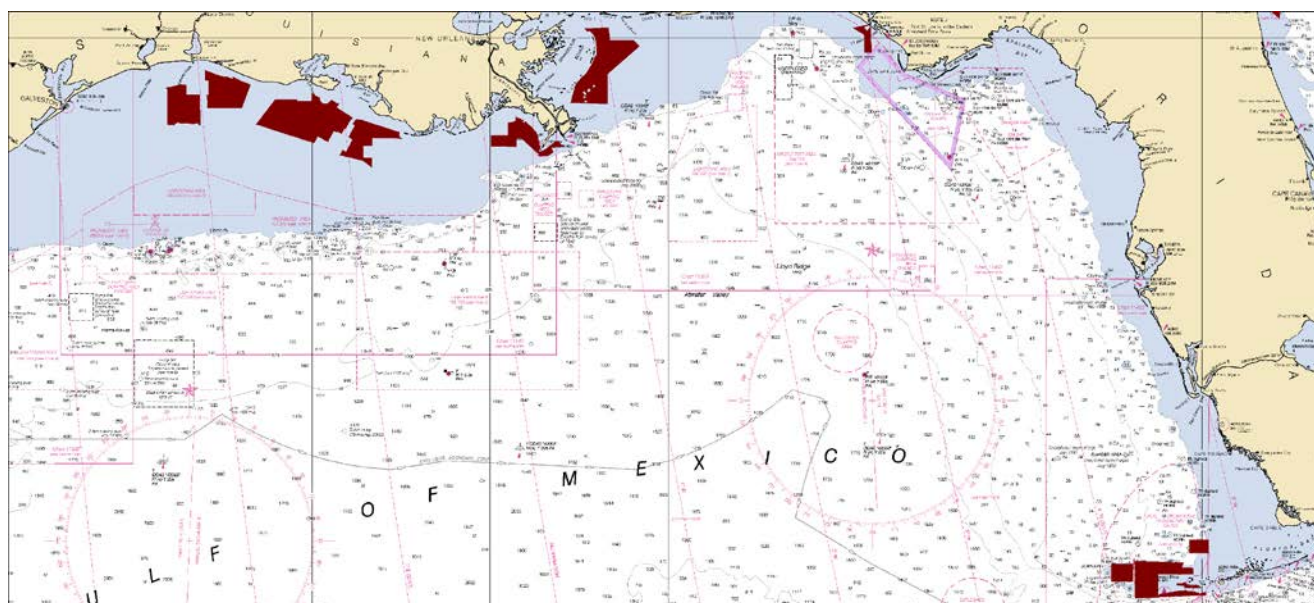


### Survey coverage since 2008



### Survey plans for the next five years in the Gulf region

Over the next five years, approximately 3,550 SNM of survey are planned for the Gulf of Mexico, including 2,980 SNM for contract surveys and 570 SNM for NOAA ships. The survey areas will focus on remaining critical survey areas. Most of the surveys will be 200% side scan sonar surveys. The map below shows planned survey areas (in red).



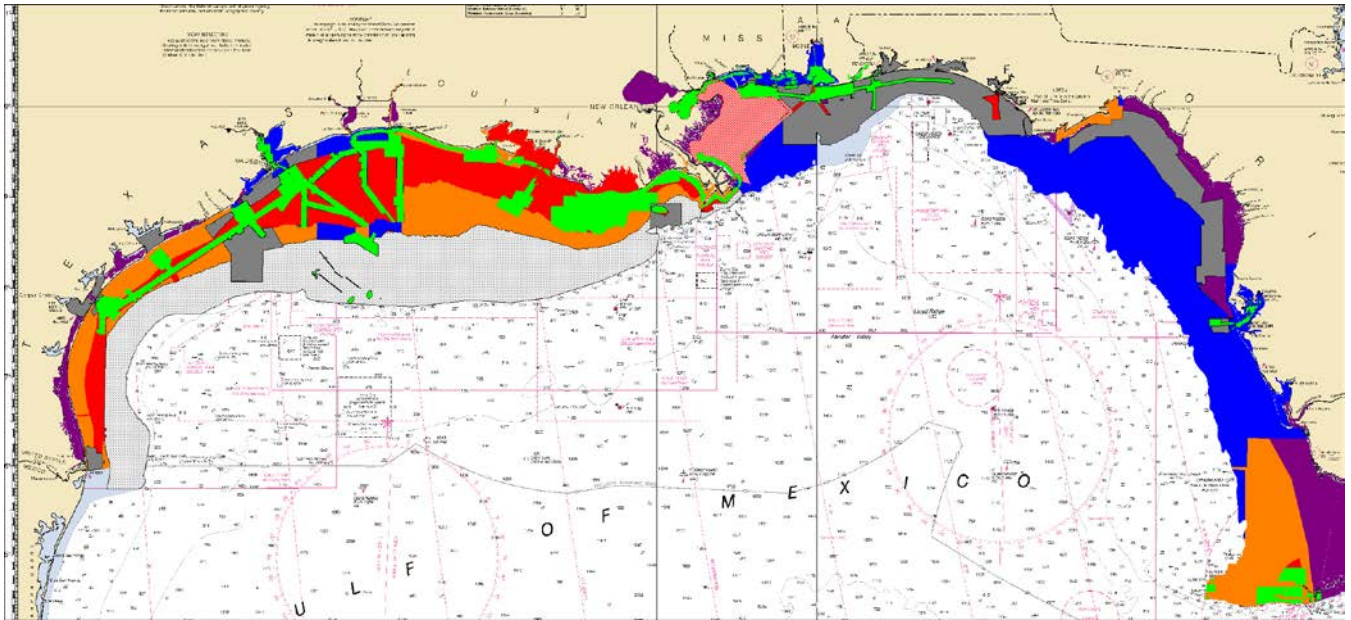
## Coast Survey Gulf-region survey priorities

The Gulf of Mexico region has the most critical survey area out of all the other regions (East Coast, West Coast, Alaska, Hawaii and Pacific Islands, and Caribbean Islands). Coast Survey will focus a large portion of contracting effort over the next five years to address critical areas in the Gulf of Mexico. At the current survey rate, it will take 11 years just to survey these remaining critical areas.

Surveys are classified according to on need and a variety of other factors.

- **Critical survey** areas are waterways with high commercial traffic volumes; extensive petroleum, liquefied natural gas or hazardous material transport; compelling requests from users to survey; or transiting vessels with low under-keel clearance over the seafloor.
- **Emerging critical areas** meet the definition of critical area, but are tracked separately from critical areas.
- **Priority One areas** are assigned to navigationally significant areas that have pre-1940 surveys and annual petroleum transports over 1,000,000 tons; coal transports over 600,000; cargo traffic over 5,000,000 tons; or passenger traffic over 10,000 persons.
- **Priority Two areas** are assigned to navigationally significant areas that have pre-1940 surveys, but no specified traffic level.
- **Priority Three areas** are those that contain pre-1970 surveys that have not been categorized previously as Priority One or Two.
- **Priority Four areas** are those areas with surveys completed between 1970 and 1994 that are not defined as a critical area.
- **Priority Five areas** are assigned to areas in the Gulf of Mexico and Alaska regions that are of greater depth (20-50 fathoms in the Gulf of Mexico, and 50-100 fathoms in Alaska), which have unsurveyed areas or pre-1940 prior surveys.

The graph on the next page displays current survey needs in the Gulf. The complete *NOAA Hydrographic Survey Priorities* is at <http://www.nauticalcharts.noaa.gov/hsd/NHSP.htm>.



*Gulf of Mexico priorities:*

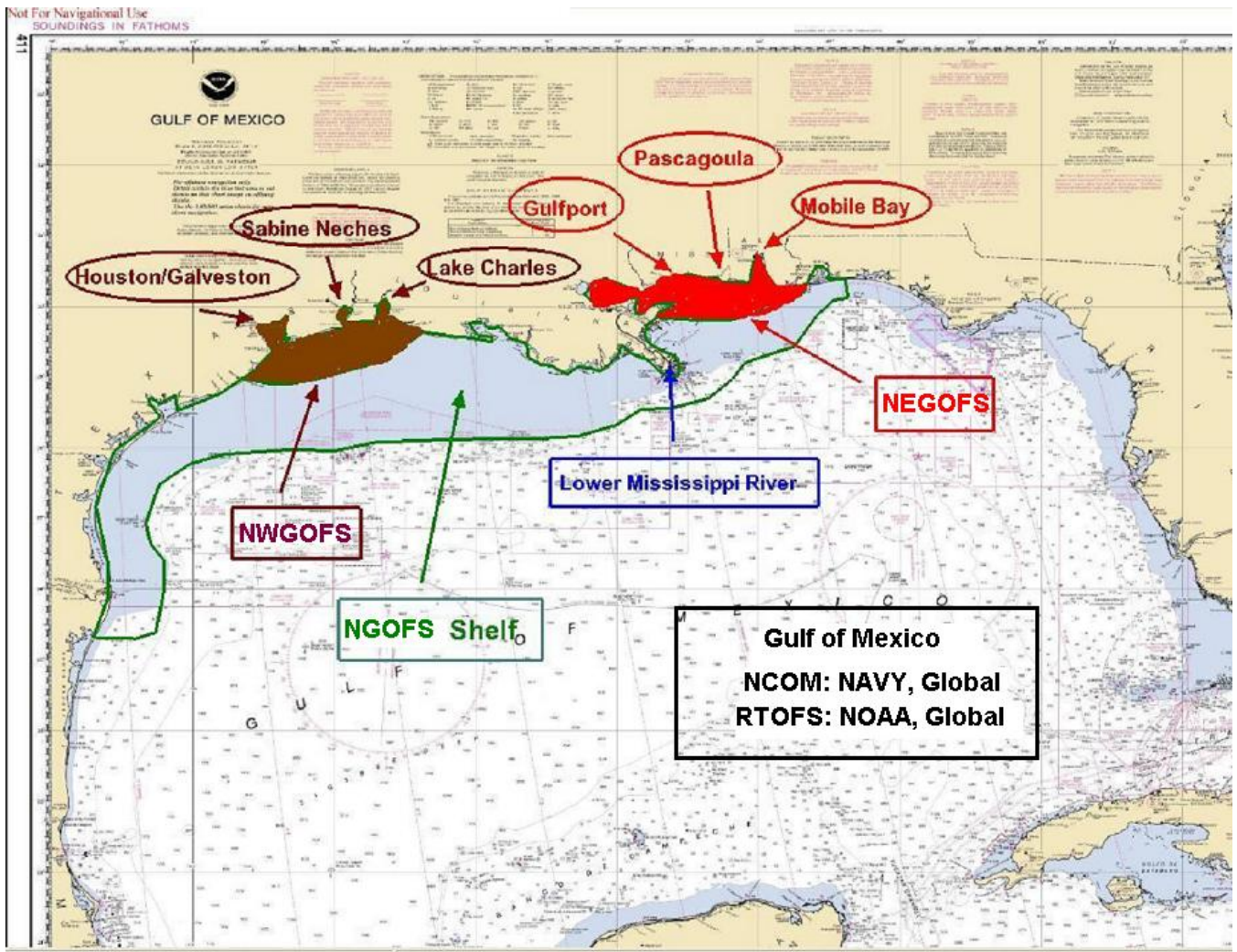
- Red - Critical (7,552 SNM remaining)
- Pink - Emerging Critical
- Orange - Priority 1 (10,812 SNM remaining)
- Purple - Priority 2 (7,976 SNM remaining)
- Blue - Priority 3 (14,355 SNM remaining)
- Grey - Priority 4 (8,596 SNM remaining)
- Light Grey - Priority 5 (14,368 SNM remaining)
- Green - completed full bottom coverage (7,745 SNM completed)

**Northern Gulf of Mexico Operational Forecast System (NGOFS)**

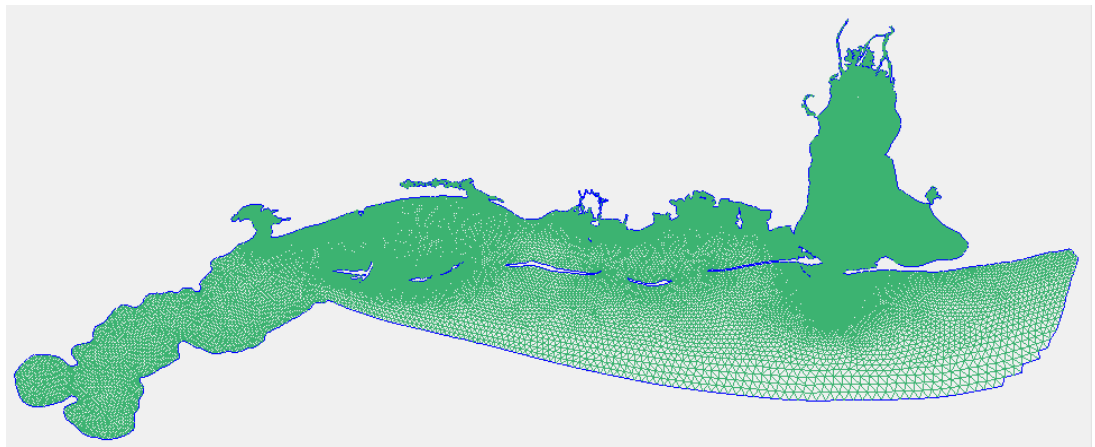
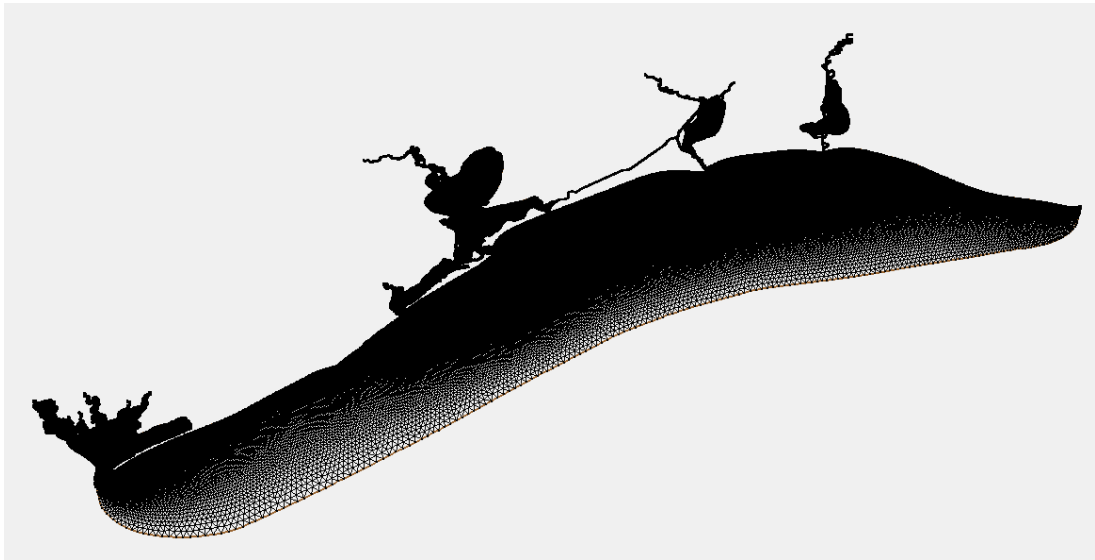
This forecast system has been developed by NOAA/NOS to provide two-day water level, current, temperature and salinity forecast guidance in northern Gulf coastal waters for marine navigation, emergency response and for ecological applications. The three-dimensional hydrodynamic model within NGOFS is based on the Finite Volume Coastal Ocean Model (FVCOM). NGOFS forecasts are available as time series at select locations, as well as full field 3-D gridded forecasts over the entire shelf area from South St. Padre Island, Texas, to Panama City, Florida. NGOFS will eventually cover seven NOS PORTS® systems (Houston/Galveston, Sabine Neches, Lake Charles, Gulfport, Pascagoula, Mobile Bay, and the planned PORTS in Matagorda Bay). Two high-resolution nests are now under development: the Northwest and Northeast Gulf of Mexico Operational Forecast Systems (NWGOFS and NEGOFS Nests). They will provide higher resolution NOWcast and forecast guidance for the nested areas that include the seven PORTS system locations.



Schematic of NGOFS Shelf domain and NWGOFS and NEGOFs Nests



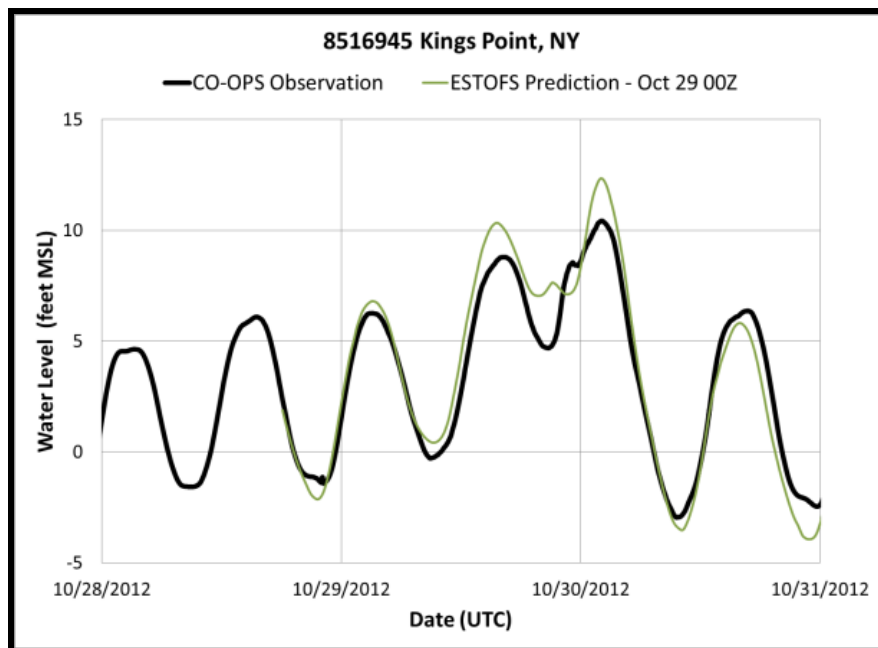
*NGOFS Shelf Grid; NWGOFS Nested Grid; and NEGOFs Nested Grid*



## Storm Surge Model

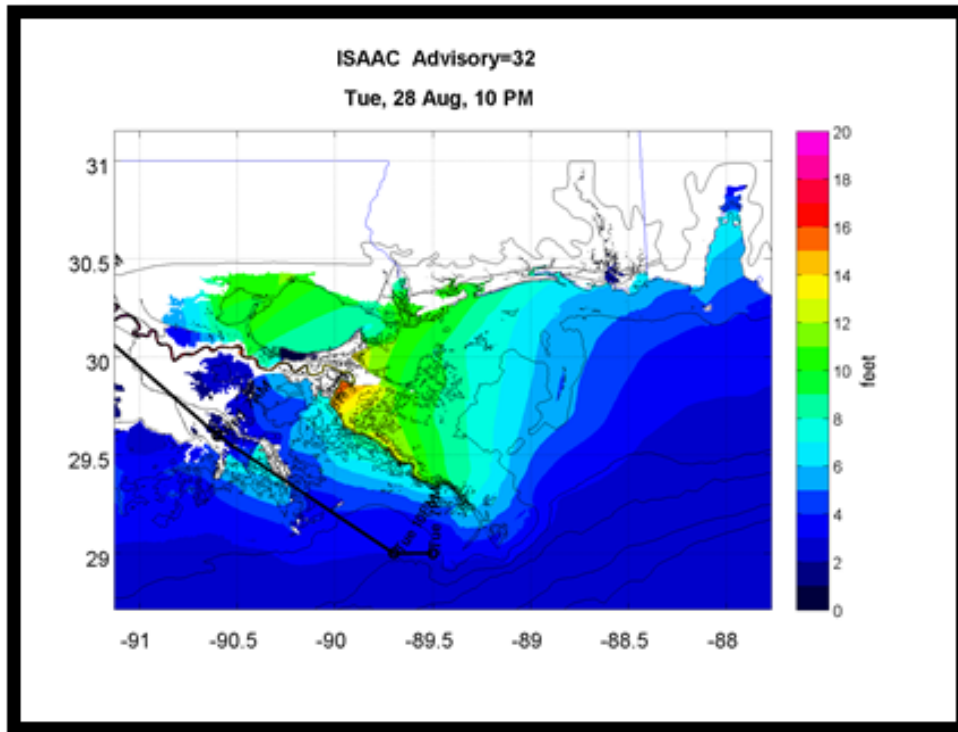
Coast Survey is developing new storm surge modeling systems for use by NOAA forecasters. One operational storm surge forecast system was made operational in late September 2012. The Extratropical Surge and Tide Operational Forecast System (ESTOFS) is the first operational NOAA storm surge model to predict the combined effect of storm surge and tides. ESTOFS generates a 180-hour forecast for the Atlantic and Gulf coasts every six hours, using the advanced circulation coastal hydrodynamic model. ESTOFS efficiently computes large scale conditions caused by extratropical storms like nor'easters; its coastal resolution is limited to 3 to 5 km, and it does not predict overland inundation. ESTOFS was used for predicting water levels from Hurricane Sandy and the nor'easter that followed.

*ESTOFS prediction for Hurricane Sandy at Kings Point, NY*

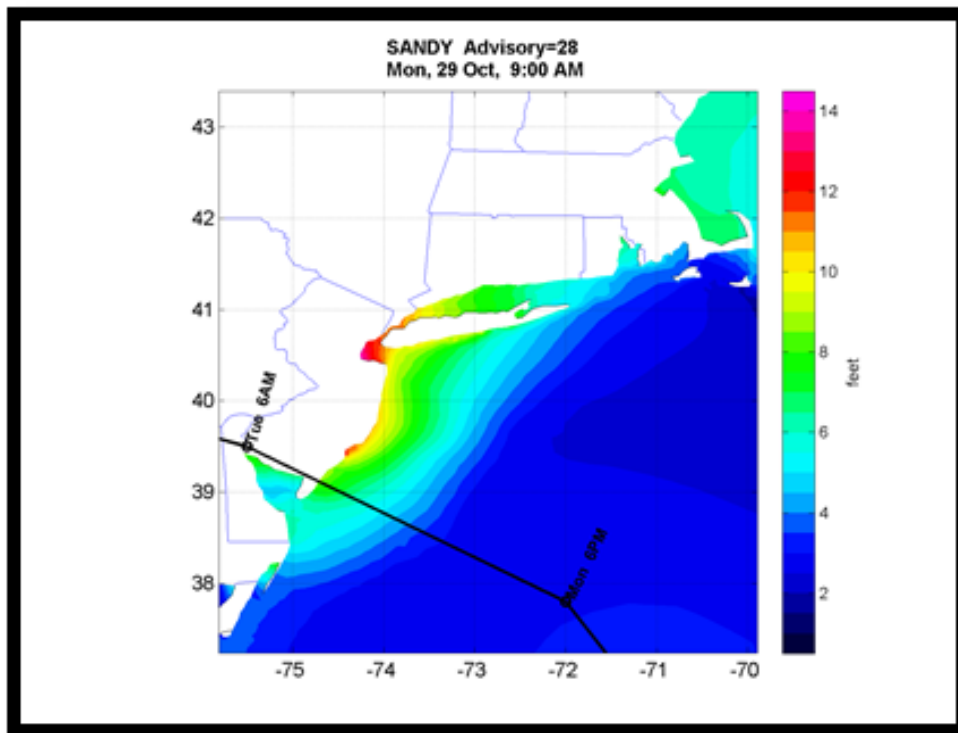


Additionally, Coast Survey is evaluating an experimental high-resolution storm surge system for hurricane surge prediction. The ADCIRC Surge Guidance System is being tested in real time through a partnership with external researchers and with support from NOAA's Hurricane Forecast Improvement Project. This system was developed through support from the U.S. Army Corps of Engineers and the Department of Homeland Security. It can use high resolution grids that cover coastal topography, with points spaced anywhere from 500 meters down to 50 meters. The model augments existing operational models by using higher resolution, larger scale domains, tides, and wave effects. Coast Survey provided experimental model output to the National Hurricane Center for Hurricanes Isaac and Sandy, helping forecasters assess the risk during these events.

*Experimental ADCIRC storm surge predictions for Hurricane Isaac*



*Experimental ADCIRC storm surge predictions for Hurricane Sandy*



## Coast Survey works with mariners to reduce storm impacts to commerce

Coastal communities can lose millions of dollars when ports close and shipping stops following a hurricane or other emergency. To reduce operational downtime that impacts thousands of maritime-related jobs, Coast Survey and National Weather Service (NWS) kicked off a new planning and preparation initiative around the Gulf of Mexico in 2012. Coast Survey and NWS are working with the Louisiana River Pilots Association to develop stronger coordination plans for transmitting and using weather and marine forecasting and observations, and to establish navigation emergency response capabilities. Working with the Southwest Pass Bar Pilots and the Lake Charles Pilots Station, the collaboration will improve plans to assist large ship transits to the ports along the Mississippi River and to the Port of Lake Charles.

## Nautical charts set foundation for new artificial reef construction

Coast Survey's charts and marine spatial expertise is providing a vital foundation for the planning and construction of new artificial reefs in Lake Pontchartrain, Louisiana. Construction of the new State of Louisiana and Louisiana Coastal Conservation Association project began on Dec. 21, 2011. Louisiana's Department of Wildlife and Fisheries and the Department of Transportation and Development used Coast Survey's hydrographic resources to aid in the siting and permitting processes, as well as setting specifications for the construction materials. This project is the second of two new artificial reefs in Lake Pontchartrain, both built with recycled concrete from the demolition of the old Interstate 10 "Twin Spans" causeway and bridges connecting New Orleans and the north shore of Lake Pontchartrain. Recycled concrete materials can replace lost hard bottom habitats that serve as a base for benthic communities as clams, oysters and other encrusting organisms. This, in turn, serves as important nursery and foraging habitat for marine fisheries.

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

### *Personnel & Products in the Gulf Region*

#### **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, and meteorological parameters (e.g., winds, atmospheric pressure, air and water temperatures) that mariners need to navigate safely. NOS operates 21 PORTS, seven 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. 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. <http://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, AL. 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. <http://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. <http://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.

<http://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. <http://tidesandcurrents.noaa.gov/ports/index.shtml?port=lc>

### **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. <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.

<http://tidesandcurrents.noaa.gov/ports/index.shtml?port=hg>

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

## **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 and the Great Lakes. Additionally, NWLON is the foundation for reference stations supporting NOAA's tide prediction products, and serve as control stations in determining tidal datums for all short-term water-level station. They provide relative sea level trends and are capable of producing real-time data for storm surge warning. NWLON data-collection

platforms collect meteorological data in addition to water level data. Currently, there are 31 NWLON stations in the Gulf from Naples, Fla., 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. <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, SW Pass; Shell Beach, Lake Borgne; Grand Isle; USCG New Canal Station; East Bank 1, Bayou LaBranche; Berwick, LAWMA, Alameda 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.

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

The NWLON in Texas is supplemented by 24 Texas Coastal Ocean Observation Network (TCOON) stations, which is operated and maintained by the Conrad Blucher Institute (CBI) at Texas A&M Corpus Christi, and is sponsored by the Texas General Land Office (TGLO). In 1988, NOAA entered into an agreement with the Conrad Blucher Institute to establish a network of water level stations to NOAA standards, making Texas the first state to establish a network to our standards. Today, CBI and CO-OPS share data, products and online services. CO-OPS has been developing a strong relationship with CBI over the past twenty years and these collaborative efforts can serve as a model for other state and federal 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 2012-2013: Mississippi Sound, Panama City, Baratarai Bay, Louisiana Coast, Galveston Bay, Sabine Pass, and Hurricane Issac Response for Port Fourchon. CO-OPS will support NGS in the following areas for 2012-2013: Alabama coast, Pensacola, Louisiana, and Texas.

#### **St. Charles Parish Water Level Monitoring System**

CO-OPS, in partnership with St. Charles Parish, operates a water level monitoring system to provide primarily storm surge data to the Parish Emergency Operations Center to assist with evacuation decision-making efforts. One long-term station at Bayou Gauche, along with the NOS NWLON stations at Grand Isle, Southwest Pass, and East Bank 1, Bayou LaBranche, provide water level and meteorological data directly to the EOC and to NOS.

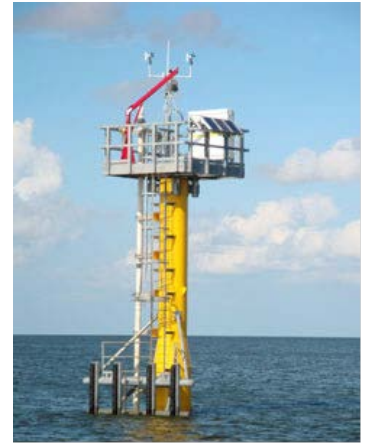


## Sentinel of the Coast Observing Systems

Two new Sentinels in Texas will replace water level stations that were destroyed or heavily damaged by recent hurricanes. 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 is partnering with Texas A&M Division of Nearshore Research and the U.S. Corps of Engineers to establish these new Sentinels. The new Sentinels are located off Houston-Galveston Bay and Sabine Pass.

### **New Sentinels of the Coast in Texas**

The Conrad Blutcher Institute has received a \$1.5 million grant from the Coastal Impact Assistance Program (CIAP) to expand the Texas Coastal Ocean Observing Network. Two new sentinels will be installed in South Padre Island and the in the Matagorda Ship Channel near Port O'Conner, Texas. The addition of these stations strengthens the TCOON, and brings the total station count to 33 water level stations, which includes four sentinel stations.



## 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 is the first time NOAA has 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 office, 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.

### *Recent Activities*

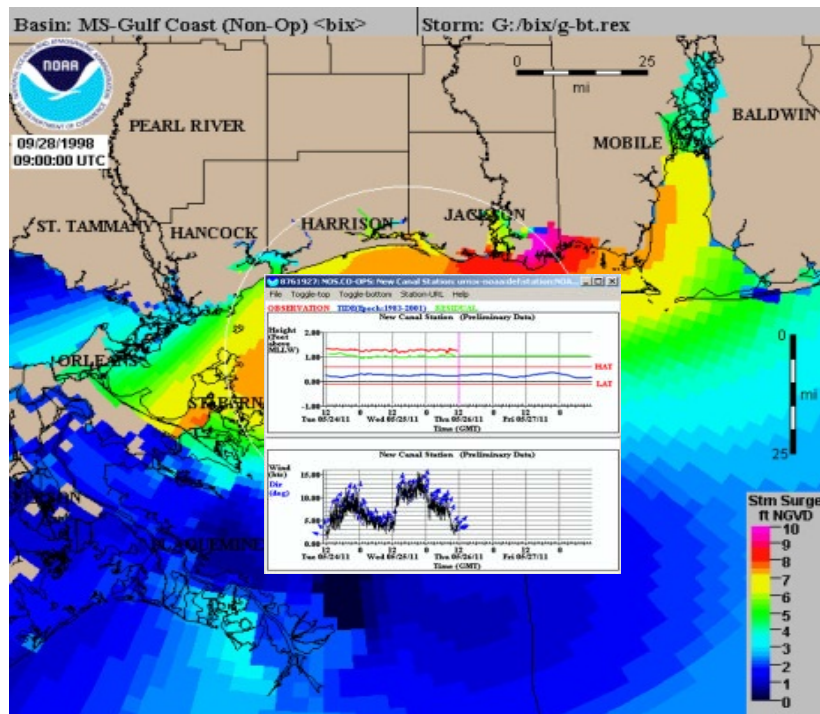
## Harmful Algal Bloom Forecasting

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. <http://tidesandcurrents.noaa.gov/hab/>



## Hurricane SLOSH Modeling

CO-OPS works closely with the National Hurricane Center to incorporate tides and water levels into the Sea, Lake, and Overland Surges from Hurricanes (SLOSH) model. In addition, CO-OPS will be supporting the datum transition of SLOSH model grids from NGVD29 to NAVD88, which will facilitate more accurate forecasts.



## IV. National Geodetic Survey (NGS)

### *Products, Personnel & Projects in the Gulf Region*

#### Damage Response Imagery

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

- High resolution, geo-referenced airborne imagery using NOAA aircraft supports NGS' Coastal Mapping Program.
- NGS posts images on the web, often within hours, to make these images available to the general public.
- The 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 2011 Joplin and Tuscaloosa tornados, the 2010 Haiti earthquake, and all major hurricanes since 2003. From the imagery, those in charge of response and restoration can determine the effect of storms on the land; for example they can determine where flooding has wiped out parts of barrier islands and affected their formation. [http://ngs.woc.noaa.gov/eri\\_page/](http://ngs.woc.noaa.gov/eri_page/)

## VDatum

In 2010, NGS, CO-OPS and Coast Survey made available the first edition of NOAA's Vertical Datum Transformation (VDatum) 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. <http://vdatum.noaa.gov/>

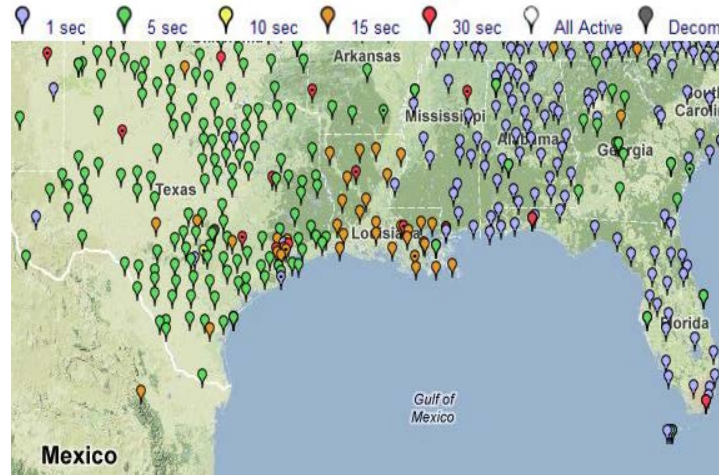
## Continuously Operating Reference Stations (CORS)

NGS manages a network of CORS that provide 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 1900 stations. <http://www.ngs.noaa.gov/CORS/>

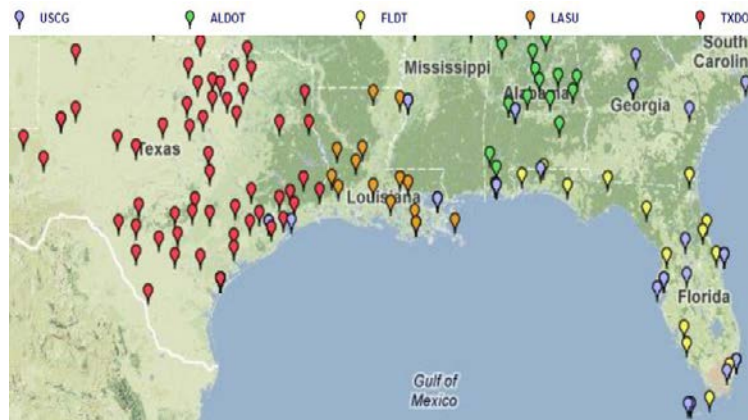


Each state bordering the Gulf of Mexico installed several regional CORS networks that are now included in the larger NGS CORS network.

*The location of all CORS in the Gulf region.  
(Color-coded bubbles represent the sampling rate of the GPS 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 (red), the United States Coast Guard DGPS network (purple), the Louisiana State University (orange), the Alabama Department of Transportation (green) and the Florida Department of Transportation (yellow) 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.

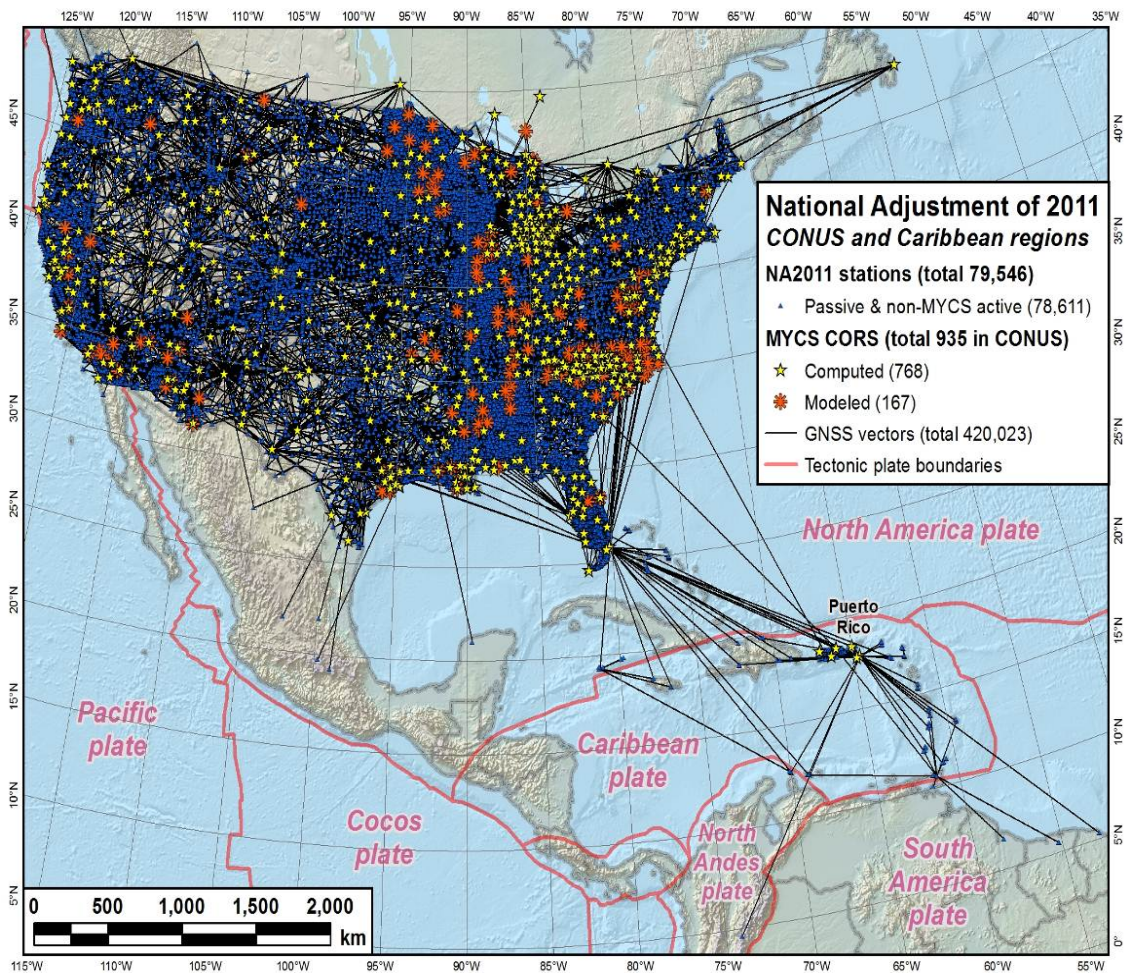


## National Spatial Reference System (NSRS)

In 2012, NGS completed a major update to the National Spatial Reference System (NSRS) with a national adjustment project referred to as the NAD 83(2011) epoch 2010.00 realization of the North American Datum of 1983 (NAD83), which is the current geometric reference frame within the NSRS. This new realization adjusted approximately 80,000 coordinates of passive geodetic control points in the NSRS, the consistent coordinate system that defines latitude, longitude, height, gravity, and other quantities throughout the U.S. NOAA maintains and provides access to the NSRS, the

foundation for the nation’s transportation, mapping, and charting infrastructure that serves a multitude of scientific and engineering applications. The new adjustment will aid professional surveyors and others who rely on the NSRS for accurate positioning, and it aligns the Continuously Operating Reference Station (CORS) network with the network of passive geodetic control monuments positioned using Global Navigation Satellite System technology. New coordinates are now available for all of the approximately 2,300 CORS and nearly 80,000 passive control stations distributed throughout the conterminous United States, Alaska, the Caribbean, and the Pacific.

[http://www.ngs.noaa.gov/web/news/NA2011\\_Announcement.shtml](http://www.ngs.noaa.gov/web/news/NA2011_Announcement.shtml)



## Hurricane SLOSH Modeling

NGS is working with the National Hurricane Center on how to incorporate NAVD 88 into Sea, Lake and Overland Surges from Hurricanes (SLOSH) models. SLOSH is a computerized model run by NHC to estimate storm surge heights resulting from historical, hypothetical, or predicted hurricanes. Properly incorporating NAVD 88 into this model will help better predict hurricane storm surge and will help local communities make better hurricane evacuation decisions.



## State Geodetic Advisors

The NGS State Geodetic Advisor Program is a cost-sharing program that provides a liaison between NOAA and the host state, usually with a jointly funded NOAA employee residing in the state to guide and assist the state's geodetic and surveying programs. NGS has advisors in Florida, Mississippi and Texas. In the Gulf of Mexico, NGS advisor program is transitioning from a state-based cost share program to a regional NGS-funded structure.

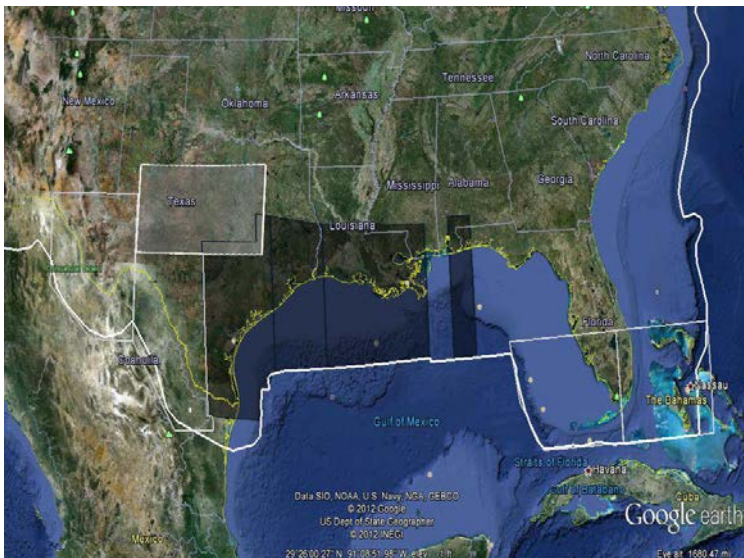
<http://www.ngs.noaa.gov/ADVISORS/AdvisorsIndex.shtml>

## Gulf Coast Height Modernization Project

This project is in a region of known subsidence spanning southeastern Texas, southern Louisiana, Mississippi, and Alabama, and westernmost Florida. Due to subsidence, many control station elevations in the region are obsolete. In 2012, new elevations were determined by combining new and old leveling observations using a technique called Vertical Time-Dependent Positioning (VTDP). VTDP compares leveling performed at different times to estimate rates of elevation change, and these rates are used in leveling adjustments to compute updated elevations. The VTDP results were also used in development of GEOID12A in this region to ensure consistency between leveling and NAD 83(2011) epoch 2010.00 ellipsoid heights. In the near future, NGS will combine VTDP results with GEOID12A and (2011) ellipsoid heights from recent GNSS surveys to determine accurate elevations at other control stations in the region. <http://www.ngs.noaa.gov/heightmod/GulfCoastProject.shtml>

## Gulf Coast Data Survey Pilot Project

In 2009, NGS completed an aerial gravity survey (one means by which NOAA collects the data to measure elevation relative to sea level) along portions of the Gulf Coast. The project collected gravity data via a Citation aircraft, from the Alabama/Georgia state line to the Mexican border, in partnership with the U.S. Army Corps of Engineers. Among several applications, the data enhances VDatum. Its applications include inundation modeling (e.g., storm surge, tsunamis, and sea-level impacts), ecosystem modeling and coastal management, hydrographic depth surveys, and shoreline extraction from LIDAR (an optical remote-sensing technology).



Data has been collected for 23.97% of the U.S. and territories to support a new vertical datum. In the Gulf of Mexico, four blocks of data (shaded dark grey below) have been collected, processed, and released to the public. Collection has started, but is not complete, in one block (shaded light grey) and there are four blocks tentatively planned for FY13 (outlined). In the next one to three years, it is expected that the coastal areas will be nearly complete, if not completed.



## *Recent Activities*

### Deepwater Horizon Response

In 2010, in response to the Deepwater Horizon Oil spill, NGS collected tens of thousands of baseline (pre-impact) shore and damage assessment images of coastal areas, especially focusing on the land/water interface in high-priority areas, in the effort to protect wildlife and the shoreline. NGS also provided personnel to acquire, process and submit aerial imagery, preparing the website for posting imagery, preparing graphics of pre-event imagery on hand, processing imagery on hand that has not been processed yet, processing incoming data, posting incoming imagery, disseminating incoming imagery, preparing graphics of areas imagery is collected, evaluating satellite imagery of the area pre- and post-landfall. To assess impacts to the ecosystem and the Trust Resources post-event, NGS, on behalf of the Natural Resource Damage Assessment Shoreline Technical Workgroup, also re-flew much of the same path as the pre-oiling imagery where there was confirmed oiling.

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

In 2012, NGS released a new geoid model for the surveying, engineering, and scientific communities for whom water flow and heights above mean sea level are critically important. NGS' new GEOID12A model is key for transformations in NOAA's VDatum tool to relate sea level with terrestrial elevations anywhere in the United States. Users now have the ability to obtain a fast, mathematical solution using GPS technology and then convert the result using GEOID12A to achieve the more critical geophysical (orthometric) heights relative to sea level to determine where water will flow. By providing more accurate height measurements, GEOID12A greatly assists those involved in flood plain management, coastal and emergency management, port operations, and river/stream flow monitoring. NOAA's new GEOID12A model will be 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>

### Florida

**Sentinel Sites Program** - The NGS part of this program is to assist the NERR with establishing elevations on the NAVD 88 datum in order to measure sea level rise. Most of the work has been completed at the Apalachicola NERR. Work is ongoing at Weeks Bay NERR. Preliminary investigation has been done at Rookery Bay NERR. Partners in this activity are the National Estuarine Research Reserves, the University of Central Florida, the Gulf of Mexico Alliance and the University of South Carolina. This will be an ongoing project over the next few years.

### Alabama

**Mobile Bay Collaborative Project** - In 2010 and 2011, CO-OPS, NGS and Coast Survey conducted a collaborative survey of Mobile Bay and its environs to produce an integrated suite of foundational datasets to meet coastal communities' challenges with respect to environmental/climate change as well as provide critical input to coastal and marine spatial planning. These challenges require a comprehensive, high quality integrated suite of geophysical and oceanographic data products and

services that are by their nature multidisciplinary. Mobile Bay was selected as a pilot project because this area was identified by Congress as a region with an urgent requirement for an enhanced forecasting capability. This survey represents the type of project that NOAA's traditional navigation services is trying to expand to better utilize their broad capabilities within a framework that places a strong emphasis on outreach to ensure that the final data product and services will meet coastal stakeholders needs.

## Mississippi

**Mississippi Receives NOAA Regional Geospatial Modeling Grants** - Mississippi has regularly received NOAA Height Modernization grant funds and regional geospatial modeling grants since 2002. Height modernization funds are used to obtain accurate heights critical for a variety of applications, such as planning evacuation routes, modeling storm surge and monitoring sea level rise. The Mississippi Spatial Reference Center (MSRC) and the University of Southern Mississippi are ongoing partners in these activities. MSRC was established and became operational in 2007. 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, using regional geospatial modeling grant funds, 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.

## Louisiana

**Louisiana Spatial Reference Center** - Partnering with NOAA, the Louisiana Spatial Reference Center (LSRC) serves as way of providing a spatial referencing liaison between federal and local authorities. The Center is a non-profit organization affiliated with Center for GeoInformatics at Louisiana State University. 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 conducting aerial photography surveys and elevation surveys of Hurricane Evacuation routes; 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.

**NGS Works with Partners on Flood Plain Mapping** - In 2008, NGS worked with the Louisiana Spatial Reference Center (LSRC) and the Federal Emergency Management Agency (FEMA) to establish guidelines and procedures for verifying the elevations of benchmarks in areas of subsidence. NGS and its partners used the NOAA-managed Continuously Operating Reference Station (CORS) network and Real Time Global Positioning System Networks to provide this critical elevation data verification, which FEMA uses for their flood plain mapping certificates. Flood zones are developed based on elevation data, and that elevation data is based on NOAA benchmarks. Providing that data is the primary mission of NGS, and of critical importance to areas where flooding can occur. Due to vertical ground movement (subsidence), providing accurate elevation data in southern Louisiana is very difficult. After Hurricane Katrina, flood insurance has obviously become a major concern to property owners in the area. NGS is helping to overcome this problem by creating a new way of

validating the elevation of our benchmarks. Through the use of GPS, NGS is able to provide a quick and inexpensive way of validating the elevation data of our passive monuments.

## Texas

**Texas Spatial Reference Center** - NGS and Texas A&M University - Corpus Christi have partnered to improve Texas' surveying and emergency response capabilities. The university has created the Texas Spatial Reference Center (TSRC) at its campus, as part of grants awarded through NOAA. With this funding, TSRC and NGS will perform hurricane evacuation route surveys, using a system that produces accurate 3-D positions within centimeters. Knowing the precise elevations of roads enables emergency planners to know how much rain and/or tidal surge would cause flooding in coastal areas. NGS work with the TSRC involves providing a spatial referencing liaison between federal and local authorities, height modernization, geodetic leveling training, leveling to Texas Continuously Operating Reference Stations (CORS) in cooperation with TXDOT, and more.  
<http://tsrc.cbi.tamucc.edu/TSRC/HomePage>

**NA2011 Adjustment in Texas** - The National Adjustment of 2011 (NA2011) Project is a nationwide, geometric adjustment of passive stations, with positions determined using Global Navigation Satellite System (GNSS) technology, which includes the Global Positioning System (GPS). NA2011 is called "geometric" because it will yield new values for latitude, longitude, and ellipsoid height; it will NOT affect the orthometric heights of stations. However, a future nationwide vertical adjustment is being considered to determine GNSS-derived orthometric heights, based on the results of NA2011. There has been continuous expansion and maintenance of the Harris Galveston Subsidence District (HGSD) GPS Subsidence Monitoring Network. Partners are HGSD, Harris County Flood Control District, Fort Bend Subsidence District, Lone Star Groundwater Conservation District, U.S. Geological Survey, University of Houston, Texas Department of Transportation, City of Houston and Texas A&M University, Corpus Christi.  
[http://www.ngs.noaa.gov/web/surveys/NA2011/NA2011\\_FAQ.shtml](http://www.ngs.noaa.gov/web/surveys/NA2011/NA2011_FAQ.shtml)

**NGS Releases Initial Gravimetric Geoid Validation Results** - In 2012, in partnership with international colleagues and state, local, and university partners, the National Geodetic Survey validated an important component of the latest gravity surface model (the "geoid") and presented initial survey results at the American Geophysical Union Conference in San Francisco. Tests performed over an approximate three-month period resulted in a comprehensive survey along a 300-kilometer route from Rockport to Austin, Texas. Through various measurements, the survey validated significant improvements in elevation data available to users as part of NGS' Gravity for the Redefinition of the American Vertical Datum (GRAV-D) Project. The Texas survey was highlighted in the December 2011 issue of *Point of Beginning* magazine, a major survey community trade publication. Airborne gravity data collected from the GRAV-D Project were shown to improve the accuracy of the gravity surface model by a factor of up to three across all distances, and these data will be made available to the public for use in additional studies. NGS hopes the new survey marks placed as part of this validation study will also accommodate future use.  
<http://www.ngs.noaa.gov/GEOID/GSVS11/index>