USGS

Sound Waves

Coastal Science and Research News from Across the USGS

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Fieldwork

USGS Scientists Revisit New Orleans Levee Breaks to Collect High-Accuracy Survey Data

By Brian Collins, Diane Minasian, Tom Reiss, and Helen Gibbons

Three scientists from the U.S. Geological Survey (USGS) visited New Orleans in March to collect highly accurate global-positioning-system (GPS) data from sites where levees failed after Hurricane Katrina made landfall on August 29, 2005. The data are being used to georeference—assign real-world geographic coordinates to—high-resolution laser scans of the levee breaks collected by USGS scientists last fall. The georeferenced laser scans will have many uses, including the accurate determination of floodwall heights in this area where subsiding land has lowered many survey benchmarks and rendered them unreliable as elevation markers.

Brian Collins, **Tom Reiss**, and **Diane Minasian** of the USGS Western Coastal and Marine Geology team were in New

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Brian Collins *oversees simultaneous laser-scanning and differential global-positioning-system (GPS) surveys at the Orleans Avenue Canal pump station, a site that he and* ***Rob Kayen*** *did not include when they scanned levee breaks last October. The tripod supports both the laser-scanning unit (cylindrical instrument) and the GPS antenna (above the scanner). Floodwaters entered neighborhoods by way of the spillway beneath the highway overpass. The spillway had been designed to be several feet lower than the maximum floodwall elevation in the area in order to protect the pump station.*

Diane Minasian *collects GPS data from a roof corner, visible in the three-dimensional laser-scan data sets, near the Inner Harbor Navigation Canal (Industrial Canal) levee breach. Two breaches of the IHNC floodwall led to the flooding of the Lower 9th Ward district.*

Tom Reiss *collects GPS data from a roof corner near one of many homes destroyed by the 17th Street Canal levee breach. In some cases, picking three-dimensional registration points was made difficult by post-flooding movement and settling of structures.*

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Fieldwork, continued

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Orleans from March 13 to 17, working with a group of researchers supported by the National Science Foundation. They revisited levee breaks at the 17th Street Canal, the London Avenue Canal, the Lakefront Airport, and the Inner Harbor Navigation Canal (IHNC, also known as the Industrial Canal). They also visited an area along the Orleans Avenue Canal at one of New Orleans' many pump stations, where floodwaters entered neighborhoods via a spillway.

These breaks were responsible for massive flooding in the aftermath of Hurricane Katrina, which left hundreds of thousands of people homeless. **Collins** and USGS research civil engineer **Rob Kayen** had traveled to the city in October 2005 to conduct high-resolution, ground-based laser scanning of numerous levee breaks (see "USGS Scientists Investigate New Orleans Levees Broken by Hurricane Katrina" in *Sound Waves*, December 2005/January 2006, at URL **http://soundwaves.usgs.gov/2006/01/**). Their work was part of a multiagency review of the levees' performance that was reported to the U.S. Senate (see URL **http://hsgac.senate.gov/_files/Katrina/Preliminary_Report.pdf**).

During their visit last fall, **Kayen** and **Collins** were struck by the desolation of vast areas of New Orleans, and when he returned in March, **Collins**' first impression was that "not a lot had changed. For the most part, the neighborhoods were still abandoned and the stores still closed. While the levee breaches that we visited were under reconstruction, they were also a tragic reminder of what had happened just 6 months earlier." After spending a few days performing surveys, however, he "realized that New Orleans was trying to rebuild and that signs of this were widespread. For one, Bourbon Street was alive and well, and restaurants in other parts of the city, saved from floodwater (but not from looting), were reopening as well."

Close-up of the GPS antenna resting on one of the registration points (corner of a roof) near the 17th Street Canal levee breach.

The March fieldwork focused on high-precision, high-accuracy surveying of "registration points" to be used for georeferencing the laser-scanning data sets gathered last October. The rapid pace of data collection after the drying out of the city in October precluded collecting survey registration points at that time. In preparation for the March surveying work, the researchers used the laser scans collected in October to virtually "revisit" each levee-breach site, pulling potential registration points from three-dimensional objects visible in the laser scans. Corners of structures, concrete founda-

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Brian Collins *next to a GPS base station set up over a temporary control point near the 17th Street Canal levee breach. "Registration points" used to assign geographic coordinates to high-resolution laser scans were referenced off these temporary control points, which in turn were referenced off updated permanent benchmarks composing the geodetic control network in New Orleans.*

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tion pads, fence posts, and levee floodwalls all made attractive targets. In the field, the team discovered that many points were no longer accessible because of reconstruction and repair efforts in the vicinity of the levee breaches; nevertheless, they succeeded in gathering a sufficient number of points to register and georeference the data sets to standard horizontal and vertical survey datums. The team was able to determine the geographic position of each registration point with centimeter-level accuracy.

After completion of the registration process currently in progress, the team's georeferenced data sets will be made available to other researchers and to engineers and construction personnel involved in rebuilding efforts through the U.S. Army Corps of Engineers. The data can be used as a layer depicting postfailure conditions in any geographic-information-system (GIS) study of the levees. A common use of the USGS data sets will be in combination with geotechnical drilling data to see how subsurface geology influenced levee failure.

In view of recent concerns regarding actual floodwall elevations in relation to supposedly "fixed" survey-control benchmarks, the USGS data sets will also be useful for measuring floodwall elevations. Throughout southeastern Louisiana, ground subsidence has caused survey benchmarks, typically used as permanent and reliable elevation indicators, to sink by different amounts, some by more than a foot after their installation. Before beginning the March survey, **Collins** contacted researchers at Louisiana State University (LSU)'s Center for GeoInformatics—headed by **Roy Dokka** and **J. Anthony Cavell**—which has been working with the National Geodetic Survey to establish a network of high-precision GPS reference stations throughout Louisiana (see URL **http://www.c4g.lsu.edu/modules.php?name=LSRC**). The LSU researchers helped **Collins** ensure that the USGS survey was tied into accurate benchmarks that had been resurveyed after Hurricane Katrina, and they assisted the USGS team with logistical support in New Orleans.

Special Feature:

Impressions of Post-Katrina New Orleans and Mississippi, March 2006

By Diane Minasian and Helen Gibbons

A global-positioning-system (GPS) survey of breached levees by U.S. Geological Survey (USGS) scientists in March 2006 was the second visit to post-Katrina New Orleans for **Brian Collins**, but his colleagues **Diane Minasian** and **Tom Reiss** were seeing the hurricane's impact for the first time, and it hit them hard. "As soon as we got off the plane and entered Louis Armstrong Airport," said **Minasian**, "we noticed empty airline counters, few people, few planes coming and going. Driving to the downtown hotel, there was an eerie feeling of empty roadways, no thought of road rules, only a few lights working." The downtown and the French Quarter were the only areas that had any feeling of normalcy—the downtown busy with office workers and the French Quarter teeming with tourists and students who had come to help on their spring break.

"The French Quarter restaurants were full," said **Minasian**. "Music was playing everywhere. In contrast, the areas where we were working were the most damaged: the areas at the levee breaks, the areas that were abandoned, the areas no one could inhabit." In these areas, the only human activity was the work by U.S. Army Corps of Engineers personnel and various contractors to repair levees and floodwalls before the next hurricane season; the deafening sound of pile drivers masked the unnatural quiet. The neighborhoods that might be salvageable had some church groups and students on spring break preparing houses for demolition. All of the debris had to be out on the street for trucks to haul away (see related article, "Post-Katrina Cleanup in Biloxi, Mississippi—a Volunteer's Reflections," in *Sound Waves*, December 2005/January 2006, at URL

A flag waves over neatly piled bricks where a house once stood on Beach Street, Bay St. Louis, Miss.

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http://soundwaves.usgs.gov/2006/01/fieldwork2.html).

After the fieldwork, **Minasian** spent an extra day in New Orleans, then drove to Mississippi to view the path of the hurricane's eye. "Driving out of New Orleans, I was amazed by the extent of the flooding and desolation," said **Minasian**. "Miles and miles of neighborhoods with no people, strip malls with no one—just emptiness, like a bad science-fiction movie." The damage she saw in Mississippi had been caused mainly by wind rather than flooding. Trees had been broken and houses literally blown away. "Reconstruction was happening," she said, "but at a very slow pace. The area was still mostly how the hurricane had left it."

An A-frame house stands behind downed trees and debris in Bay St. Louis, Miss. The red car never made it out of town.

Release of usSEABED Offshore Sediment Data for the Atlantic Coast Region—a Tool for GIS Mapping and Research

By S. Jeffress Williams

Explosive population growth and development are affecting all coastal regions of the Nation, and demographic projections indicate that people will continue moving to the coast, putting more people and development at increased risk from natural hazards. With the prospect of global climate change likely causing increased storminess and accelerated sea-level rise, coastal regions will be even more dynamic and vulnerable to erosion and storm-surge flooding.

Continental-shelf regions adjacent to the U.S. mainland are products of complex geologic histories and dynamic oceanographic processes, dominated by marine transgression during Pleistocene and Holocene time (a rise in sea level of more than 100 m during the past 20,000 years). The Nation's Exclusive Economic Zone, generally defined as the area extending 200 nautical miles seaward from the coast, is larger than the continental United States and contains submerged landforms that provide various natural and societal benefits. These landforms serve as critical habitats for fisheries, landmarks for navigation, and sites for engineering activities (for example, oil and gas platforms, pipeline and cable routes, and potential wind-energy-generation sites). Some parts of the continental margins contain unconsolidated hard-mineral deposits, such as sand and gravel, which are regarded as potential aggregate resources to meet beach-nourishment needs or to augment aggregate resources from onshore deposits. A better understanding of the sea floor off the United States is also of growing concern for specialists in homeland security.

The USGS, in collaboration with other Federal agencies, coastal States, and universities, is leading a Nation-wide program to gather existing marine geologic data into a fully integrated digital database called usSEABED (URL **http://walrus.wr.usgs.gov/usseabed/**). This innovative database, which combines a broad array of physical data and information about the sea floor, including textural, statistical, geochemical, geophysical, and compositional information, is being used to produce a suite of maps of sea-floor characteristics suitable for use in any geographic information system (GIS). These maps are part of ongoing efforts to conduct regional assessments of potential marine sand and gravel re-

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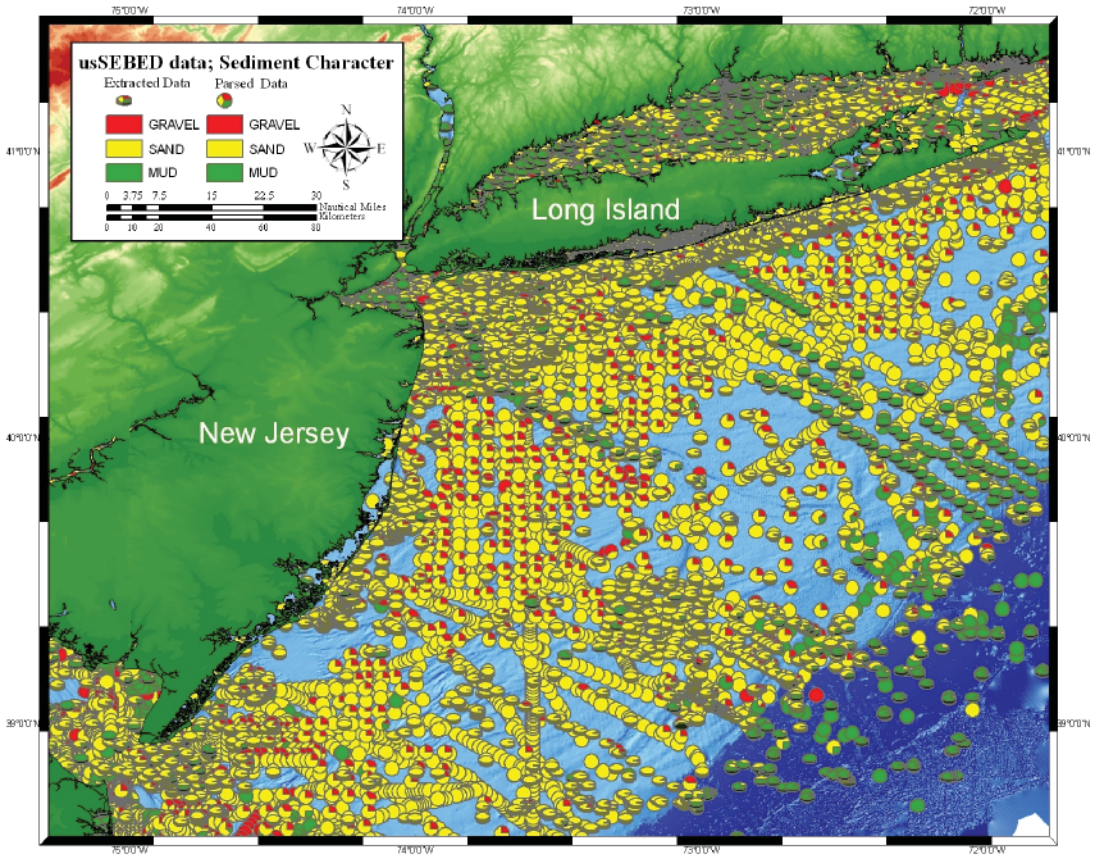
sources and to map sea-floor habitats; however, GIS products from usSEABED can also be used by planners and managers for numerous other purposes.

The first of the data releases, **usSEABED: Atlantic Coast Offshore Surficial Sediment Data Release, version 1**, was published in 2005 as USGS Data Series 118 (URL **http://pubs.usgs.gov/ds/2005/118/**). This report was coauthored by **Jamey Reid**, **Jane Reid**, **Larry Poppe**, the late **Polly Hastings**, **Jeff Williams** (all USGS), and **Chris Jenkins** of the University of Colorado. Other such publications for the Gulf of Mexico and the Caribbean (USGS Data Series 146, **Buczkowski** and others) and the Pacific coast (USGS Data Series 182, **Reid** and others) will be published over the next few months. Data are currently being compiled for sea-floor areas off Alaska and Hawaii. Each publication will be updated as additional data become available, with notices about these updates and other information posted on the usSEABED Web site (URL **http://walrus.wr.usgs.gov/usseabed/**).



*Sediment map of the New York-New Jersey offshore region, showing the distribution of three main sediment classes (red, gravel; yellow, sand; green, mud). Although sand predominates across the region, muddy sediment is associated with the Hudson shelf valley and deeper regions, and gravel is patchy and common in erosional areas. The seabed composition is the product of the framework geology underlying the shelf, Holocene marine transgression, and modern oceanographic processes. Similar GIS maps can be created by using the usSEABED database. This map was generated from the recently published Atlantic coast offshore sediment data release, USGS DS 118 (URL **http://pubs.usgs.gov/ds/2005/118/**).*

The data supplied in these reports are made available with geographic coordinates so that the data can be incorporated into any GIS product. Layers include numeric data from field or laboratory measurements (extracted, or EXT), numeric data from word-based descriptions (parsed, or PRS), data mined from the EXT and PRS data files using known relations (calculated, or CLC), composition and feature data of the sea floor as individual components (CMP), and combined facies (FAC) output files, along with base-map layers compiled in an ArcView project file. The database currently includes more than 340,000 stations of sea-floor and sediment data. Federal Geographic Data Committee metadata are included, with data layers in three formats: HTML, FAQ, and text.

In an effort to make the data more accessible to the public, geographically relevant subsets of DS 118 are being posted by **Matthew Arsenault** (USGS) to State GIS clearinghouse Web sites, such as the Rhode Island Geographic Information System (URL **http://www.edc.uri.edu/rigis/**) and the Florida Geographic Data Library (URL **http://www.fgdl.org/**). Many of these sites serve as the primary source of GIS information for State and local agencies. The response from the State clearinghouses has been both positive and enthusiastic. Most of the holdings on these sites are for terrestrial features, and the addition of usSEABED data constitutes a substantial expansion of their coverage. As an added bonus, many of the clearinghouses have helped the USGS usSEABED team establish additional connections with local agencies and their data collections.

Within regions of dense, high-quality data coverage on the continental margin, such as the New York Bight, usSEABED is being used to generate maps of sea-floor sediment types, such as gravel, sand, and mud. The database can also be used to generate maps of various other seabed parameters, such as areas of hard ground, texture classification, color, carbonate content, organic-carbon content, sea-floor roughness, and sediment shear stress. The resultant GIS sea-floor maps are providing fresh scientific insights into the geologic character and history of continental margins.

USGS Scientists Participate in Workshop on GIS and Ocean Mapping in Support of Fisheries Research and Management

By Fran Lightsom

U.S. Geological Survey (USGS) scientists presented their research at a workshop sponsored by the Massachusetts Institute of Technology (MIT) Sea Grant College Program and the National Oceanic and Atmospheric Administration (NOAA) Northeast Fisheries Science Center on April 11, 2006, in Cambridge, Mass. The workshop focused on the needs and challenges of using ocean mapping and geographic information systems (GIS) to support fisheries management and research, with an emphasis on the U.S. eastern seaboard from Cape Hatteras northward. (For more information, see the workshop announcement at URL **http://web.mit.edu/seagrant/GIS06/**.) The workshop program emphasized poster presentations and informal discussions, with a small number of oral presentations to provide an overview of needs, methods, and organizational programs.

One invited speaker was **John Haines**, program coordinator for the USGS Coastal and Marine Geology Program (CMGP), who presented the program's sea-floor-mapping activities. **Haines** emphasized the importance of working as partners and the need to integrate a geologic framework into the knowledge base for all aspects of ocean management. Scientists from the USGS Woods Hole Science Center who attended the workshop to present posters included **Seth Ackerman** (also affiliated with the Massachusetts Office of Coastal Zone Management), **Brian Andrews**, **Matt Arsenault**, **Walter Barnhardt**, **Brian Buczkowski**, **Brad Butman**, **Jane Denny**, **Larry Poppe**, **Page Valentine**, and **Jeff Williams** (all of the USGS CMGP). **Bill Schwab**, chief scientist of the Woods Hole Science Center, served on the workshop steering committee.

Three New Mendenhall Postdoctoral Research Fellows Will Conduct Coastal and Marine Research

By Helen Gibbons

A new group of Ph.D. graduates will join the U.S. Geological Survey (USGS) as Mendenhall Postdoctoral Research Fellows in fiscal year 2007 (FY07, starting October 2006). **Linda Gundersen**, USGS Acting Associate Director for Geology, announced their names in early April, noting that "we continue to attract some of the best new Ph.D. graduates to address a broad range of research topics." Three of the new Mendenhall Fellows plan to conduct research in coastal or marine areas:

- **Alberto Lopez** (Northwestern University) will work with **Uri ten Brink**, **Eric Geist**, and **Homa Lee** on a "Quantitative Evaluation of Tsunami Hazard to the Atlantic and Caribbean Coasts."
- **John Pohlman** (College of William and Mary) will work with **Deborah Hutchinson** and **Timothy Collett** on "The Occurrence and Behavior of Gas Hydrate in Natural Environments."
- **Lee Florea** (University of South Florida) will work with **Kevin J. Cunningham**, **Peter Swarzenski**, and **Eugene Shinn** on the "Application of Sequence Stratigraphy to Delineate Heterogeneous Ground-Water Flow in Karstic Platform Carbonates."

The FY07 Fellows will be the seventh group hired for 2-year appointments under the Mendenhall program, which began in 2001. "The influx of postdoctoral talent continues to be a vital resource for the future of our science," wrote Gunderson, adding that she has been quite impressed by "the energy and productivity of our Mendenhall Fellows and the stimulation they provide our permanent staff." To learn more about the program and projects being conducted by current Mendenhall Fellows, please visit URL **http://geology.usgs.gov/postdoc/.**

Walter C. Mendenhall *(1871-1957), fifth Director of the USGS, for which the Mendenhall Postdoctoral Research Fellowship Program is named. For more information about his term (1930-43), visit URL* ***http://pubs.usgs.gov/circ/c1050/depress.htm****.*

USGS Biologist Coauthors Book on the Florida Manatee

The Florida Manatee: Biology and Conservation, by **Roger Reep** and **Robert Bonde**, was recently published by the University Press of Florida.

The authors engage the reader with a tale that weaves facts and real-life scenarios to explain what science has learned from the endangered Florida manatee. From complex long-range migrations to microorganisms that cause manatee die-offs during red-tide blooms, a range of issues affecting manatee survival are discussed in the book. The complex biology of the manatee, landmark legislation of the 1970s, and the biopolitics that result when science and wildlife management intersect are all vital aspects of the ongoing story of the manatee.

Reep is a neuroscientist and professor in the College of Veterinary Medicine at the University of Florida; **Bonde** is a biologist with the U.S. Geological Survey (USGS)'s Sirenia Project (see URL **http://cars.er.usgs.gov/Manatees/manatees.html**).

Cover photograph from The Florida Manatee: Biology and Conservation*, showing a swimmer and a wild manatee in Crystal River National Wildlife Refuge, Fla. (URL* ***http://www.fws.gov/crystalriver/****). Photograph courtesy of the USGS Sirenia Project.*

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