

Fieldwork

Earthquake Swarms in the Puerto Rico Trench Monitored by Ocean-Bottom Seismometers [revised February 2008]

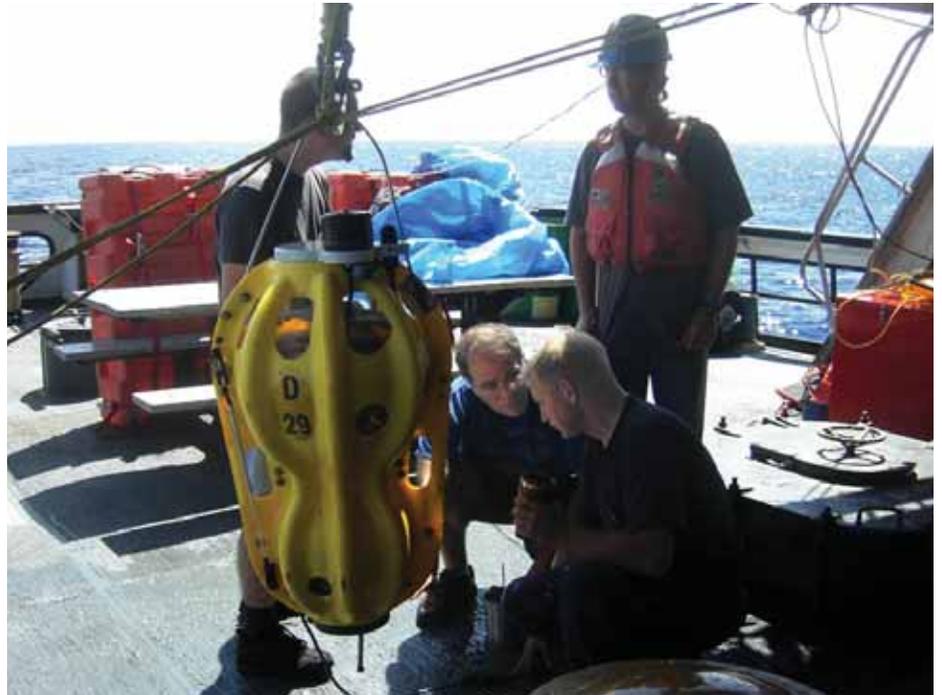
By Uri ten Brink and Alberto Lopez

Scientists monitored sea-floor earthquake activity northeast of Puerto Rico during a 6-month period this year, collecting data that could lead to a better understanding of the danger from large subduction-zone earthquakes and tsunamis in the Caribbean region.

Five ocean-bottom seismometers (OBSes) were deployed on March 8, 2007, by researchers from the U.S. Geological Survey (USGS) and the Woods Hole Oceanographic Institution (WHOI). Each OBS is a self-contained data-acquisition system that free-falls to the ocean floor, where it converts motions of the sea floor into electrical signals that are recorded digitally (see URL <http://woodhole.er.usgs.gov/operations/obs/>). The scientists deployed short-period OBSes that record frequencies from about 2 to 80 Hz. The instruments were picked up on September 3, 2007, after spending 6 months collecting data at water depths of more than 5,000 m.

The area northeast of Puerto Rico is characterized by frequent swarms of seismic tremors lasting a week or two at a time. One such swarm in 2001 included three earthquakes with moment magnitudes of 5.5 to 6. Although the cause of these recurring swarms is unknown, a study of earthquake hypocenters (points where earthquake ruptures begin), using data from OBSes deployed by the USGS in 2005, suggests that the tremors originate along the subduction zone between the North American and Caribbean tectonic plates. (See article in *Sound Waves*, June 2005, URL <http://soundwaves.usgs.gov/2005/06/fieldwork.html>.) Because of the geography of the northeastern Caribbean, earthquakes in this region cannot be accurately located by using land stations

(Earthquake Swarms continued on page 2)



Inspection of OBSes aboard the U.S. Coast Guard cutter *Dauntless* after recovery. Standing: WHOI technicians **Alan Gardner** (left) and **Dave DuBois**. Kneeling: USGS scientist **Uri ten Brink** (left) and USCG Chief Electrician's Mate **Tim Glasgow**. Photograph by **Alberto Lopez**, USGS.



Caribbean region, showing study area. See detailed map on page 3.

Sound Waves

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Submission Guidelines

Deadline: The deadline for news items and publication lists for the March issue of *Sound Waves* is Friday, January 11.

Publications: When new publications or products are released, please notify the editor with a full reference and a bulleted summary or description.

Images: Please submit all images at publication size (column, 2-column, or page width). Resolution of 200 to 300 dpi (dots per inch) is best. Adobe Illustrator® files or EPS files work well with vector files (such as graphs or diagrams). TIFF and JPEG files work well with raster files (photographs or rasterized vector files).

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Can't find the answer to your question on the Web? Call 1-888-ASK-USGS

Want to e-mail your question to the USGS? Send it to this address: ask@usgs.gov

Fieldwork, continued

(Earthquake Swarms continued from page 1)



GPS dome antenna (background) and seismic vault housing temporary broadband seismometer (foreground) on the island of Anegada. Photograph by **Alberto Lopez**, USGS.

alone—hence the need to deploy ocean-bottom seismometers.

If confirmed by analysis of the recently acquired OBS data, the locations of the tremors at the plate interface may have profound implications about the capability of the Puerto Rico Trench to generate large earthquakes. Additionally, the tectonic setting of the Puerto Rico Trench is sometimes compared to that of the Sumatra subduction zone, the site of the earthquake that triggered the devastating Indian Ocean tsunami of December 2004. This similarity has caused great interest in the assessment of potential tsunami hazard to the U.S. east coast and the northeastern Caribbean from a large subduction-zone earthquake along the Puerto Rico Trench.

All five OBSes recorded data during the entire 6-month deployment. As it happened, the region was unusually active, with three swarms and at least 518 earthquakes. The OBS data are currently being merged with seismic data recorded on land in Puerto Rico and the Virgin Islands by the Puerto Rico Seismic Network, seismic data recorded on land in the Netherlands

Antilles by the Royal Netherlands Meteorological Institute and the Meteorological Service of the Netherlands Antilles and Aruba, and data recorded by a temporary broadband seismometer on the island of Anegada, British Virgin Islands. A global-positioning-system (GPS) station on the island of Anegada, the island closest to the swarm, will help determine whether the swarm is at the edge of an aseismic segment of the subduction zone—a phenomenon observed elsewhere in the world, where swarms of minor earthquakes occur at the edge of subduction-zone segments that are not producing earthquakes, either because they are locked or because they are moving smoothly, without the “stick slip” motion that triggers earthquakes. An integrated analysis of the various data sets will likely provide accurate locations of the earthquakes,

knowledge about their focal mechanisms (earthquake-slip directions and orientations of the earthquake fault), and an understanding of the potential earthquake and tsunami hazards from the Puerto Rico Trench.

The five OBSes were deployed by **Alberto Lopez**, a Mendenhall Postdoctoral Research Fellow at the USGS Woods Hole Science Center in Woods Hole, Massachusetts, and **David DuBois** of WHOI, aboard the National Oceanic and Atmospheric Administration (NOAA) ship *Nancy Foster* (URL <http://www.moc.noaa.gov/nf/>) on transit to Puerto Rico from her home port in Charleston, South Carolina. The instruments were picked up by **Lopez**, **Uri ten Brink** (USGS Woods Hole Science Center), **DuBois**, and **Alan Gardner** (WHOI) aboard the U.S. Coast Guard cutter *Dauntless* (URL <http://www.uscg.mil/lantarea/cutter/dauntless/dauntless.htm>), a 210-ft Reliance class cutter out of Galveston, Texas. The cutter's crew, under the command of Commander **Dwight Mather**, helped stage the recovery operation. Assisting with logistics on land was Chief Warrant Officer

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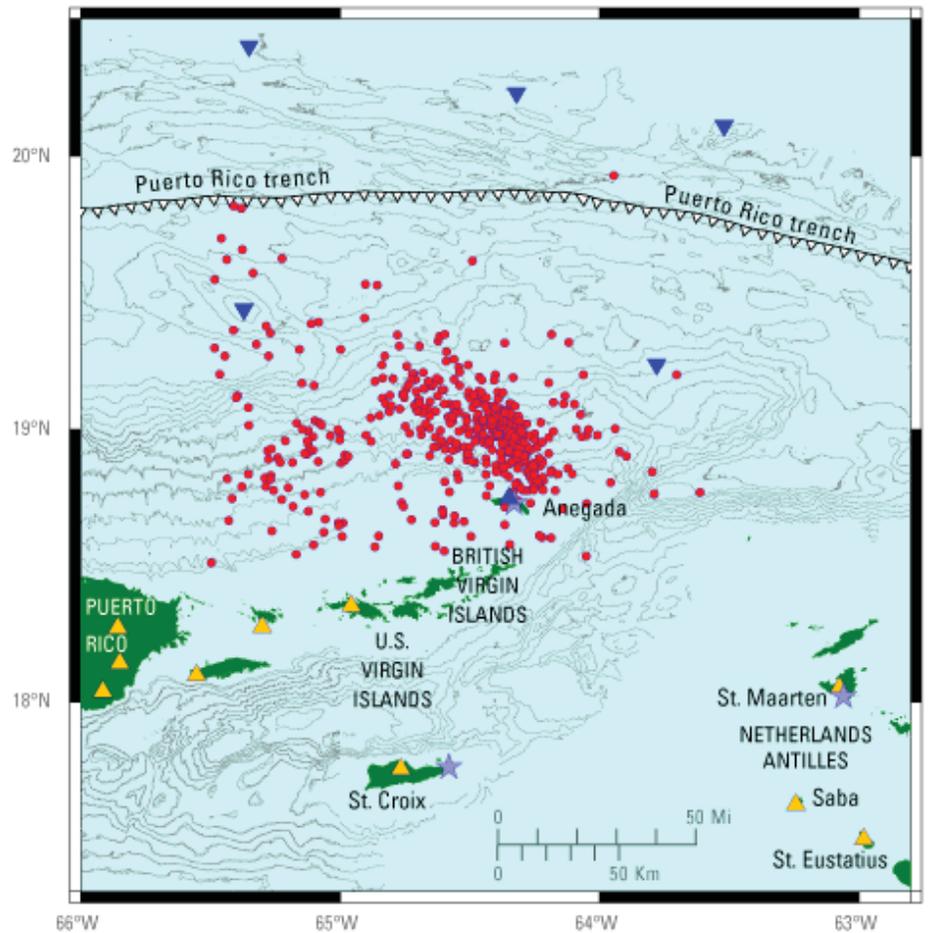
Fieldwork, continued

(Earthquake Swarms continued from page 2)

Michael Mullen of the U.S. Coast Guard station in San Juan, Puerto Rico. While on the way to pick up the OBSes, the *Dauntless* was diverted to pick up 31 Dominican migrants drifting on a small boat in the high seas (see URL <https://www.piersystem.com/go/doc/586/170631/>), an interesting and moving experience for the scientific team on board.

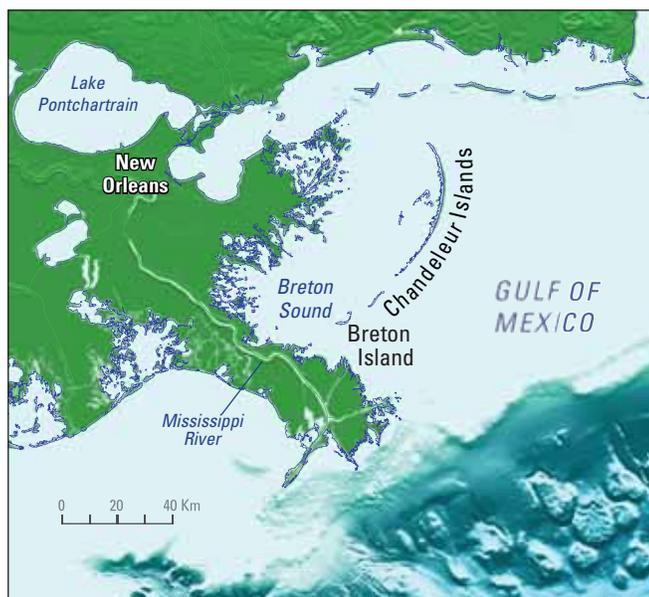
Additional partners in this study are **Victor Huérfano Moreno** and **Christa von Hillebrandt-Andrade** from the Puerto Rico Seismic Network and **Jay Pulliam** from the University of Texas' Institute for Geophysics. ☼

Preliminary locations of epicenters of earthquakes that took place during 2007 OBS deployment, determined by the Puerto Rico Seismic Network (PRSN; URL <http://redsismica.uprm.edu/english/>). Also shown are locations of OBSes (inverted blue triangles), a temporary broadband seismometer in Aneгада (blue triangle), and GPS stations installed in Aneгада and St. Maarten (purple stars) as part of the project, as well as broadband seismometers (yellow triangles) operated by the PRSN, the Royal Netherlands Meteorological Institute (KNMI; URL http://www.knmi.nl/about_knmi/), and the Meteorological Service of the Netherlands Antilles and Aruba (MDNA&A; URL <http://www.weather.an/>).



Assessing the Resilience of a Vital Barrier-Island Chain—Chandeleur and Breton Islands, Louisiana

By Chandra Dreher, Jim Flocks, and Dawn Lavoie



The Chandeleur and Breton Islands make up a north-south-trending island chain, remnants of the St. Bernard Delta that occupied the area 2,000 years ago. The ancient delta was deposited by the Mississippi River, and its remnants lie northeast of the modern river delta. Since abandonment, the St. Bernard Delta, including the

Chandeleur Islands, Breton Island, and Breton Sound. The Chandeleur and Breton Islands constitute Breton National Wildlife Refuge.

islands and the adjacent Breton Sound, has undergone erosion and subsidence.

In 1904, the island chain became the Nation's second wildlife refuge, Breton National Wildlife Refuge (URL <http://www.fws.gov/breton/>), when **President Theodore Roosevelt** learned of disruption to the nesting habits of migrant birds and pushed to protect the flora and fauna of the islands from human intervention. The islands have been home to wildlife, a lighthouse station (destroyed by Hurricane Katrina), a quarantine station, a small fishing village, and even an oil-production facility.

Over the years, the islands not only provided sanctuary for the endangered and threatened wildlife species that seasonally inhabit them, but also protected the mainland, wetlands, and population centers,

(Barrier Islands continued on page 4)

Fieldwork, continued

(Barrier Islands continued from page 3)

such as New Orleans, from countless tropical storms and everyday wave activity. Erosion and subsidence, however, along with the increasing strength and frequency of hurricanes and storms, have negatively impacted the islands. Since the 1880s, the documented impacts of severe weather on the islands have illustrated a constant state of dynamic change as the islands respond to hurricanes and other natural processes. These events have caused breaches that fragment the islands. In 2005, Hurricanes Katrina and Rita turned the fragmented

and fragile islands into splinters of marsh and a mosaic of submerged shoals, destroying the integrity of the island chain and reducing its area by 85 percent.

In 2006, the USGS collaborated with the University of New Orleans (UNO)'s Pontchartrain Institute of Environmental Studies (PIES)—with partnership and support from the Louisiana Coastal Area (LCA) Ecosystem Restoration Science and Technology Program of the Louisiana Department of Natural Resources (LDNR)—to provide a new set of post-Katrina baseline bathymetric and topographic data

and maps for all the sandy shorelines in Louisiana. During 2006, the first year of this 2-year project, the scientific partners conducted extensive surveys of the northern part of the Chandeleur island chain to produce a data set needed to evaluate shoreline change. Such baseline data sets will be used to measure island response to future events. The 2006 survey was featured in *Sound Waves*, August 2006 (URL <http://soundwaves.usgs.gov/2006/08/>).

In 2007, the same team of scientists expanded its collaborators, gaining an additional partner, the U.S. Fish and Wildlife Service (FWS). The team also expanded the scope of work to include the southern part of Breton National Wildlife Refuge. As the refuge manager, the FWS has the task of making restoration-management decisions, when feasible, to protect endangered wildlife struggling to recover from Hurricane Katrina and restore decimated land. To accomplish this task and the expanded project goals, the scientists collected additional bathymetric and topographic data along the south half of the island chain and investigated the subsurface geology through geophysical surveys and subbottom sediment sampling. These data will be entered into models to predict the future of the island chain under various restoration scenarios.

The team is focusing on three critical questions posed under the expanded project, titled "Predicting the Resilience of the Chandeleur Island Chain as a Function of Restoration Options":

- Can the islands be restored, and is it feasible in the long and short term to restore and rehabilitate parts of Breton National Wildlife Refuge?
- How much benefit will restoration provide to struggling habitats, or will the islands rebuild themselves naturally?
- Is there a point of no return for the Chandeleur and Breton Islands; are they ultimately going to disappear completely?

(Barrier Islands continued on page 5)



▲ Shoreline-change map of the Chandeleur Islands after the 2005 hurricane season. Land areas shown in green from a 2004 survey were obliterated by the 2005 hurricanes, leaving only the land areas shown in brown above water by the end of the season. Modified (type enlarged) from a Barrier Island Comprehensive Monitoring Program (BICM) Interim Product of 2006 by UNO-PIES, USGS, LDNR, and the U.S. Army Corps of Engineers.

Fieldwork, continued

(Barrier Islands continued from page 4)

To answer these questions, the team spent summer 2007 completing the survey of the southern Chandeleurs to provide information on the processes that change the extent of the islands and shoals. The team is continuing to monitor short- and long-term habitat change and island evolution. Shoreline change is monitored by using lidar (light detection and ranging) and aerial photography, comparing images collected every 3 to 4 months to a baseline survey and to prestorm images (for more information on the lidar and aerial-photography efforts, please contact **Abby Sallenger** at asallenger@usgs.gov).

In June 2007, USGS and UNO scientists collected bathymetric data off the southern Chandeleur Islands, Breton Island, and the west Louisiana coastline as part of the Barrier Island Compre-

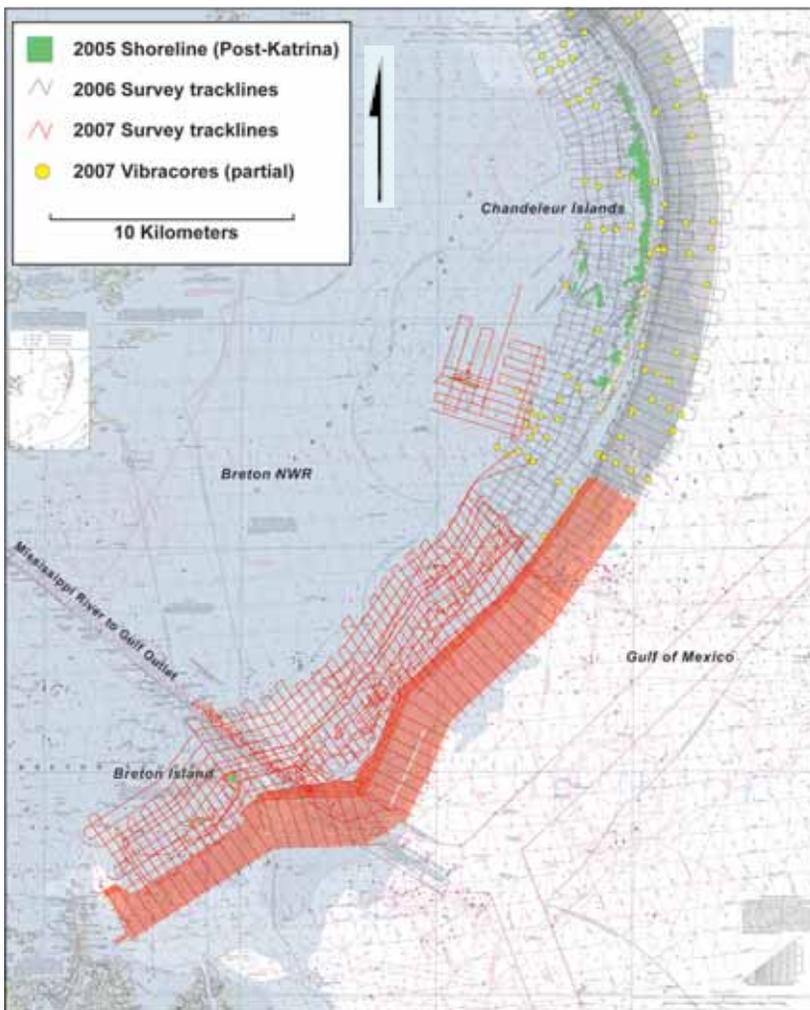


The Chandeleur Islands. The houseboat Pelican, one of the base stations for operations, is visible between patches of marsh. View southward; photograph by Mike Miner, UNO.

hensive Monitoring (BICM) program with LDNR. Teams from USGS offices in St. Petersburg, Florida (**Jim Flocks**, **Dana Wiese**, and **Rich Young** on the research vessel *G.K. Gilbert*), and Woods

Hole, Massachusetts (**Dave Twichell**, **Chuck Worley**, **Emile Bergeron**, **Bill Danforth**, and **Wayne Baldwin** on the research vessel *Acadiana*), collaborated to collect high-resolution geophysical and bathymetric data (including Chirp subbottom data, sidescan-sonar data, and interferometric swath bathymetry). Shallow-water bathymetric data were collected simultaneously by teams from the USGS office in St. Petersburg (**Nancy Dewitt**, **BJ Reynolds**, and **Dawn Lavoie**) and from UNO (**Mark Kulp**, **Jeff Motti**, **Dallon Weathers**, **Mike Miner**, **Phil McCarty**, and **Mike Brown**). The 2007 bathymetric surveys are currently being processed and will be integrated with data from the 2006 surveys to develop a landmark database of sea-floor and subbottom information. The bathymetric data will allow the team to assess sediment budgets, including sediment-transport, sediment-distribution, and erosional patterns for the islands, and the integrated data will be used in models to project future trends for the islands.

(Barrier Islands continued on page 6)



Trackline map representing the collaboration of four teams that operated simultaneously to collect bathymetry in 2006 (gray lines) and 2007 (red lines). In addition, Chirp subbottom data, sidescan-sonar data, and interferometric swath bathymetry were collected on the gulf side of the islands (dense grids), and Chirp subbottom data on the Breton Sound side of the islands. Sediment cores were collected in 2007 (yellow circles) around the northern islands, and additional cores and grab samples (not shown) nearshore. Survey lines laid over a National Oceanic and Atmospheric Administration (NOAA) bathymetric chart, with the 2005 (post-Katrina) land area superimposed (green).

Fieldwork, continued

(Barrier Islands continued from page 5)

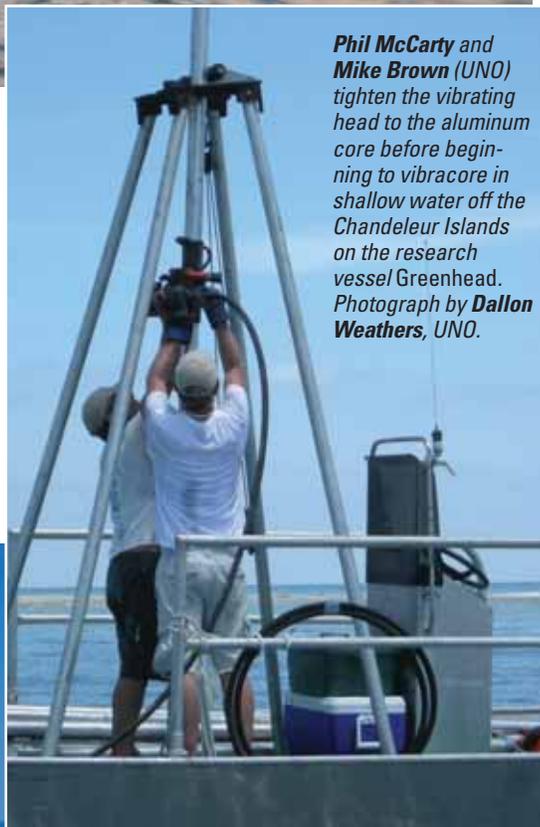
Data from the geophysical surveys conducted in 2006 were used to develop a coring strategy to ground-truth the data and provide textural classification of the sediments that make up the geologic framework of Breton National Wildlife Refuge. In 2007, teams from the USGS office in St. Petersburg (**Nick Ferina, Chandra Dreher, Jordan Stanford, and Keith Ludwig** on the *Gilbert*) collected vibracores in the waters surrounding the islands, while a team from UNO-PIES (**McCarty and Brown**) collected shallow-water and marsh vibracores. Concurrently, another team—**Ioannis Georgiou, Jeff Motti, and Dallan Weathers** (UNO) and colleague **Duncan FitzGerald** (Boston University)—collected grab samples of sediment on the shoreface, in the surf zone, and in the backbarrier of the Chandeleurs, as well as in tidal inlets. Data from the samples will be used to develop simulation tools and models to document and forecast the recovery processes taking place since the 2005 hurricanes. Sample data will also be used in regional wave and storm-surge models to characterize island response to intermediate-magnitude storms and to provide estimates of sediment-transport rates. The scientific data collected during these efforts will provide the FWS with information on the stability and fate of the islands and help the agency make sound management decisions.

The USGS and its partners are integrating all data types to provide the short-term data needed for the next step, which is modeling the data to predict island response to future events. The near-term goal of the cooperative effort is to determine how or whether the islands will recover naturally, to estimate the magnitude of effort required to push the islands toward recovery, and to ascertain what a sustainable “recovery cure” might be. ❁

Sunset at the vessel Southern 6, home base for all the bathymetric and shallow-water seismic surveys during summer 2007. Photograph by **Mike Miner, UNO**.



Phil McCarty and Mike Brown (UNO) tighten the vibrating head to the aluminum core before beginning to vibracore in shallow water off the Chandeleur Islands on the research vessel Greenhead. Photograph by **Dallan Weathers, UNO**.



USGS crew on the research vessel *G.K. Gilbert* collect a 20-ft sediment core, using a Rossfelder electric vibracore system and hydraulic crane.



Students Enjoy Earth Science Day 2007 at USGS in Menlo Park, California

By Helen Gibbons

Occasional rain could not dampen the spirits of more than 1,000 students from more than 40 local schools when they attended Earth Science Day at the U.S. Geological Survey (USGS) campus in Menlo Park, California, on October 16, 2007. Numerous hands-on exhibits were set up for this 1-day celebration of Earth Science Week, an annual event established by the American Geological Institute to help the public gain a better understanding and appreciation of the Earth sciences.

At this year's Earth Science Day, students could make their own landslides, experience simulated earthquake shaking, see a demonstration of the dangers of volcanic CO₂ emissions, and much more. In addition to USGS exhibits, displays and activities were presented by the California Geological Survey, the San Francisco Zoo, the American Red Cross, PG&E, and the California Academy of Sciences. (Visit URL <http://geomaps.wr.usgs.gov/EarthScienceWeek/exhibits.html> for a complete list of exhibits.)

Several of the displays had coastal or marine themes:

- At "Submarine Landslides Can Cause Destructive Tsunamis"—presented by **Lori Hibbeler** and **Homa Lee** of the Western Coastal and Marine Geology (WCMG) team—students slid a brick into a tub of water to trigger a



Students view tiny marine organisms through microscopes in a popular activity presented by **Mary McGann** (not shown). Photograph by **Mike Diggles**, USGS.

miniature tsunami, and then watched it sweep plastic buildings off a second brick representing the coast.

- At "Topo Salad Trays (Landforms in 3D)"—presented by **Helen Gibbons**, **Rachel Dunham**, **Laura Torresan**, and **Mike Torresan** (WCMG)—students learned about contour lines and topographic maps as they stacked up clear plastic trays, each with a labeled contour line on the bottom, and saw Monterey Submarine Canyon and Angel Island take shape in three dimensions.

- At "Dive into Marine Geology"—presented by **Carol Reiss** (WCMG)—students learned about plate tectonics, handled sea-floor rock samples, and watched deep-sea hydrothermal vents videotaped from a submersible at a midocean spreading ridge.
- At "Our Micro-World"—presented by **Mary McGann** (WCMG)—students looked through microscopes at shells of tiny marine organisms, learned about one-celled animals that have invaded San Francisco Bay, and handled equipment used to collect and analyze marine microorganisms.
- At "How Clean Is Clean?"—presented by **Jim Kuwabara** of Water Resources Discipline's National Research Program—students used a salinity meter to try to differentiate between ocean water, bay water, tap-water, bottled water, and high-purity lab water.
- At "Tsunami: When the World Waves Back"—presented by **Shane Detweiler**, **Jillian McLaughlin**, **Walter Mooney**, and **Jesse Kass** of the Earthquake Hazards Team, with assistance from **Eric Geist** of WCMG—students moved a sub-

(Earth Science Day continued on page 8)



Left: **Lori Hibbeler** helps a student line up a brick before sliding it into water to simulate a landslide-induced tsunami. Right: Enthusiastic student triggers an impressive wave at the "Submarine Landslides Can Cause Destructive Tsunamis" display. Photographs by **Mike Diggles**, USGS.

Outreach, continued

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merged piece of plastic to simulate a sea-floor earthquake and trigger a miniature tsunami that ran up on a sandy beach.

Several WCMG scientists provided logistical support: **Carol Reiss** served on the planning committee, and **Clint Steele**, **Carolyn Degnan**, and **Pete Dartnell** helped prepare and hang signs in Building 1. **Clint** replenished handout stacks and directed visitors in Building 1, and **Carolyn** directed visitors in Building 3.

The invitation-only event was designed for children from grades 1 through 8 and included home-schooled students as well as students from public and private schools around the San Francisco Bay area. Exhibits were open from 9:30 a.m. until 2:00 p.m., with groups assigned different arrival times to prevent overcrowding. Although the campus got congested around the noon hour, all the attendees seemed to enjoy themselves, and rewarded exhibitors with appreciative comments. The event

organizer, **Christy Ryan**, received some glowing thanks from teachers, including the following e-mail message: "This event [and] the open house [held every 3 years] are always slam-dunk events. The scientists sharing their passion with the kids is priceless! We got back to school, and the kids were bubbling with all of the 'cool' stuff they learned. It's amazing to me just how much they actually walk away with in their brains!"

The USGS in Menlo Park was just one venue in the nationwide celebration of Earth Science Week, held this year from October 14 through 20 with the theme "The Pulse of Earth Science" (see URL <http://www.earthsciweek.org/>). Earth scientists at universities, government agencies, and businesses nationwide opened their doors to visitors, visited classrooms, and hosted field trips. For more information about USGS Earth Science Week activities, visit URL <http://www.usgs.gov/earthscience/2007/>. ❁



Rachel Dunham uses a set of plastic trays on which contour lines have been drawn to give students a three-dimensional view of Monterey Submarine Canyon. Photograph by **Mike Diggles**, USGS.

Meetings

USGS Emeritus Scientist Leads Field Trip to Ancient Submarine-Canyon Fill on Central California Coast

By Amy Draut



Field-trip leader **Ed Clifton** explains how complex structures observed in the Carmelo Formation may have formed. Visible in background is conglomerate of the Carmelo Formation.

Glorious fall weather and a striking coastal setting added to participants' enjoyment of a daylong field trip to exposures of submarine-canyon fill in Point Lobos State Reserve, south of Carmel, California. The October 7 field trip was organized by the Pacific Section of SEPM (Society for Sedimentary Geology) and led by **Ed Clifton**, a U.S. Geological Survey (USGS) Emeritus scientist with the USGS Western Coastal and Marine Geology team. Trip leader **Clifton** and coleader **Larry Rychner**, retired from Chevron Production, both volunteer as docents at Point Lobos State Reserve, renowned for its scenic beauty and rich diversity of plants and wildlife (see URL <http://pt-lobos.parks.state.ca.us/>).

Approximately 70 field-trip participants spent the day walking through the reserve and learning about sandstone and conglomerate outcrops of the Carmelo Forma-

tion, interpreted as Paleogene submarine-canyon-fill deposits resting unconformably on Cretaceous granodiorite of the Salinia terrane. **Clifton** summarized his 42 years of work on the Carmelo Formation, pointing out features of these spectacular, complex deposits that reveal new insights into physical processes of submarine gravity flows and the geometry of potential hydrocarbon-reservoir facies. **Clifton's** guidebook to the geology of the Point Lobos State Reserve was newly published for this field trip and is available through the Pacific Section of SEPM as Book 105.

The Point Lobos field trip was one of two field trips offered this fall by the Pacific Section of SEPM in the San Francisco Bay area; the other, held October 6, examined the stratigraphy and depositional environments of rocks exposed at the Stanford Linear Accelerator Center

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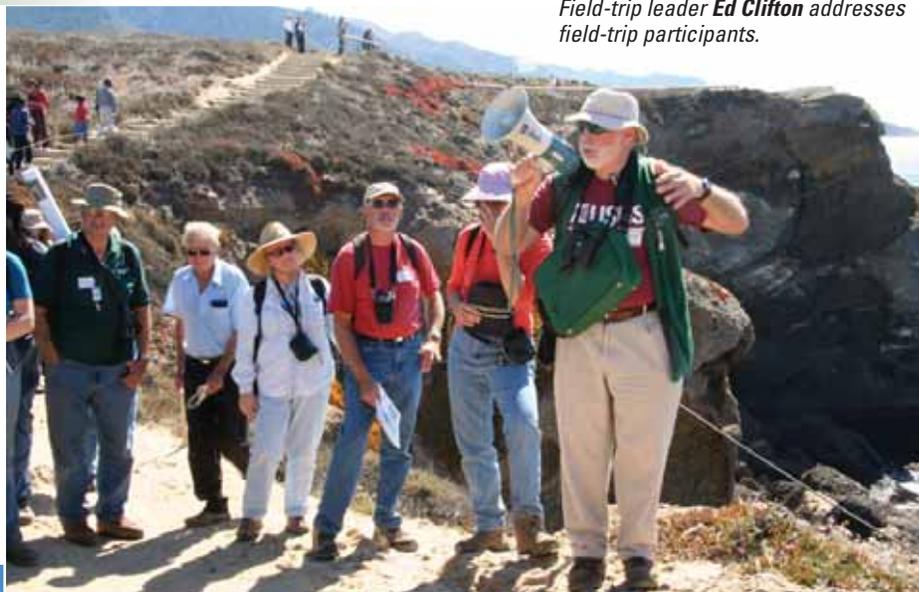
Meetings, continued

(Field Trip continued from page 8)

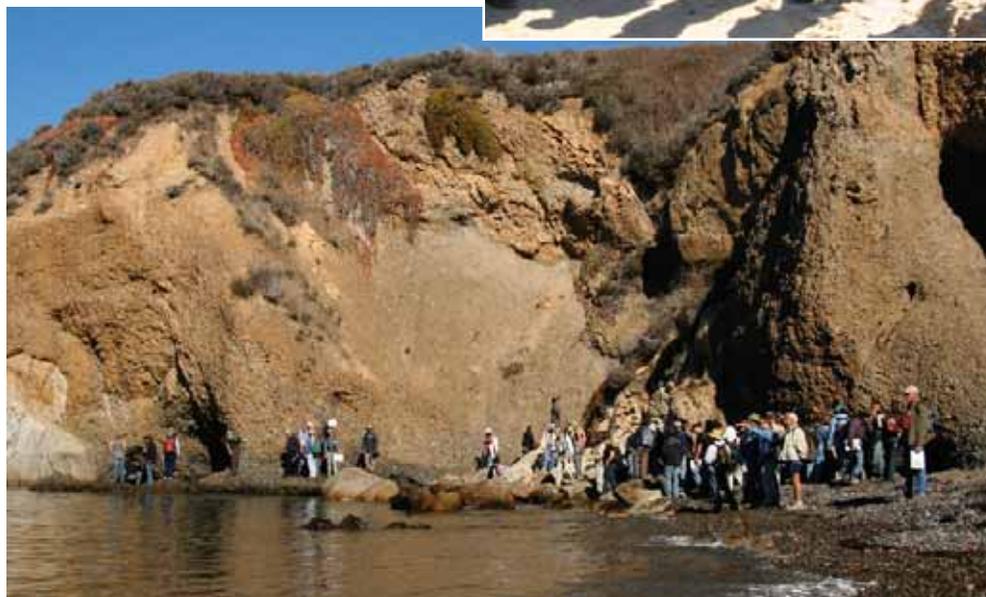
(SLAC) in Menlo Park, California. For short descriptions of both trips, visit URL <http://www.sci.sdsu.edu/pacsepm/SEPMfieldtrips.htm>.

Coastal and marine scientists are encouraged to join and participate in the Pacific Section of SEPM, which offers great-value membership rates (\$7.50 per year, or \$20 for 3 years). For more details, visit the organization's Web site at URL <http://www.sci.sdsu.edu/pacsepm/>.

Field-trip participants examine an outcrop of the Carmelo Formation near its contact with Cretaceous granodiorite (light-colored rock at far left).



Field-trip leader **Ed Clifton** addresses field-trip participants.



Trace fossil in the Carmelo Formation.

Awards

Hurricane and Coastal-Change Expert Abby Sallenger Wins USGS Shoemaker Award for Lifetime Achievement in Communication

U.S. Geological Survey (USGS) oceanographer **Asbury (Abby) H. Sallenger** recently received the USGS Shoemaker Award for Lifetime Achievement in Communication. The award was announced on August 31, 2007, and conferred in a formal ceremony at USGS headquarters in Reston, Virginia, on September 27. Below is the citation for the award.

“The Shoemaker Award for Lifetime Achievement in Communication honors

a USGS scientist who demonstrates great skill in presenting complex concepts to nontechnical audiences. This lifetime achievement award honors the recipient's skill and enthusiasm for conveying science in multiple media.

“This year we recognize USGS oceanographer **Asbury H. Sallenger**. The substantial impact and national recognition of the USGS coastal program is widely recognized as a direct result of **Sallenger's**

efforts—particularly his skills as a communicator. Whether it is a briefing on the Hill, a presentation to the research or local community, or an interview with the media, **Sallenger** knows how to communicate the value of USGS science and its relevance to the audience in question. He has become the voice of the USGS with respect to hurricanes and coastal change. With an unassuming, can-do manner, **Sal-**

(Shoemaker Award continued on page 10)

Awards, continued

(Shoemaker Award continued from page 9)

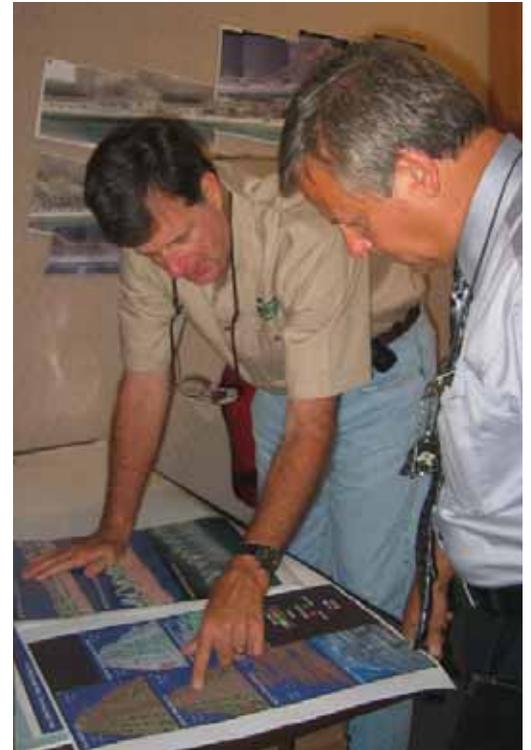
Sallenger attends to multiple demands in the face of a hurricane and its aftermath, and he has done so repeatedly—during a single season and year after year—responding to the surge of media requests for interviews, taking reporters into the field, and keeping managers and support personnel informed. His ability to communicate the value of the science reaches from the personal level, inspiring more than 10 of the technicians who have worked for him to continue their education through the doctorate level, to the national level, inspiring major media networks to return for additional, in-depth interviews.”

To learn more about the scientific work of **Sallenger** and his research team, visit “Coastal Change Hazards: Hurricanes and Extreme Storms” at URL <http://coastal.er.usgs.gov/hurricanes/> and “National Assessment of Coastal Change Hazards” at URL <http://coastal.er.usgs.gov/national-assessment/>.

The Shoemaker Awards Competition was established in 1997 in memory of

Eugene M. Shoemaker to recognize extraordinary examples of communicating and translating complex scientific concepts and discoveries into words and pictures that capture the interest and imagination of the American public. **Shoemaker**, a USGS astrogeologist considered the founder of the science of lunar and planetary geology, was an effective and prolific communicator, as well as an innovative scientist and researcher. One of his greatest assets was his ability to communicate scientific concepts to nonscientists in a way that could be easily understood and appreciated. Today, many USGS employees carry on his enthusiasm, giving voice to all our science programs.

USGS employees can find additional information about the Shoemaker Awards Competition, including lists of past and present winners, on the USGS Intranet. ❁



Abby Sallenger shows Fox TV reporter **Steve Nicholls** how Dauphin Island, Alabama, changed during Hurricane Katrina.

American Fisheries Society Honors Biologist Walter R. Courtenay

The American Fisheries Society (AFS) honored biologist **Walter R. Courtenay** with the 2007 William E.



American Fisheries Society President **Jennifer Nielsen** (USGS, Anchorage, Alaska, left) presents the William E. Ricker Resource Conservation Award to **Walt Courtenay** at the society's annual meeting.

Ricker Resource Conservation Award on September 3, 2007, at the society's annual meeting in San Francisco, California. AFS president **Jennifer Nielsen** of the U.S. Geological Survey (USGS)'s Alaska Science Center presented the award to **Courtenay** at the opening plenary session, while another AFS officer, **William Franzin** of Canada's Department of Fisheries and Oceans, read a citation highlighting **Courtenay's** many contributions to benefit native aquatic communities through research and publications on introduced fishes.

The Ricker Award is presented to an individual or organization for outstanding accomplishment or activity in resource conservation

that is significant at a national or international level. **Courtenay**, currently an emeritus professor of zoology at Florida Atlantic University in Boca Raton, Florida, and a volunteer fishery research biologist at the USGS Florida Integrated Science Center office in Gainesville, Florida, was recognized for his long career of fishery research, conservation, and education. Here is the award citation (also posted at URL <http://fisc.er.usgs.gov/courtenay/courtenay.html>):

“**Dr. Walter Courtenay** has worked tirelessly for more than 30 years, conducting research, educating students, and raising public awareness of the environmental threats posed by invasive species. His studies and his publications encompass exotic fish populations throughout their ranges—introduced and indigenous. Most of these species are important in the ornamental and aquaculture industries and can be extraordinarily destructive to

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Awards, continued

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native communities. Consequently, the work of **Dr. Courtenay** influences trade and conservation policy at scales ranging from regional to international. His work benefits conservation of native aquatic communities in North America and elsewhere in the world.

“First working as a fish morphologist in the late 1960s, **Dr. Courtenay** soon began intensive study of the ecology of invasive fishes in Florida. His work, describing and publicizing environmental dangers

of these sometimes innocuous-appearing species, made his name synonymous with invasive-species research by the mid-1970s. At that time, he was conducting innovative pond studies to evaluate impacts of cichlids and walking catfish on native fishes. In the following decades, **Dr. Courtenay** and his students continued to provide the scientific community and the general public with case studies and comprehensive overviews of the introduction, spread, persistence, and ecological effects

of invasive fishes. Because of his work, people of all backgrounds have been sensitized to impacts of invasive species; they are less likely to release nonnative species and more likely to support management and control programs.

“**Walter Courtenay** merits this award for two very basic reasons: he has spent a lifetime devoted to fish conservation and education, and he is sharing that lifetime of experience, insight, and wisdom with new generations of conservationists.” ❁

Renee Takesue Recognized by AGU for Excellence in Refereeing

Renee Takesue, a research geochemist with the U.S. Geological Survey (USGS)'s Western Coastal and Marine Geology team, was among the recipients of the American Geophysical Union (AGU)'s 2006 Editors' Citations for Excellence in Refereeing. The awardees, cited by editors of AGU journals, were recognized for their service to AGU and commended for consistently providing constructive and thoughtful reviews. **Takesue** was cited by **Laurent Labeyrie**, editor of

Geochemistry, Geophysics, Geosystems. Other USGS recipients were **Roland von Huene** (USGS Scientist Emeritus, cited by editor of *Journal of Geophysical Research –Solid Earth*), **Gerald Bawden** (research geophysicist, cited by editor of *Geophysical Research Letters*), **Hedeff Essaid** (research hydrologist, cited by editor of *Water Resources Research*), and **Jim O'Connor** (research hydrologist, cited by editor of *Water Resources Research*). Congratulations to all! ❁

Renee Takesue



Staff and Center News

USGS Director Mark Myers Visits the Florida Integrated Science Center

By Ann B. Tihansky and Anne-Berry Wade

Mark Myers, Director of the U.S. Geological Survey (USGS), spent several days in early October (Oct. 1-4, 2007) touring selected Florida locations by powerboat, airboat, van, and helicopter to view environments where USGS scientists are conducting research. Staff shared the latest information about coastal erosion and coastal-change hazards; integrated scientific

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Director **Mark Myers** and company on the research vessel G.K. Gilbert in St. Petersburg, Florida. Left to right: **Jess Weaver**, **Nancy Dewitt**, **Anne-Berry Wade**, **Barry Rosen**, **Jim Flocks**, **Sonya Jones**, **Mike Gauldin**, **Mark Myers**, **Jack Kindinger**, **John Brock**, and **Rich Young**. Photograph by **Ann Tihansky**.



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studies in the northern Gulf of Mexico; mangrove ecology; hypoxia and climate change; microbial communities in ground water; ecological modeling; the Everglades Depth Estimation Network (EDEN, URL <http://sofia.usgs.gov/eden/>); manatees; invasive species; and issues pertaining to water quality, quantity, and flow modeling, particularly as related to South Florida Greater Everglades Ecosystem Restoration efforts (URL <http://sofia.usgs.gov/>).

After a morning trip out onto Tampa Bay to observe vibracoring on the research vessel *G.K. Gilbert*, **Director Myers** held an all-hands meeting at the USGS' Florida Integrated Science Center (FISC) office in St. Petersburg. He highlighted the importance of integrated scientific efforts and shared his vision for the USGS in the next decade as a leader in Earth science for the Nation. He discussed the importance of the USGS Strategic Science Plan ("Facing Tomorrow's Challenges," USGS Circular 1309, URL <http://pubs.usgs.gov/circ/2007/1309/>) and urged FISC staff to look at various issues and think about how they can be addressed.

Director Myers left St. Petersburg and traveled to South Florida to learn about several collaborative science projects with the National Park Service, the U.S. Fish and Wildlife Service, and partners in academia. In Big Cypress National Preserve, the group learned about the dynamics of sheet flow—the landscape here is so flat that water flows over it in a continuous sheet rather than in channels—and experienced firsthand the wonders of a cypress swamp during a guided "wet walk." Later, they took a nighttime trip in Water Conservation Area 3-A to participate in an alligator-monitoring program conducted jointly



*Big Cypress Wet Walk (right to left): **Arturo Torres**, Deputy Coordinator of USGS Greater Everglades Priority Ecosystems Science, leads **Barry Rosen**, **Jess Weaver**, USGS Director **Mark Myers**, Everglades National Park Superintendent **Dan Kimball**, Big Cypress National Preserve Superintendent **Karen Gustin**, **A.B. Wade**, Big Cypress student intern **Alyssa Parker Geisman**, Everglades Restoration Program Assistant Field Supervisor **Pam Repp**, and South Florida Ecosystem Restoration Task Force Executive Director **Terrence "Rock" Salt**. (Additional participants not shown.)*

by the USGS and the University of Florida. Twice a year, scientists capture about two-dozen alligators from 10 areas and take various measurements to assess the animals' fitness, which is an indicator of the overall fitness of the ecosystem; after measurement, the alligators are tagged and released. The group also visited a laboratory where they observed the implantation of a radio transmitter into a 14-ft-long Burmese python. Radio tracking is part of an effort to monitor and eventually eradicate this invasive species in Everglades National Park.

Understanding the complexities of the Greater Everglades ecosystem and addressing a range of issues is an ongoing challenge that requires extraordinary interagency cooperation. **Ronnie Best**, the USGS Coordinator for the Greater Everglades Science Program, worked closely with scientists in South Florida to coordinate science presentations for the Director's visit. **Director Myers** was accompanied by Southeast Regional Executive **Jess Weaver**, FISC Director **Barry Rosen**, USGS Press Officer **Michael Gauldin**, and Eastern Region Chief of Communications **A.B. Wade**. ❁



*USGS scientist **Ken Rice** (khaki shirt, center) works with veterinarians and other scientists in the Burmese python-capture program to monitor the invasive species' activities in the wild. This snake is being anesthetized before having a tracking device implanted.*

***Director Myers** addresses a full house at the Normile Conference room in the St. Petersburg office of the USGS Florida Integrated Science Center (FISC).*



Arc Marine: GIS for a Blue Planet—Case Studies in New Book Include USGS Sea-Floor Data

Chris Polloni and Brendan Dwyer

Data from two U.S. Geological Survey (USGS) coastal sea-floor mapping projects are showcased in *Arc Marine: GIS for a Blue Planet*, a new reference book published by ESRI Press that details the Arc Marine data model—an evolving database design for managing spatial data from various types of marine research, including sea-floor mapping, fisheries management, marine-mammal tracking, monitoring of shoreline change, and oceanographic measurements. In addition to facilitating data organization and analysis, the new data model helps users create maps and three-dimensional scenes of the marine environment to assist decision making. An online companion to the book contains PowerPoint presentations, posters, and downloadable datasets to help readers further explore the capabilities of the data model.

The book's authors are a multidisciplinary team of geographic-information-system (GIS) scientists: **Dawn Wright** (Oregon State University), **Michael Blongewicz** (DHI Water and Environment, Inc.), **Pat Halpin** (Duke University), and **Joe Breman** (ESRI). All have extensive experience in applying GIS science to the marine realm and an appreciation for the complexity of the task: "The dynamic nature of ocean and coastal systems and the three-dimensional nature of water volumes require a fundamental rethinking of the often static and planar representation of spatial features used in terrestrial applications." The Arc Marine data model is intended to serve a wide range of users in the marine community, including "academic, government, military, and private oceanographers, resource managers, conservationists, geographers, nautical archeologists," and more.

The book opens with an introduction (chap. 1) and an explanation of "Com-

mon Marine Data Types" (chap. 2), intentionally broad categories that can be adapted by users for specific databases. Subsequent chapters present a range of studies for which the Arc Marine data model can be used. Titles include "Marine Animal Data Applications," "Implementing Time Series and Measurements," and "Nearshore and Coastal/Shoreline Analysis." Chapters on "Model Meshes" and "Multidimensional GIS" address two

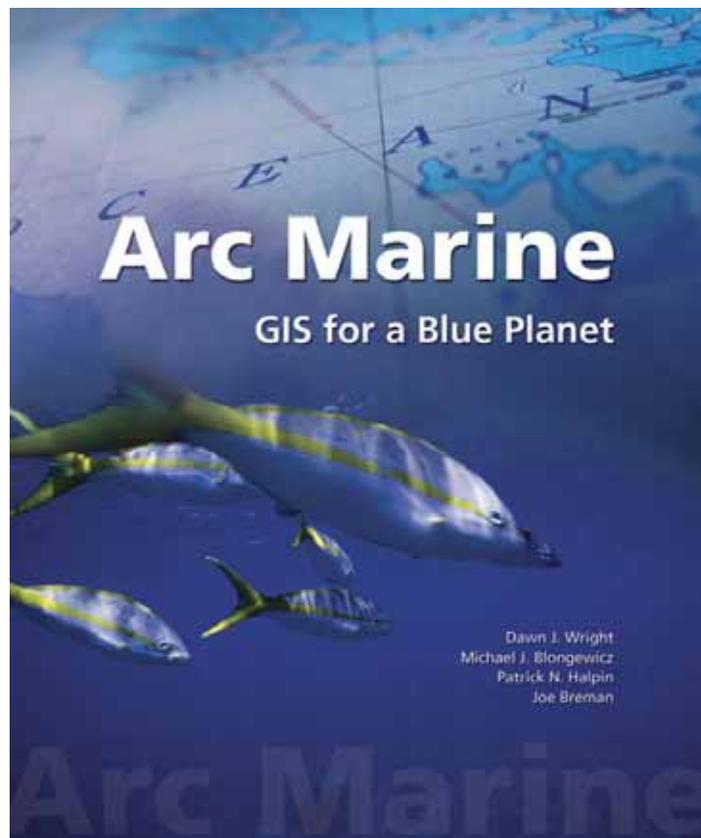
geologic framework of the Massachusetts inner continental shelf; and (2) a marine-survey geodatabase developed by Photo Science, Inc., for the USGS' Florida Integrated Science Center (FISC) office in St. Petersburg, Florida, from data collected to study land subsidence and sea-level rise in southeastern Louisiana.

The USGS/CZM/NOAA cooperative project serves as an Arc Marine case study for handling marine geophysical-survey data collected in nearshore environments. **Brian Andrews** (USGS) used the Arc Marine data model in collaboration with **Seth Ackerman** (CZM) and **Walter Barnhardt** (USGS) to manage, analyze, and publish marine geophysical-survey data from six research cruises conducted over 5 years offshore of Massachusetts.

The geodatabase case study from the USGS/Photo Science collaboration contains a description of a database structure for storing seismic tracks and survey points, using the Louisiana Sedimentary and Environmental Database, or LASED (lah-sed'), as an example. LASED (URL <http://coastal.er.usgs.gov/lased/>) is the result of combined efforts by the USGS and academic collaborators to manage decades of geologic data from the

Louisiana coastal zone. The principal data in LASED are sediment-core locations and descriptions, and seismic tracklines, shot-points, and profiles from various sources. Recently, the data in LASED were reorganized into the Arc Marine data model. Chapter 3 describes some of the challenges of incorporating existing data into the Arc Marine data model, including some of the drawbacks of using the data model.

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interesting topics that push the limits for GIS systems.

The book's third chapter, "Marine Surveys," features two USGS projects as case studies: (1) sea-floor mapping and geologic sampling by the USGS Woods Hole Science Center in cooperation with the Massachusetts Office of Coastal Zone Management (CZM) and the National Oceanic and Atmospheric Administration (NOAA) to characterize the regional

(Arc Marine continued from page 13)

The Arc Marine data model makes such tasks as loading and editing data easier for the data manager; however, data in an Arc Marine structure may be confusing to users who are unfamiliar with the Arc Marine data model or do not understand database relations. Users accustomed to seeing records in one form or table might not be able to make sense of the “cascading” relations in Arc Marine. Although the Arc

Marine data model can make managing data easier and more consistent, data managers must make accessing the data simple and intuitive to users. To make LASED more user friendly, for example, data manager **Brendan Dwyer** plans to create tools in ArcMap that access the LASED database and allow users to easily select and view the records they want. These tools will present the user with a form that dis-

plays the parameters available to choose from and responds to their selections.

We recommend *Arc Marine: GIS for a Blue Planet* as an excellent treatise on database design and large-scale GIS solutions for the coastal- and marine-science community. Visit URL <http://dusk2.geo.orst.edu/djl/arcgis/> to learn more about the new book and the Arc Marine data model. ☼

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