USGS
science for a changing world

Florida Integrated Science Center, St. Petersburg, Florida

Mapping and Vessel-Based Capabilities

U.S. Geological Survey (USGS) scientists from the Florida Integrated Science Center (FISC) conduct scientific investigations of submerged coastal and marine resources using new and existing technologies. Each contributing technique, method, or product adds to our understanding of coastal and marine resources and provides information for resource-management decisionmaking. In support of this mission, the USGS St. Petersburg office maintains a fleet of research vessels used for inland, coastal, and open-water marine surveys and investigations. Each vessel has advantages and limitations related to water depth, carrying capacity, speed, operation in open water, and other functions. These research platforms are staffed by experienced technical and scientific professionals with expertise in marine navigation, geology, geophysics, engineering, biology, and oceanography.

Scientists and engineers from USGS FISC in St. Petersburg prepare a sediment core barrel onboard the R/V Gilbert.

Research Facilities and Vessels

The USGS St. Petersburg office oversees facilities and vessels staffed by experts and equipped with the latest technology. Onshore labs, computers, and experts are on hand to help prepare, and then support the missions by analyzing and storing information.

Facilities include a fully operational shop, an electronics lab, sediment and core labs, a clean lab, a microbiology lab, and a biology lab. State of the art information technology support is available for computing, data analysis, archiving, and servers. Geographic Information System (GIS) and remote sensing capabilities and expertise are also housed at FISC in St. Petersburg.

Vessels and platforms are available to perform bathymetric surveys, sidescan sonar sea-floor imaging, sub-bottom seismic profiling, swath bathymetry surveys, and coring operations. Vessels also support scientific investigations on coral reefs, aquifers, water quality, coastal and benthic habitats, fish and turtle populations, underwater imaging, and assist with marine education.

R/V Gilbert traveling to coring site in Tampa Bay, Florida.

Research Vessel G.K. Gilbert—This 1993 research vessel is a 50-foot, semi-V-hulled Munson Hammerhead with a shallow, 2.5-foot draft. The vessel can operate at 30 knots with three 425-horsepower turbodiesels powering three quiet Hamilton Jets. With all exhaust outlets above the waterline, the vessel is relatively quiet, with an excellent acoustic signal-to-noise ratio to optimize survey data quality. The jet propulsion also eliminates propeller entanglement with sensor cables and improves shallow water access without damage to the boat. Fully-equipped, the R/V Gilbert can simultaneously run sidescan sonar imaging, swath bathymetry, high-resolution bathymetry, and three levels of seismic profiles, while maintaining coring and dive platform capabilities.

Houseboats—Two USGS houseboats serve as home base for biological monitoring and extended site-specific data collection. The houseboat, R/V Marjorie Douglas, is a 50-foot aluminum custom-built Clark Boat with 22-inch draft, 200-gallon freshwater carrying capacity, and a 10-day field range. The Marjorie Douglas has a wet-lab and can house a 4-person crew. Houseboats provide basic living facilities, onsite laboratories, 24-hour data collection, and eliminate travel time during extended field sessions.

R/V Catboat—This 1999 research vessel is a 26-foot fiberglass Glacier Bay Coastal Runner with Twin Yamaha 115-horsepower engines and a cruising speed of 25 knots. It is used to perform shallow water and nearshore bathymetric surveys, sidescan sonar seafloor imaging, and swath bathymetry surveys. The vessel can cruise at 40 knots fully loaded, enabling daily surveys in large estuaries, lakes, bays, or rivers, and nearshore ocean environments that require long transits.

Pontoon Barges—The USGS has two identical pontoon barges; one is used as the primary transport vessel for the Portable Auger Drilling System (PADS), and the other is used to transport drilling gear and other supplies, as well as other projects and outreach activities.

Shallow Draft Boats—These small vessels powered by outboard motors, are used by the USGS for surveying and biological monitoring in tidal creeks and inland waterways.

Pontoon barge carrying the Portable Auger Drilling System (PADS).

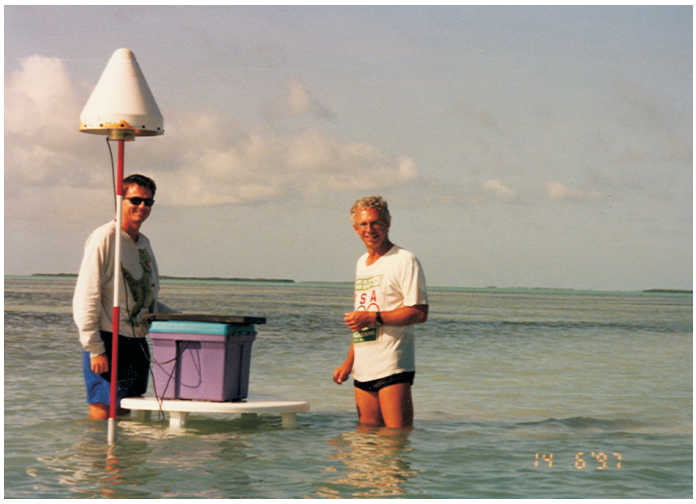
Research Tools and Capabilities

Shallow-Water Vibracore—The vibracore rig is powered by an electric, motor-driven, eccentric-cam vibrator (Rossfelder model P3) to penetrate bottom sediments in waters 1-100 feet deep. Lowering the 800-pound rig to extract 20-foot sediment cores from the R/V Gilbert requires four crewmen and a Hiab SeaCrane. Cores are transported to the Sediment Lab in St. Petersburg, where they are split lengthwise and analyzed for stratigraphic horizons and sediment types to ground-truth seismic data. Alternatively, sediment cores are discretely sampled at various depths and analyzed for their chemical and biological properties. These data indicate the location of sand resources for barrier island and beach renourishment projects, and provide a historical record of deposition, storm records, and anthropogenic impacts.

Vibracore system being lowered from the R/V Gilbert. The sediment core is used to ground-truth seismic data.

USGS technicians prepare the R/V Catboat for a shallow-water bathymetric survey.

System for Accurate Nearshore Depth Surveys (SANDS)—SANDS is an acoustic-based nearshore mapping system that was developed in St. Petersburg for operation from a shallow-draft boat in water to 30-foot depth. Single depth measurements are collected at 10 Hz, or approximately every 9-10 feet, along the survey path with a depth accuracy of 3-4 inches. Seafloor grids are produced from the depth measurement.



USGS St. Petersburg scientists setting up a Real-Time Kinematic (RTK) Global Positioning System (GPS) receiver.

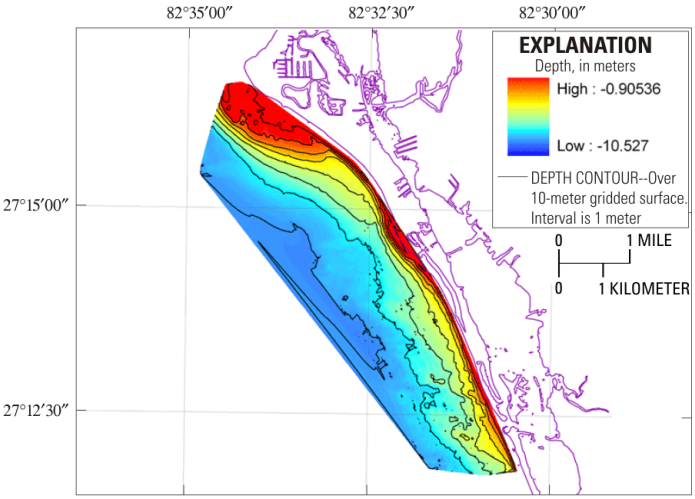
Mapping Technology

Scientific investigations by the USGS of ocean and coastal processes provide critical information for managing resources in a time of rapid change. Coastal and sea-floor investigations and mapping efforts rely on new and established technologies deployed from shipboard and airborne platforms throughout the United States. Technologies include state of the art navigation and computing systems, sonar technology, sediment and water sampling systems, and imaging systems.

Bathymetry, seafloor imagery, geologic cross-sections, water quality and coastal hazard assessments, biological studies, and maps of habitat and important resources are among the products. Combined, the techniques, maps, and scientific interpretations

provide insight into the state of our Nation's resources as well as information for effective resource management.

USGS scientists use modern techniques for navigation and precise position of acquired data. Until recently, open-water navigation depended on celestial observations, coastal landmarks, radio beacons, or early satellite signals. Today the NAVSTAR GPS satellite constellation and GPS receivers are used for navigation. A GPS receiver onboard the ship receives broadcast signals from orbiting satellites and calculates ship position using time and range information.



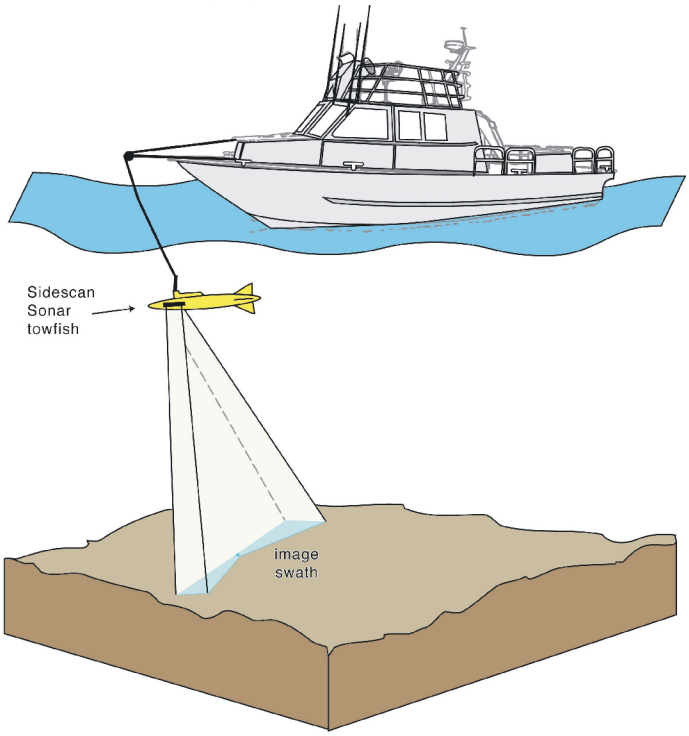
Bathymetric or water depth map created from single-beam soundings off Sarasota, Florida.

Sonar Systems

Sound navigation and ranging (sonar) methods rely on bouncing sound waves off a target and intercepting the return signal. Several types of sonar devices are used to map water depths and sea floor characteristics.

Seafloor Bathymetry—Water depth is measured by a sonar system mounted on the boat. A swath sonar system uses the difference between two or more receivers to measure the range and angle of the target return signal. The USGS uses a high-resolution sonar system, which is effective for quick bathymetric measurements.

Jon boat towing seismic "boomer" equipment to map bathymetry of an inland canal in Florida.

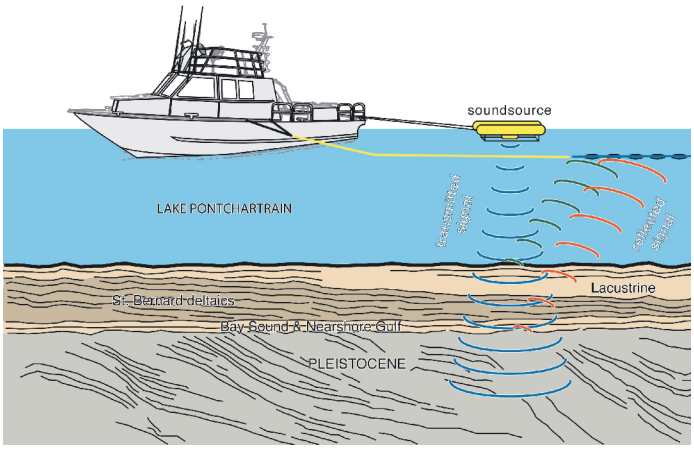


Deployment of sidescan sonar system with fan-shaped path perpendicular to vessel track-line.

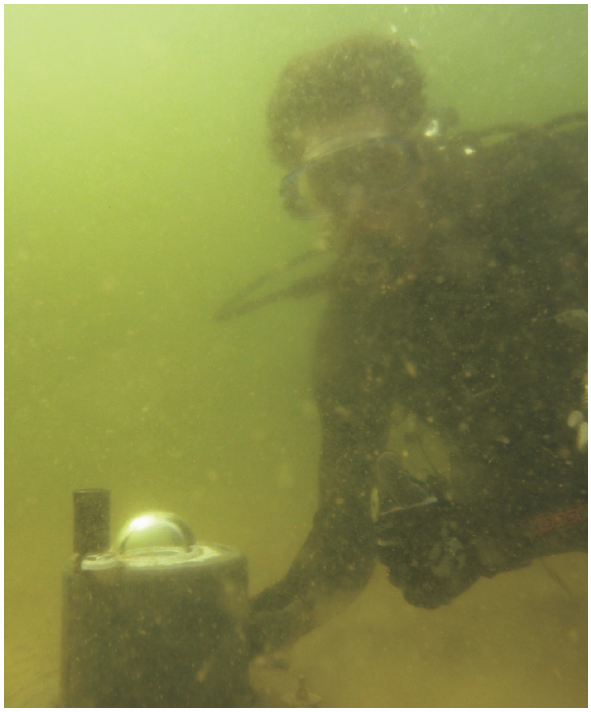
Seafloor Imaging—A sidescan sonar system is designed to image the seafloor by transmitting sound energy and analyzing the return signal or echo that is reflected off of the seafloor, or from submerged objects. A tow fish transmits energy in a fan shape to both sides of the survey path. The shape and character of seabed features are displayed in gray-scale images. USGS scientists in St. Petersburg, FL use an EdgeTech digital sidescan sonar model DF 1000 mounted on a tow fish with an ISIS side-mounted transducer acquisition system.

Seismic Profiling—Seismic surveys map the details of sediment deposits and geologic structure below the seafloor. The seismic profiling technique passes sound waves from a towfish through the water column and into the seafloor. Three types of seismic sub-bottom profilers are used by the USGS:

- Seismic boomer: low-resolution deep-penetration
- 512 CHIRP: high-resolution, medium penetration
- 424 CHIRP: high-resolution, shallow penetration



Seismic system collecting soundings from below seafloor.



USGS diver measures water clarity in Tampa Bay, Florida.

Underwater Imaging

The USGS developed the Along Track Reef Imaging System (ATRIS), a boat-mounted instrument that acquires continuous digital images of shallow-marine substrates. This system is deployed on a small vessel and incorporates subsystems for navigation, real-time differential GPS positioning, autonomous digital camera benthic imaging, and acoustic bathymetric surveying.

Mapping with Airborne Sensors

Vessel-based mapping capabilities can be supplemented in nearshore and shallow coastal areas with airborne sensors such as laser altimetry, hyperspectral and thermal imaging. Where water is shallow or unnavigable, airborne sensors provide mapping capabilities without impacting sensitive resources.

Hyperspectral image shows details of shallow bottom features at the entrance to Longboat Pass, Florida. Imagery courtesy of West Coast Inland Navigation District.

USGS and University of South Florida (USF) researchers deploy C3D sidescan systen to map water depth and bottom characteristics in the Gulf of Mexico.

Cooperative Partnerships

All USGS offices in Florida are part of the Florida Integrated Science Center (FISC). FISC offices work cooperatively to conduct scientific investigations. The USGS partners with Federal, State and local agencies, research and educational institutions, and nongovernment organizations to conduct collaborative research and produce interpretive products. Collaboration within the USGS and with external partners, expands and enhances existing resources such as vessels, lab facilities, equipment, and scientific expertise.

—Ellen A. Raabe and Lisa L. Robbins

USGS scientists from FISC offices collaborate on essential fish habitat research.

For Further Information:

Jack Kindinger
Assoc. Director for Science
727-803-8747 x3002
jkindinger@usgs.gov

Terry Kelley
Marine Operations Manager
727-803-8747 x3050
tkelley@usgs.gov

U.S. Geological Survey
600 4th Street South
St. Petersburg, FL 33701

FLaSH website: *http://coastal.er.usgs.gov/flash/*
Capabilities website: *http://coastal.er.usgs.gov/capabilities/*