USGS
Sound Waves Coastal and Marine Research News from Across the USGS
http://soundwaves.usgs.gov/

Spotlight on Sandy

Science Brings Clarity to Shifting Shores—The USGS Coastal Change Hazards Portal

By Lindsay Mann, Jessica Robertson, Rob Thieler, and Hilary Stockdon

[Slightly modified from USGS Science Features: Top Story at <**http://www.usgs.gov/blogs/features/usgs_top_story/science-brings-clarity-to-shifting-shores/**>]

Each and every day, waves move sand back and forth, onto and away from beaches. The thin ribbon of sandy barrier islands and beaches along America's coastline shifts constantly, especially during hurricanes, nor'easters, and other extreme storms.

How vulnerable would your favorite beach be if a hurricane like Katrina, Ike, or Sandy paid a visit? What did your beach look like 50, 100, or 150 years ago? What might it look like in the future? About 40 percent of the nation's population lives in coastal counties on both the East and West Coasts (<**http://oceanservice.noaa.gov/facts/population.html**>), so answering questions like these will help protect millions of citizens who are at risk from changing sea level, retreating shorelines, and extreme coastal storms.

To help ensure safe and resilient coasts, the U.S. Geological Survey (USGS) has created an online tool that allows anyone to interactively "see" past, present, and future hazards. This tool—the USGS Coastal Change Hazards Portal (<**http://marine.usgs.gov/coastalchangehazardsportal/**>)—can aid in decisions that involve emergency preparedness, ecosystem restoration, and where and how to develop coastal areas.

No sophisticated technology is required. The tool runs on web browsers, tablets, and smartphones. It is designed for a wide range of audiences, from federal and state agencies to non-governmental organizations, public entities, and private citizens.

"Our nation's coastlines are constantly changing landscapes that pose unique management challenges," said **Suzette Kimball**, USGS acting director. "This new USGS portal is truly one-of-a-kind, providing a credible foundation for making decisions to protect resources, reduce risk, and prevent economic losses."

*Houses in Rodanthe, North Carolina, are left in the waves at the ocean's edge after the passage of Hurricane Isabel, which made landfall as a category 2 storm in the Outer Banks on September 18, 2003. USGS photograph by **Hilary Stockdon**.*

"Essentially, the portal is an interactive mapping product with layers of information, but don't let that simple explanation be deceiving," Kimball continued. "The portal is unique in that it compiles a diverse array of science—science that is unbiased—to provide a comprehensive picture needed to visualize and understand how coasts behave under various conditions."

How It Works

One key component of the portal (<**http://marine.usgs.gov/coastalchangehazardsportal/**>) is the ability to explore coastal-hazard risks at varied scales, from a local area of interest to a national perspective. This location-specific capability is extremely valuable for planning and preparedness and for making decisions to build coastal resilience.

For example, if a hurricane alert is issued, users can input their city and state to see maps and imagery of potential

(Coastal Hazards Portal continued on page 2)

Sound Waves

Editor
Helen Gibbons
Santa Cruz, California
Telephone: (831) 460-7418
Email: hgibbons@usgs.gov
Fax: (831) 427-4709

Print Layout Editors
Susan Mayfield, Sara Boore
Menlo Park, California
Telephone: (650) 329-5066
Email: smayfiel@usgs.gov; sboore@yahoo.com
Fax: (650) 329-5051

Web Layout Editor
Jolene Gittens
St. Petersburg, Florida
Telephone: (727) 502-8038
Email: jgittens@usgs.gov
Fax: (727) 502-8182

SOUND WAVES (WITH ADDITIONAL LINKS) IS AVAILABLE ONLINE AT URL
http://soundwaves.usgs.gov/

Contents

Spotlight on Sandy 1
Research 6
Outreach 10
Meetings 12
Publications 17

Submission Guidelines

Deadline: The deadline for news items and publication lists for the November/December issue of *Sound Waves* is Wednesday, September 24, 2014.
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).

Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

U.S. Geological Survey
Earth Science Information Sources:

Need to find natural-science data or information? Visit the USGS Frequently Asked Questions (FAQ's) at URL **http://www.usgs.gov/faq/**

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

Spotlight on Sandy, continued

(Coastal Hazards Portal continued from page 1)

impacts for a similar storm scenario. If a family is planning to move to a beach, they can type a location into the portal to view what types of coastal hazards and impacts have occurred nearby. The Coastal Vulnerability Index (<**http://marine.usgs.gov/coastalchangehazardsportal/ui/info/item/CARv9Z5**>) shows the relative susceptibility of the Nation's coasts to sea-level rise. Resource managers can also make decisions on how best to protect precious ecosystems. These are just a few ways the portal may be used.

Video Tutorial

A short video posted at <**http://www.youtube.com/watch?v=ZvlITDs9PII**> demonstrates how a resident in Rodanthe, North Carolina, can use the portal to answer the question: As a long-term resident in this coastal community on the Outer Banks, how much beach erosion is occurring in my community?

Technology Sets Sail—New "Mashup" Capabilities

A range of information is provided through the portal, such as historical data, existing publications, satellite imagery, maps, and more. This "mashup" of information is possible because of the wide scope of USGS expertise. For example, USGS scientists have completed a national research project that measures and interprets coastline change from the past 150-plus years. By looking to the past, scientists have direct evidence of how our diverse shorelines have behaved, allowing for more accurate analyses of future change. The USGS also investigates coastal change during extreme storms to help understand hazards such as severe beach erosion, island overwash (transport of sand inland by waves), or coastal inundation. The portal will enable users to view USGS science in conjunction with their own personalized data to answer specific questions.

Partnerships are Essential

The maintenance of an accurate and up-to-date portal relies on relationships with both federal agencies and non-gov-

(Coastal Hazards Portal continued on page 3)

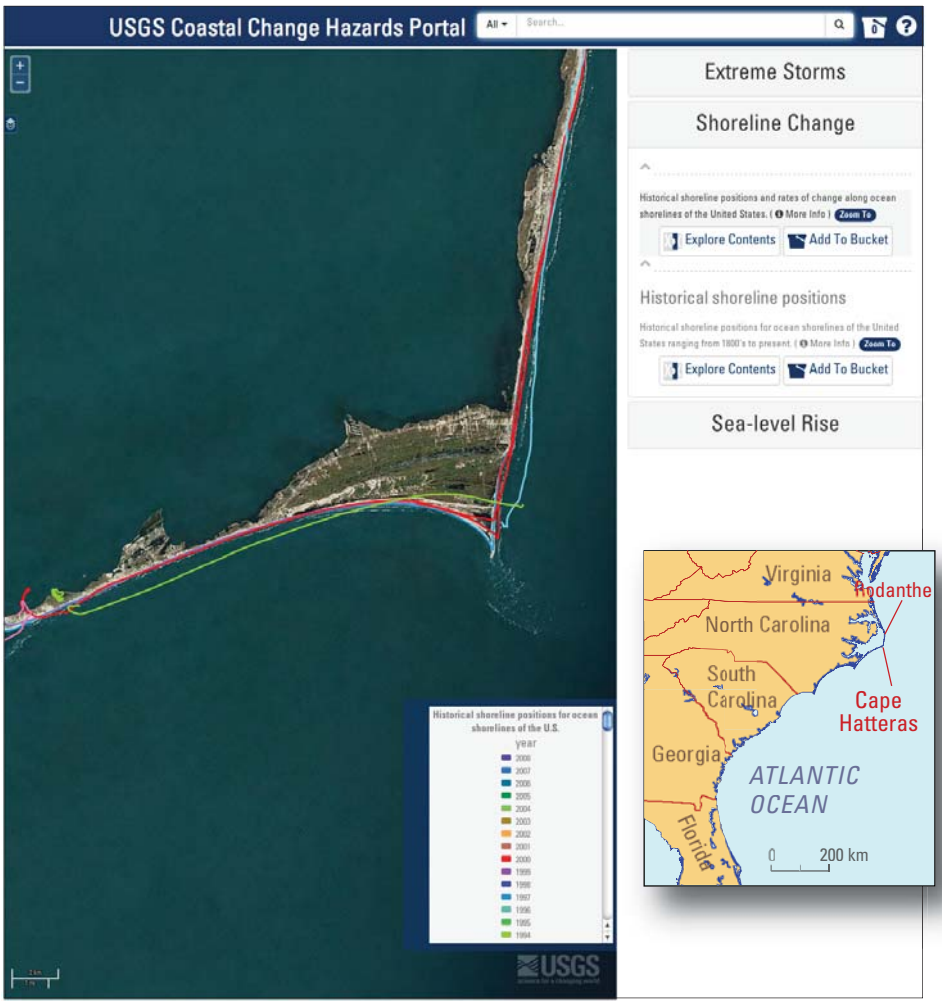
*Upper aerial photograph shows Rodanthe, North Carolina, looking south along the coast on August 30, 2011, three days after landfall of Hurricane Irene. The central and lower aerial photographs show pre-storm and post-storm extreme coastal change, with the yellow arrow in all three photographs pointing to the same cottage. USGS photograph by **Karen Morgan**.*

(Coastal Hazards Portal continued from page 2)

ernmental organizations. This cooperation includes, for example, the upcoming incorporation of coastal-change forecasts for approaching hurricanes using wave and surge input from the National Hurricane Center (<**http://www.nhc.noaa.gov/**>). Another partnership, with the National Weather Service (<**http://www.weather.gov/**>), is helping to achieve real-time predictions of coastal change for all wave conditions.

Similar collaborations are also necessary to make sure the portal addresses the needs of information users. For example, refuge managers at the U.S. Fish and Wildlife Service (<**http://www.fws.gov/**>) will be able to use this tool in combination with many of their own mapping products to develop an appropriate forecast for endangered species and resource management. Managers with the National Park Service (<**http://www.nps.gov/**>) can apply these data to evaluate how to reduce or prevent vulnerabilities at specific facilities or cultural resources due to exposure to coastal hazards.

The information provided through the portal also enables state agencies to improve their ability to monitor and assess their coastlines. "The ability to easily locate and access USGS research and data through the new Coastal Change Hazards Portal is of great value for coastal managers," said Massachusetts Office of Coastal Zone Management Director **Bruce Carlisle**. "This information directly supports our work with local cities and towns to assess risk and communicate current and future hazards."



*Sample image from the USGS Coastal Change Hazards Portal showing historical shoreline change at Cape Hatteras, North Carolina. (Rodanthe, North Carolina, is on the same chain of barrier islands, off the image to the north; see small inset map.) Lines representing historical shorelines are color-coded by year. Visit the portal (<**http://marine.usgs.gov/coastalchangehazardsportal/**>) to view details.*

Future Portal Plans and Enhancements

Coastlines are constantly changing landscapes that pose unique management challenges requiring fresh information. The USGS Coastal Change Hazards Portal is designed to be continually updated with the most current catalogues of information and tools that can be used to evaluate risk and inform actions that lead to improved coastal resilience.

In the future, the portal will evolve into an even more advanced web tool to forecast shoreline variations and provide managers and planners with information they need to protect resources, reduce risk, and prevent economic losses. Future refinements will sharpen information to the highest resolution available and provide capabilities for real-time storm vulnerability assessments.

Start with Science

Informed management and policy decisions require expert science as their foundation. The USGS is dedicated to addressing this need and providing unbiased coastal science. The USGS Coastal Change Hazards Portal is an internal partnership between the Coastal and Marine Geology Program (<**http://marine.usgs.gov/**>), which develops the data and understanding to forecast coastal change, and the Center for Integrated Data Analytics (<**http://cida.usgs.gov/**>), which provides the advanced software development and delivery capabilities to ensure that USGS science is available as widely and effectively as possible.

Get Onboard and Explore

Visit the USGS Coastal Change Hazards Portal at <**http://marine.usgs.gov/coastalchangehazardsportal/**> to investigate the coast and learn more about impending hazards.

New Tide Gage/Weather Station Installed in Collaboration with the Mashpee Wampanoag Tribe, Mashpee, Massachusetts

By Monique Fordham and Richard Verdi

On July 11, 2014, representatives from the U.S. Geological Survey (USGS), the Mashpee Wampanoag Tribe, and the town of Mashpee, Massachusetts, gathered at the site of a newly installed tide gage/weather station at Mashpee Neck Landing on Popponesset Bay to participate in a demonstration of the gage's construction and functionality.

This collaboration between the USGS and the Mashpee Wampanoag Tribe was made possible by Department of the Interior (DOI) Hurricane Sandy supplemental funds (see <**http://soundwaves.usgs.gov/2013/12/research.html**>). The tide gage/weather station was installed and activated on June 17 by the Massachusetts Office of the USGS New England Water Science Center and reports seven different parameters in near real-time: water level, rainfall, wind speed, wind direction, barometric pressure, relative humidity, and temperature. Data are recorded in 15-minute intervals and transmitted to the National Oceanic and Atmospheric Administration (NOAA) Geostationary Operational Environmental Satellite (GOES) (<**http://www.ospo.noaa.gov/Operations/GOES/**>) every hour. Once transmitted, the data are automatically uploaded to the web in a matter of minutes. The real-time data are available at <**http://waterdata.usgs.gov/ma/nwis/uv?site_no=413601070275801**>.

George "Chuckie" Green, Assistant Director for the Tribe's Department of Natural Resources, stated that "accurate tidal data in the vicinity of the Tribe's Popponesset Bay Restoration Project will finally give us a record of tide and storm surge to assist the Tribe in protection of our shellfish farm, coastline, wild resources and to prepare for the next major storm event. Being able to monitor and record temperature, wind, humidity, precipitation, rain fall, and barometric pressure will also support the Tribe's Emergency Preparation Team efforts to establish a record of future storm events for planning purposes."

Group at the tide gage location discussing the functions of the gage, the data it will produce, and how it will help the Tribe and the Town in their natural-resource-management operations. Left to right: ***Richard Verdi****, Supervisory Hydrologist, USGS New England Water Science Center (NEWSC);* ***Andy Waite****, Hydrologist, NEWSC;* ***George "Chuckie" Green****, Assistant Director, Department of Natural Resources, Mashpee Wampanoag Tribe;* ***Trish Keli'inui****, Councilwoman, Mashpee Wampanoag Tribe;* ***Quan Tobey****, Director, Department of Natural Resources, Mashpee Wampanoag Tribe;* ***Richard York****, Shellfish Constable, Town of Mashpee, Massachusetts. Photograph by USGS National Tribal Liaison* ***Monique Fordham****.*

Richard Verdi *(left, USGS New England Water Science Center) explaining to* ***Trish Keli'inui*** *(Councilwoman, Mashpee Wampanoag Tribe) and* ***Quan Tobey*** *(Director, Department of Natural Resources, Mashpee Wampanoag Tribe) how the data are collected and transmitted via the satellite antenna to which the men are pointing. Photograph by USGS National Tribal Liaison* ***Monique Fordham****.*

Group viewing data on USGS National Water Information System Web Interface (NWISWeb). Left to right: ***Andy Waite****, Hydrologist, USGS New England Water Science Center (NEWSC);* ***Trish Keli'inui****, Councilwoman, Mashpee Wampanoag Tribe;* ***Quan Tobey****, Director, Department of Natural Resources, Mashpee Wampanoag Tribe;* ***George "Chuckie" Green****, Assistant Director, Department of Natural Resources, Mashpee Wampanoag Tribe;* ***Richard York****, Shellfish Constable, Town of Mashpee, Massachusetts;* ***Monique Fordham****, USGS National Tribal Liaison;* ***Richard Verdi****, Supervisory Hydrologist, NEWSC. Photograph by* ***Christina Stringer****, U.S. Forest Service.*

Oceanographic Gear Retrieved from Offshore of Fire Island, New York

By John C. Warner and Jeffrey H. List

In April 2014, U.S. Geological Survey (USGS) scientists retrieved oceanographic instruments that had been collecting data for two months off Fire Island, New York. Recovery of the instruments wraps up the field portion of an effort by the USGS Coastal Change Hazards Project to study how sediment moves in response to storms (see <**http://soundwaves.usgs.gov/2014/04/spotlight.html**>).

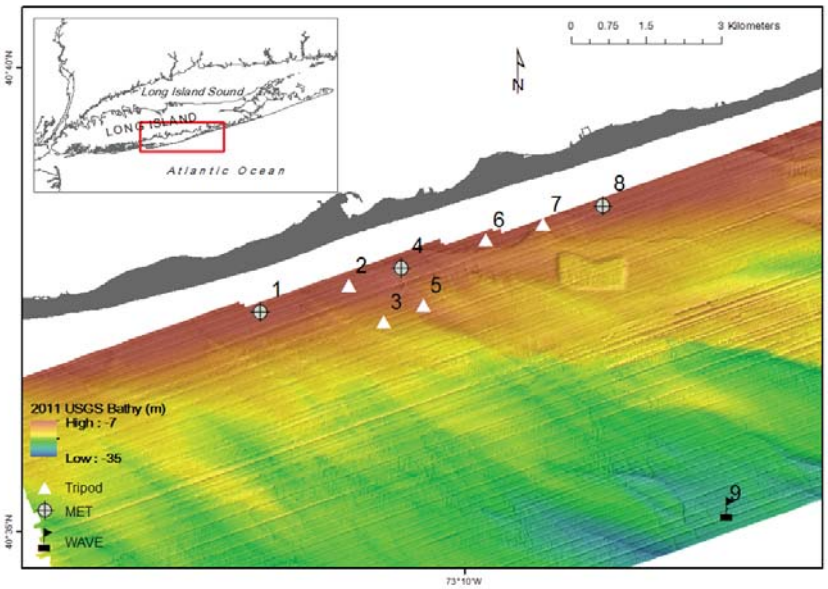
Instrumented tripods deployed on the seafloor from February to April 2014 (<**http://soundwaves.usgs.gov/2014/02/spotlight3.html**>) measured ocean currents, water temperature and salinity, suspended-sediment concentrations, and other parameters that could shed light on sediment transport. Surface buoys protected the seafloor tripods, and some held instruments to measure meteorological variables, such as air temperature and wind speed and direction. A specialized wave buoy was deployed at the site farthest from shore to measure the height, period, and direction of surface waves and telemeter the data to the Coastal Data Information Program (CDIP, <**http://cdip.ucsd.edu/**>).

All of the instruments except for the wave buoy were recovered in April. The wave buoy will be left on site for several years—its data can be viewed in near-real time at the CDIP website, buoy 207—Fire Island Nearshore NY (<**http://cdip.ucsd.edu/?sub=data&nav=historic&pub=public&stn=207&stream=p1**>), or at the National Data Buoy Center, Station 44094—Fire Island Nearshore, NY—207 (<**http://www.ndbc.noaa.gov/station_page.php?station=44094**>). Learn more about the wave data at <**http://cdip.ucsd.edu/?sub=faq&nav=documents**>.

Screenshot from video clip showing gear recovery aboard the research vessel Connecticut *offshore of Fire Island, New York. The clip shows recovery of one large tripod, two smaller tripods, and two yellow surface buoys, one of which held a set of meteorological instruments. The weather was rather calm and made for smooth retrieval of the equipment. View video clip—produced from GoPro® images by* ***Peter Traykovski*** *(Woods Hole Oceanographic Institution)—at <****https://www.youtube.com/watch?v=Bf6kpK5x6DQ****>.*

Three cruises onboard the research vessel (R/V) *Connecticut* were required to gather all the gear and transport it back to the dock at the Woods Hole Oceanographic Institution (WHOI) in Woods Hole, Massachusetts. Operations ran during daylight hours and were recorded using a GoPro® camera. Project collaborator **Peter Traykovski** (WHOI) merged images taken at 30-second intervals to create a short (50-second) video clip showing a full day of recovery activities. View the video clip at <**https://www.youtube.com/watch?v=Bf6kpK5x6DQ**>.

Project scientists are currently analyzing the accumulated data. Stay tuned for further developments!



*Locations of oceanographic equipment deployed from February to April 2014 offshore of Fire Island, New York. MET, meteorological station; WAVE, buoy that telemeters surface-wave data to the Coastal Data Information Program (CDIP, <****http://cdip.ucsd.edu/****>); m, meters. Color-coded high-resolution bathymetry from Schwab and others, <****http://dx.doi.org/10.2112/JCOASTRES-D-12-00160.1****>.*

Coral Reefs Along West-Central Guam—Historical Impact of Watershed Change and Sedimentation

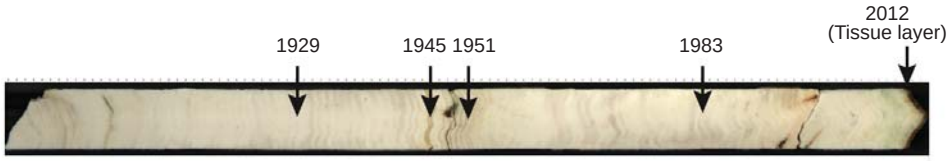
By Nancy Prouty and Curt Storlazzi

Erosion on land and associated sedimentation along the coast are significant threats to Guam's terrestrial and marine resources, including its coral reefs. Understanding land-based sources of pollution is a high priority for the U.S. Coral Reef Task Force (<**http://www.coralreef.gov/**>) and resource managers in War in the Pacific National Historical Park on Guam's west-central coast (<**http://www.nps.gov/wapa/**>). Until recently, however, there have been no systematic studies of historical sedimentation and its effects on Guam's coral reefs.

To fill this gap, the U.S. Geological Survey (USGS), in conjunction with the U.S. National Park Service and the University of Guam, set out to augment instrumental records of rainfall, climate, and land use in the northwestern tropical Pacific with "proxy" records from geochemical analysis of coral cores from the west-central coast of Guam. Climate proxies are natural recorders of climate variability, such as tree rings, fossil pollen, and, in this case, chemical characteristics preserved in coral skeletons.

"The goal of this study was to provide a historical perspective on sediment input to coral reefs adjacent to a watershed with a history of land-use change and determine the implications for future management policies," explains lead scientist **Nancy Prouty**, a research oceanographer at the USGS Pacific Coastal and Marine Science Center in Santa Cruz, California.

*USGS research oceanographer **Nancy Prouty** (left) and University of Guam graduate student **Amanda de Villers** take notes and measurements after coral cores were collected in Guam.*



Photograph of Asan-1 core (1.17 meters [3.84 feet] long) taken for image analysis using a Geotek Multi-Sensor Logger (MSL) system. Skeletal material from four distinct growth bands was collected for x-ray diffraction (XRD) analysis. The growth bands, listed by year of formation (and distance from the "tissue layer"—the layer that was alive at time of collection), are: 1929 (75 centimeters [30 inches]), 1945 (60 centimeters [24 inches]), 1951 (54.5 centimeters [21.5 inches]) , and 1983 (27 centimeters [11 inches]).

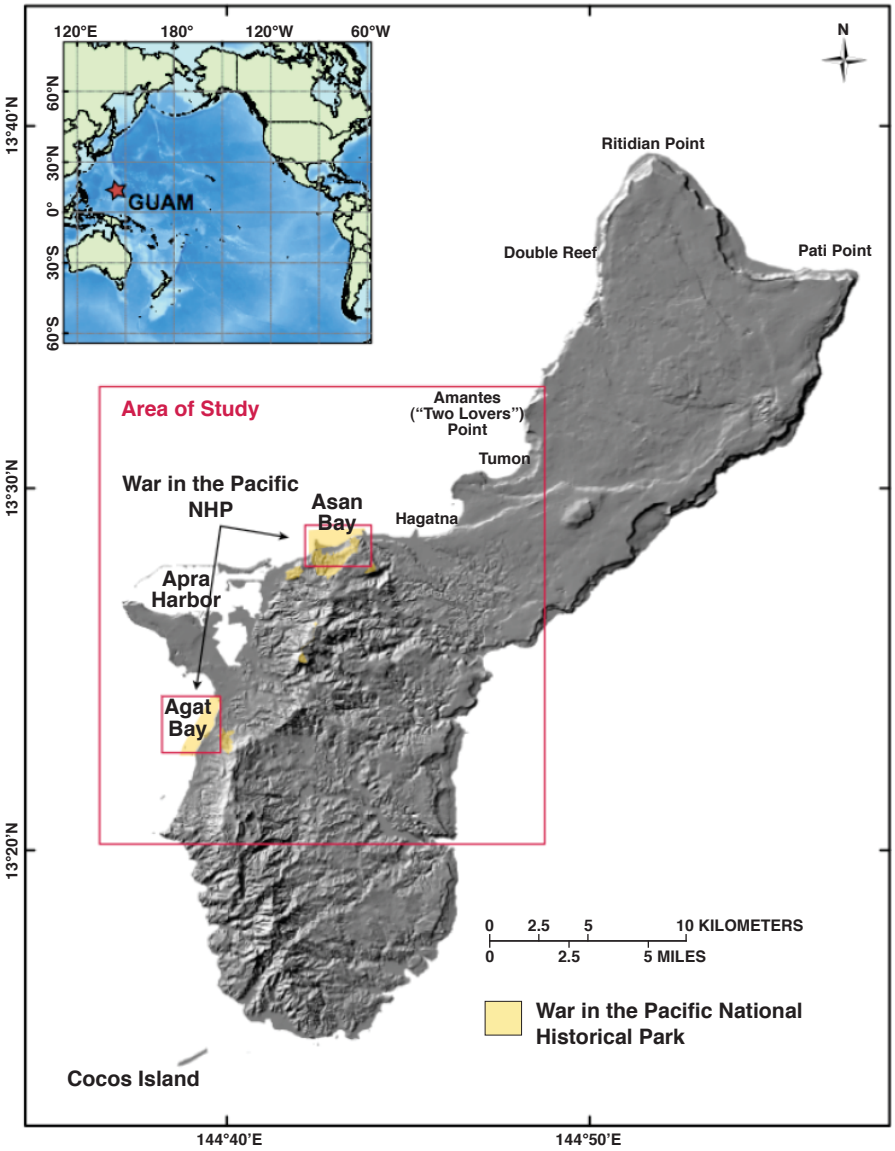
*Photograph from July 31, 1944, illustrating denudation of the landscape by explosives during World War II at Asan Point, Asan, Guam. A column of smoke and debris on the far left mark one section of a fortification being demolished just off the beach. (National Archive 80-G-239017.) Image can be viewed at <**http://www.nps.gov/history/history/online_books/npswapa/gallery/albums/Box-1/44_dogout_blown.htm**>.*

By measuring certain elements in the coral cores collected from west-central Guam, Prouty and her team demonstrated that the ratio of terrestrially derived barium to calcium (Ba/Ca) can be used as a historical indicator of sedimentation. In general, the higher the ratio Ba/Ca, the greater the input of terrestrial sediment. The results, published in May 2014 in the journal *Coral Reefs* (<**http://dx.doi.org/10.1007/s00338-014-1166-x**>), show that the fore reef at Asan Bay is within the zone of impact from sediment transported from the Piti-Asan watershed. (The fore reef, which slopes down from the reef crest toward the open ocean, is typically home to the largest corals and highest coral diversity on the reef.)

"Our proxy record illustrates elevated terrestrial sedimentation since the 1940s,"

(Guam Coral Reefs continued on page 7)

(Guam Coral Reefs continued from page 6)



Map of Guam and its location in the western Pacific Ocean. Red boxes outline study areas; coral cores were collected in Asan Bay, Agat Bay, and Apra Harbor, with emphasis on Asan Bay because of the history of landscape change in the Piti-Asan watershed. Yellow shading shows area of War in the Pacific National Historical Park (WAPA).

Prouty says. "In the mid-1940s, we see an abrupt shift in sedimentation recorded in coral from Asan Bay in War in the Pacific National Historical Park." This shift occurred at the same time as the sudden denudation of the landscape by military ordnance during pre-invasion bombardment by the U.S. Navy in July 1944; landings at Asan Beach by the U.S. 3rd Marine Division on July 21, 1944; the ensuing battle to retake Guam; and the development of the Asan area for military operations through the end of the war in 1945.

The abrupt shift in Ba/Ca values in the Asan Bay coral record, centered in the mid-1940s, was accompanied by a decrease in coral growth and calcification rates and an increase in density, suggesting a response to increased sedimentation and concomitant reduction in light levels. These patterns were not seen in coral cores collected from nearby reefs associated with watersheds that have not undergone the same degree of landscape denudation.

"The high susceptibility of Guam's soil to erosion, coupled with increasing human activities in the watershed, illustrates how compounding natural factors and watershed land-cover change can lead to increased sediment loading in nearshore environments," notes Prouty.

The reefs of Guam provide an estimated value of US$127 million a year in tourism and fishing revenue. Because Guam's population is expected to keep increasing over the next few decades, the current threat to this valuable ecosystem will likely continue or grow unless measures are taken to mitigate erosion and surface runoff.

"There is mounting evidence that the vulnerability of coral reefs to the effects of climate change is increased by chronic, local stressors," explains Prouty. "Therefore, managing and mitigating local stressors, particularly sedimentation, will play a critical role in enhancing reef resilience and the possibility for acclimation under future climate-change scenarios."

This study of historical sedimentation along west-central Guam complements measurements of present-day sedimentation patterns, such as a 2007 study described in "USGS Researchers Collaborate with National Park Service Scientists to Understand the Impact of Watershed Erosion on Coral Reefs in War in the Pacific National Historical Park, Guam," *Sound Waves*, October 2007, <**http://soundwaves.usgs.gov/2007/10/**>. To read about USGS sedimentation studies in other Pacific coral reef areas, please visit "Circulation and Sediment, Nutrient, Contaminant, and Larval Dynamics on Reefs" (<**http://coralreefs.wr.usgs.gov/sediment.html**>).

The full citation for the recent article is:

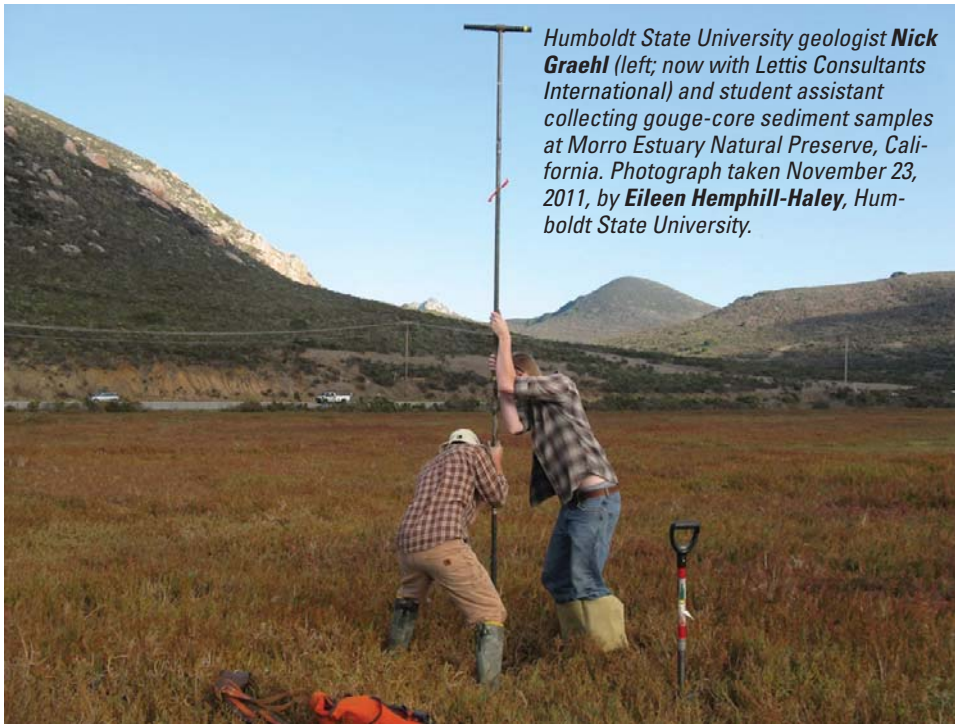
Prouty, N.G., Storlazzi, C.D., McCutcheon, A.L., and Jenson, J.W., 2014, Historic impact of watershed change and sedimentation to reefs along west-central Guam: Coral Reefs, v. 33, no. 3, p. 733–749, [**http://dx.doi.org/10.1007/s00338-014-1166-x**].

Geologic Evidence of Past Tsunamis in California

By Bruce Richmond, Rick Wilson (California Geological Survey), Eileen Hemphill-Haley (Humboldt State University), and Bruce Jaffe

An extensive sedimentary deposit formed by a tsunami in 1946 was recently discovered at Pillar Point Marsh near Half Moon Bay, California. Although there were photos and eyewitness accounts of the tsunami and resulting damage at the time, finding the tangible evidence in the geologic record is an important part of assessing the long-term hazard that tsunamis pose to California coastal communities. A better awareness of tsunami potential will help local authorities devise improved mitigation and evacuation plans.

For California, the history of tsunamis is limited by a relatively brief written record that goes back only to the late 1700s. To extend that record into the past, scientists have completed a new study looking for pre-historical evidence of tsunamis in California. As part of the U.S. Geological Survey (USGS) Science Application for Risk Reduction (SAFRR) Tsunami Scenario project <**http://www.usgs.gov/natural_hazards/safrr/projects/tsunamiscenario.asp**>, experts from the USGS, Humboldt State University, and the California Geological Survey searched for geologic evidence of past tsunamis in marshlands along the entire California coast, from Crescent City in the north to the Tijuana River in the south.



*Humboldt State University geologist **Nick Graehl** (left; now with Lettis Consultants International) and student assistant collecting gouge-core sediment samples at Morro Estuary Natural Preserve, California. Photograph taken November 23, 2011, by **Eileen Hemphill-Haley**, Humboldt State University.*

"The evidence of past tsunamis—as well as the lack of evidence—will help establish the baseline for tsunami-hazard analysis and preparedness," said geologist **Rick Wilson** of the California Geological Survey. "Continuing this type of work is essential for characterizing the long-term tsunami threat to California."

The study found that strong evidence of tsunamis was absent from most marshlands examined, except for two locations in the state. In Crescent City, new information helped to better define the extent of flooding from a historical tsunami that occurred in 1964, as well as a pre-historical tsunami that occurred in 1700. An extensive deposit from a tsunami that occurred in 1946 was found at Pillar Point Marsh near Half Moon Bay. A third location, Carpinteria Marsh near Santa Barbara, contains multiple sand layers that are still being evaluated for a possible tsunami origin.

*(Left to right) **Mike Torresan** (USGS), **Nick Graehl** (Humboldt State University [now with Lettis Consultants International]), and **Bob Peters** (contractor, USGS) collecting sediment samples at Pillar Point, California, with a vibracorer. (This tool vibrates a long core barrel into the sediment; it works best in soft sand and mud.) USGS photograph by **Bruce Richmond**.*

This research focused on impacts from tsunamis generated far away at major earthquake-generating fault systems. All Californians should be aware that local, smaller earthquakes can generate submarine landslides capable of producing damaging local tsunamis.

When the ground shakes, move away from the coast.

"This study is the most comprehensive paleotsunami exploration project to be conducted in the state of California," says USGS geologist **Bruce Richmond**. "No one has looked at so many locations over this large of a geographical area."

Tsunami deposits are often composed of thin, continuous sand layers with unique

(California Tsunamis continued on page 9)

(California Tsunamis continued from page 8)

grain-size and microfossil characteristics that may help to differentiate them from other kinds of coastal deposits, such as those from large storms. Coastal marshes, ponds, and lagoons are the most likely areas where these tsunami deposits can be preserved in the geologic record and later recognized, because the tsunami-deposited sands contrast with plant-rich material that accumulates in marshes and the dark, muddy deposits of ponds and lagoons.

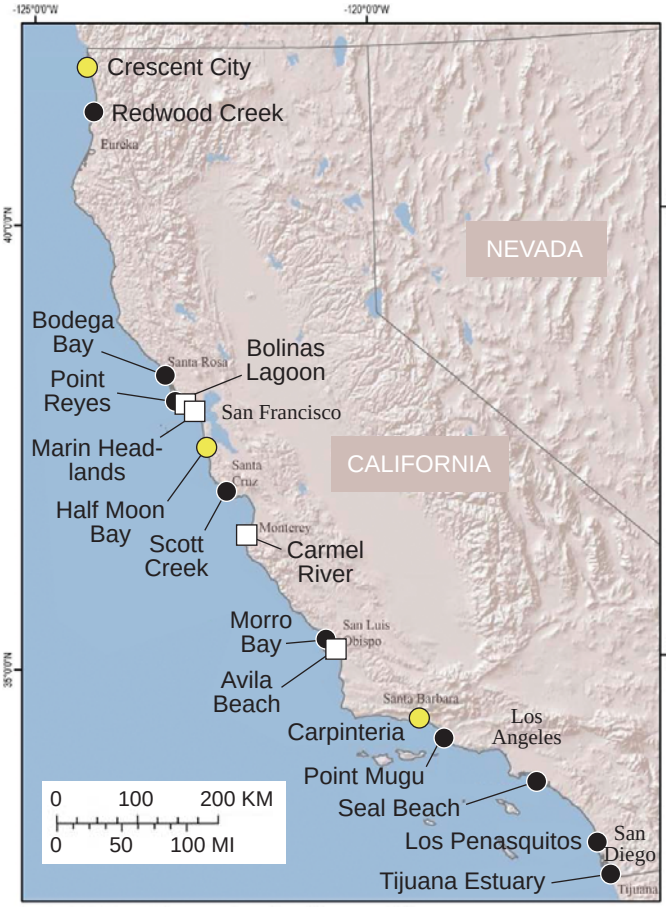
"We worked hard to identify locations along the California coast where there would be a potential for finding paleotsunami deposits," said geologist **Eileen Hemphill-Haley** of Humboldt State University. "This was a challenge considering the many miles of rocky coastline along California where tsunami deposits would not be preserved, and the fact that many low-lying coastal wetlands—even some that are now parks or preserves—have been impacted in the past 150 years by agricultural practices or other land uses."

"This report presents results from data collected by a team of 15 scientists working for more than a year," said USGS geologist **Bruce Jaffe**. "And there is still much to be done to reconstruct the tsunami history of California."

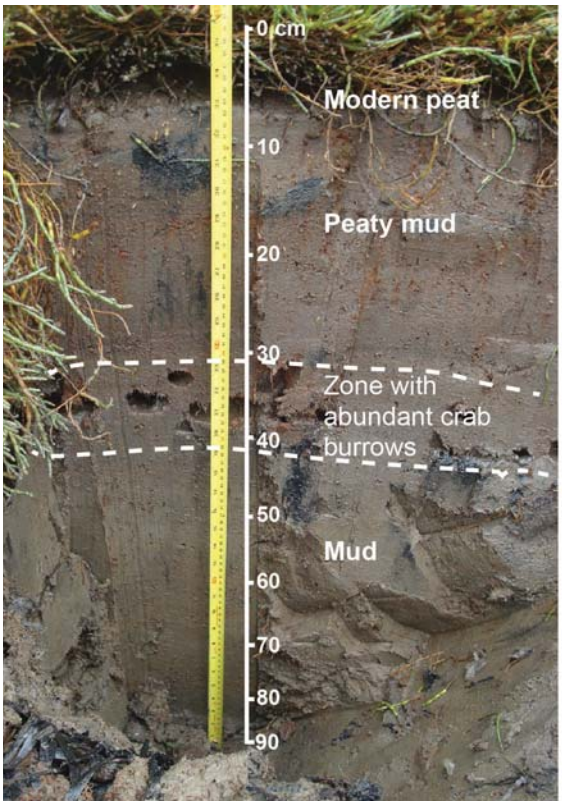
The new report, "The Search for Geologic Evidence of Distant-Source Tsunamis Using New Field Data in California," is available online at <**http://dx.doi.org/10.3133/ofr20131170c**>. It is a chapter in a large report, "The SAFRR (Science Application for Risk Reduction) Tsunami Scenario," posted at <**http://pubs.usgs.gov/of/2013/1170/**>.

To learn more about the SAFRR Tsunami Scenario, read the *Sound Waves* article at <**http://soundwaves.usgs.gov/2013/10/research.html**> and visit the SAFRR website at <**http://www.usgs.gov/natural_hazards/safrr/projects/tsunamiscenario.asp**>.

For more information about tsunamis, visit the California Geological Survey tsunami website at <**http://www.conservation.ca.gov/cgs/geologic_hazards/Tsunami/Inundation_Maps/Pages/**> and the USGS tsunami website at <**http://walrus.wr.usgs.gov/tsunami/**>.



*Map of California, showing sites where scientists looked for geological evidence of tsunamis. White squares, sites where scientists did visual reconnaissance; black dots, visual reconnaissance and coring; yellow dots, detailed evaluations and coring. Modified from figure 5 in "The Search for Geologic Evidence of Distant-Source Tsunamis Using New Field Data in California," <**http://dx.doi.org/10.3133/ofr20131170c**>.*



*No tsunami deposits are evident in this cutbank outcrop at Home Bay marsh, Point Reyes National Seashore, California. Photograph shows the subsurface stratigraphy to a depth of 90 centimeters (35 inches) exposed during low tide. Holes about halfway down the exposure are from burrowing crabs populating a narrow zone at the transition from underlying inorganic mud deposits to overlying peaty mud and peat deposits. Photograph taken July 27, 2011, by **Eileen Hemphill-Haley**, Humboldt State University.*

USGS Helps Celebrate the Monterey Bay National Marine Sanctuary

By Helen Gibbons

Visitors enjoyed interactive U.S. Geological Survey (USGS) displays at the Monterey Bay National Marine Sanctuary Celebration held May 17, 2014, on the municipal wharf in Santa Cruz, California. The family-oriented Sanctuary Celebration was one of a series of events marking the wharf's 100th year. Among the many offerings were live music, arts and crafts, bird spotting, a boat-building demonstration, a treasure hunt for kids, and numerous informational booths.

The event opened with remarks from several dignitaries, including **Leon Panetta**, who was instrumental in establishing the Monterey Bay National Marine Sanctuary (<**http://montereybay.noaa.gov/**>) when he served as Representative of California's 16th Congressional District, which at that time encompassed coastal communities around Monterey Bay. Panetta called this achievement one of the greatest highlights in his long career as a lawmaker. Established in 1992, the sanctuary has a shoreline length of 444 kilometers (276 miles) and an area of 15,783 square kilometers (6,093 square miles) of ocean, making it larger than Yellowstone National Park.

***Kurt Rosenberger** shows a young visitor how a current meter (suspended in tank) measures the speed and direction of currents and displays the readings on a monitor (right). USGS photograph by **Helen Gibbons**.*

As part of the celebration, the USGS Pacific Coastal and Marine Science Center hosted a booth where visitors could:

- create water currents in a large tank and watch how they move sediment and affect the readings from a current meter (presented by oceanographer **Kurt Rosenberger**),
- observe single-celled marine organisms called foraminifera through microscopes and learn how they are used to date seafloor sediments and study climate change (presented by micropaleontologist **Mary McGann**), and
- view a three-part movie compiled by geographer **Nadine Golden** and intern **Parker Allwardt** featuring rare observations of submarine turbidity currents in Monterey Canyon (produced by Rosenberger), video footage of the Monterey Bay seafloor (produced by Golden), and virtual "flyovers" of seafloor terrain from north of San Francisco to Monterey Canyon (produced by physical scientist **Pete Dartnell**).

***Mary McGann** (right) helps visitors prepare to observe foraminifera (single-celled marine organisms) through a microscope while a couple (rear left) watch a virtual "flyover" of the seafloor off the central California coast. USGS photograph by **Helen Gibbons**.*

The weather was fine, and visitors and presenters alike enjoyed the festivities. In addition to the contributors listed above, several members of the Pacific Coastal and Marine Science Center helped make the day a success: **Helen Gibbons** made exhibit labels and coordinated many of the logistical details, **Sara Kaiser** helped prepare name tags and handouts, and **Alan Allwardt**, **Amy Foxgrover**, Gibbons, **Ann Gibbs**, **Andy O'Neill**, and **Jane Reid** helped with set up, relief staffing, and tear down. Thanks to all for a fun event!

***Andy O'Neill** (far left, back to camera) and **Mary McGann** (center, dark green shirt) talk to visitors at the USGS booth. USGS photograph by **Helen Gibbons**.*

Public Lecture on Deep-Sea Corals Takes Audience "Into the Abyss"

By Helen Gibbons

U.S. Geological Survey (USGS) research oceanographer **Nancy Prouty** took her audience into the ocean depths for a look at deep-sea coral communities in a public lecture titled "Into the Abyss: Living Without Light" on June 26, 2014, at the USGS center in Menlo Park, California.

Prouty enchanted her audience with images of deep-sea corals and the diverse community of animals that live with them in the dark, cold, high-pressure environment of the deep sea—a region where scientists once thought life could not exist. She showed video footage of remotely operated vehicles (ROVs) collecting samples deep in the ocean and being recovered onto the deck of a research vessel, which gave viewers a feel for how information about deep-sea corals is gathered. Her brief overview of deep-sea exploration over the past century demonstrated how human understanding of the deep-sea environment has changed over time, and how much we have yet to explore.

◂***Nancy Prouty*** *gives a public lecture on deep-sea corals titled "Into the Abyss: Living Without Light" on June 26, 2014, at the USGS center in Menlo Park, California. USGS photograph by* ***Helen Gibbons****.*

*Like an old-growth forest, the deep-sea corals pictured here (*Lophelia pertusa*) provide habitat for many other organisms, including the Galatheid crab in center of photo. Screenshot from archived lecture video at <**http://online.wr.usgs.gov/calendar/2014/jun14.html**>.*

▸*A piece of black coral (the skeleton is black, the living tissue orange) collected during a research cruise in the northern Gulf of Mexico in 2009 (<**http://oceanexplorer.noaa.gov/explorations/09lophelia/welcome.html**>). These deep-sea corals grow very slowly and can live for hundreds, even thousands, of years. (Learn more at <**http://soundwaves.usgs.gov/2011/03/research2.html**>.) Photograph by* ***Steve Ross****, research professor at University of North Carolina, Wilmington, Center for Marine Science.*

As a scientist at the USGS Pacific Coastal and Marine Science Center in Santa Cruz, California, Prouty analyzes coral skeletons to interpret how physical and chemical conditions in the ocean have changed throughout the lifespan of the coral. She studies both shallow-water corals (for example, see "Coral Reefs Along West-Central Guam," this issue, <**http://soundwaves.usgs.gov/2014/08/research.html**>) and the deep-sea corals that were the subject of her June lecture.

Prouty's talk emphasized the following points:

- Deep-sea coral communities are biological hotspots that are among the most diverse and productive on Earth.
- As slow-growing and long-living animals, deep-sea corals are windows to the past.
- Because deep-sea corals are sensitive to both natural events and human activities, studying them is important to promoting healthy ecosystems.

The talk ended with a question-and-answer session, and many audience members lingered to speak to Prouty and examine her deep-sea coral specimens. An archived video of the lecture is posted on the USGS Evening Public Lecture Series webpage at <**http://online.wr.usgs.gov/calendar/2014/jun14.html**>.

To learn more about Prouty's deep-sea coral studies, view *Sound Waves* articles at <**http://soundwaves.usgs.gov/2014/02/research2.html**>, <**http://soundwaves.usgs.gov/2013/06/fieldwork3.html**>, and <**http://soundwaves.usgs.gov/2011/03/research2.html**>.

Prouty's work is part of the USGS Diversity, Systematics and Connectivity of Vulnerable Reef Ecosystems (DISCOVRE) Project, <**http://fl.biology.usgs.gov/DISCOVRE/**>.

USGS Gas Hydrates Project Hosts Japanese Colleagues to Advance Collaboration on Nankai Trough Hydrate-Bearing Pressure Cores

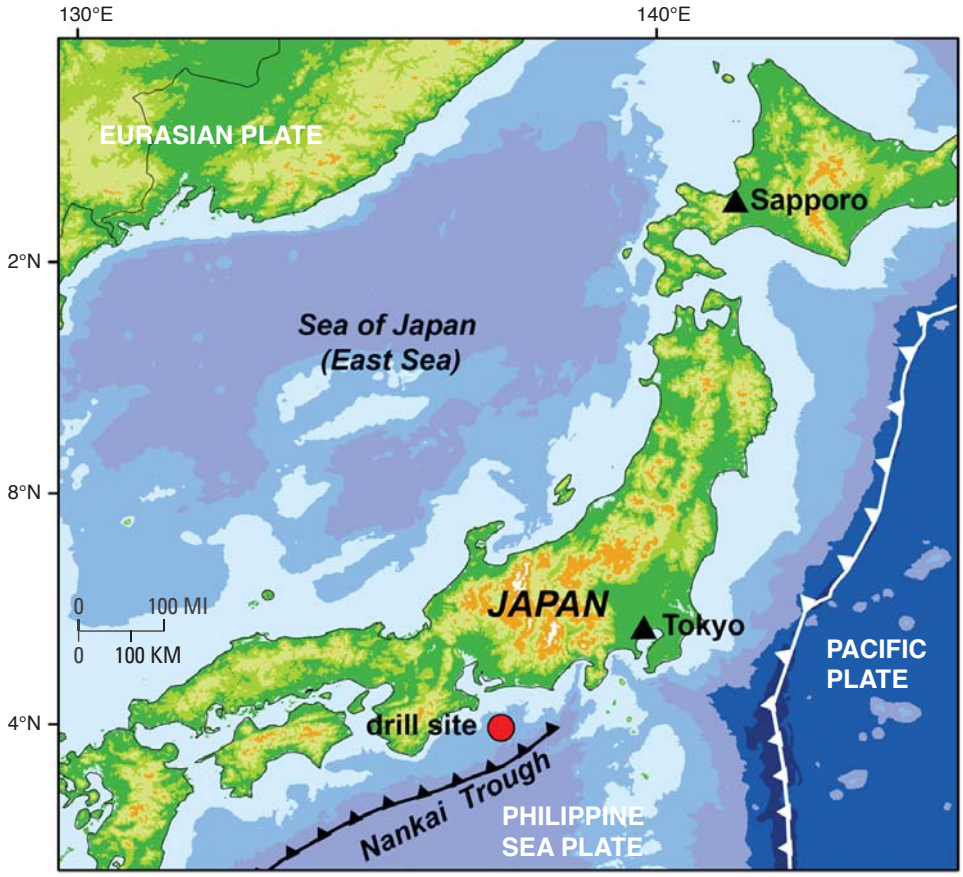
By William Waite

The U.S. Geological Survey (USGS) Gas Hydrates Project hosted Japanese colleagues in Woods Hole, Massachusetts, in summer 2014, to further their ongoing collaborative study of gas hydrates in the Nankai Trough, offshore Japan. The eastern Nankai Trough has been the focus of an extensive multiyear program, supported by Japan's Research Consortium for Methane Hydrate Resources (MH21, <**http://www.mh21japan.gr.jp/english/**>), to explore the potential for using methane from gas hydrates as an energy resource. In March 2013, the MH21 program accomplished the first-ever production of methane from deepwater gas hydrate deposits, and a second production test in the eastern Nankai Trough could occur as early as 2015.

In support of the MH21 program, researchers from the USGS and the Particulate Media Research Laboratory at the Georgia Institute of Technology (Georgia Tech, <**http://pmrl.ce.gatech.edu/**>; **J. Carlos Santamarina**, director) partnered with Japanese colleagues in January 2013 for several weeks' worth of joint analyses of cores containing hydrate-bearing sediment recovered from the deepwater production site (see "Groundbreaking Gas Hydrate Research," *Sound Waves*, March/April 2013, <**http://soundwaves.usgs.gov/2013/04/research.html**>).

(Nankai Trough continued on page 13)

*The USGS Gas Hydrates Project, represented by **William Waite** (USGS, far left), hosted (left to right) **Jiro Nagao** (Advanced Industrial Science and Technology [AIST]), **Tetsuya Fujii** (Japan Oil, Gas and Metals National Corporation [JOGMEC]), and **Yoshihiro Konno** (AIST) at the USGS Woods Hole Coastal and Marine Science Center in summer 2014. USGS photograph by **Colleen Clark**.*



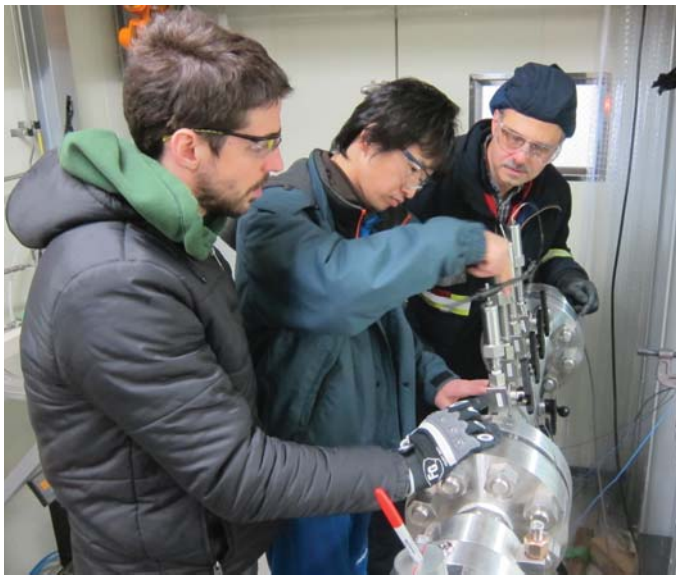
*Map of Japan, showing collection site (red dot) for the gas hydrate-bearing pressure cores being studied collaboratively by Japanese and U.S. researchers. At the same site, Japan's Research Consortium for Methane Hydrate Resources (MH21, <**http://www.mh21japan.gr.jp/english/**>) achieved the first-ever production of methane from deepwater gas hydrate deposits in March 2013. White curve shows trench where the Pacific plate subducts beneath Japan and the Philippine Sea plate. Black curve indicates the Nankai Trough, where the Philippine Sea plate subducts beneath Japan.*

(Nankai Trough continued from page 12)

On June 30 and July 1, 2014, USGS and Japanese collaborators met at the USGS Woods Hole Coastal and Marine Science Center (WHCMSC, <**http://woodshole.er.usgs.gov/**>). **William Waite** of the USGS Gas Hydrates Project welcomed **Jiro Nagao** and **Yoshihiro Konno** from Japan's Advanced Industrial Science and Technology laboratory (AIST, <**http://www.aist.go.jp/index_en.html**>) and **Tetsuya Fujii** from the Japan Oil, Gas and Metals National Corporation (JOGMEC, <**http://www.jogmec.go.jp/english/**>) to discuss their hydrate-bearing core analyses.

Gas hydrate, often referred to as "methane hydrate" or just "hydrate," is a frozen form of methane and water that occurs naturally in sediments beneath waters deeper than about 500 meters (1,600 feet) and where temperatures are relatively low. Gas hydrate breaks down ("dissociates") when pressure is decreased and (or) temperature is increased. The March 2013 production test in the Nankai Trough took advantage of this property by lowering bottom pressure in the production well to cause dissociation and release methane. (Learn more about the production test at <**http://www.netl.doe.gov/File%20Library/Research/Oil-Gas/methane%20hydrates/MHNews_2013_October.pdf**>, 10.1 MB.)

Water and gas released by gas hydrate dissociation destroy the properties of the original sediment. To preserve these properties for study, scientists use specialized coring techniques that prevent hydrate dissociation by maintaining pressure on the hydrate-bearing sediments close to their original pressure ("pressure coring"). Pressure coring has been conducted in marine gas hydrate provinces for nearly two decades, but the instrumentation has advanced in recent years to permit recovery of longer cores and sediments rich in sand and (or) containing high saturations of gas hydrate.



(Left to right) ***Efthymios Papadopoulos*** *(Georgia Tech),* ***Yoshihiro Konno*** *(AIST), and* ***William Winters*** *(USGS) insert a sensor into a pressure core specimen in January 2013 at the AIST facility in Sapporo, Japan. (Read more about this work in "Groundbreaking Gas Hydrate Research,"* Sound Waves*, March/April 2013,* <***http://soundwaves.usgs.gov/2013/04/research.html***>*.) USGS photograph by* ***William Waite****.*

Another important advance in the past decade has been the development of tools to acquire oriented X-rays of hydrate-bearing cores and analyze the sediments' seismic, electrical, strength, and other properties while the sediments are still held at their in situ pressure. The USGS Gas Hydrates Project currently operates one such tool in support of U.S. and international pressure coring programs: the Instrumented Pressure Testing Chamber (IPTC), built at Georgia Tech in 2005. With these tools, it is now possible to measure most of the in situ geomechanical properties necessary to, among other things, guide drilling and production strategies for extracting methane from gas hydrate as an energy resource.

The summer 2014 meeting in Woods Hole focused on finalizing data sets obtained on eight pressure cores recovered at the MH21 Nankai Trough deepwater production site. Analyses of data sets from AIST, JOGMEC, the USGS, and Georgia Tech, as well as from colleagues at Geotek, Inc. and the University of Calgary, will be the basis of a thematic issue of the journal *Marine and Petroleum Geology* to be published in spring 2015, with **Koji Yamamoto** (JOGMEC) and **Carolyn Ruppel** (USGS Gas Hydrates Project) as guest editors.

Use-Case Training for the Woods Hole, Massachusetts, Research Community

By Fran Lightsom

On May 19, 2014, twenty-three individuals from three local Woods Hole, Massachusetts, research organizations—the U.S. Geological Survey (USGS), the Woods Hole Oceanographic Institution (WHOI), and the Marine Biological Laboratory (MBL)—sat down in the USGS conference room on the WHOI campus to hear **Peter Fox** (Rensselaer Polytechnic Institute, adjunct to WHOI) describe a "use-case" methodology for systems engineering and the design of business processes. The participants included researchers, data managers, programmers, and students. Some were skeptical but nevertheless intrigued. Some were initially overwhelmed with new terminology, but in the breakout groups that followed, they began to learn, engage, and explore the process. Two days later, these participants unanimously considered use-case methodology to be beneficial for collaborating in research, data management, and software development. The participants concluded the workshop by proposing a new Woods Hole virtual organization for those trained in this process.

So, what is a use case? The term is used in systems and software engineering

(Use-Case Training continued on page 14)

(Use-Case Training continued from page 13)

to describe the interactions between a user and a system or software to achieve a specific goal. The methodology has been expanded by Fox and colleagues at Rensselaer Polytechnic Institute (RPI) to include other types of goals—data management, for instance—and has been applied in particular to interdisciplinary collaborations in the sciences. The RPI methodology is officially titled the "TWC Semantic Web Methodology," with "TWC" referring to the RPI Tetherless World Constellation group and "semantic web" referring to a broad range of work conducted by this group to facilitate sharing data and information over the Internet. (Learn more about the TWC Semantic Web Methodology at <**http://tw.rpi.edu/web/doc/TWC_SemanticWebMethodology**>.) It turns out that semantics—the meaning of words, phrases, and symbols in a particular context—is important in most collaborations, especially interdisciplinary scientific collaborations in which people from diverse backgrounds share a common goal but need to develop common vocabularies and protocols for exchanging data in order to achieve that goal.

After the introductory lecture by Fox, each participant wrote down an individual goal, following a basic template used in Fox's e-Science courses at RPI. (e-Science refers to computer-intensive methods of managing, sharing, and analyzing large data sets—often called "big data" in the press.) Then each participant shared his or her individual use-case goal with the whole group. In plenary, we decided on three of the use cases to pursue further in smaller groups: "Citizen Science Biodiversity," "Compliance Checker," and "Protein Portal." Each small group consisted of participants from the three institutions—USGS, WHOI, and MBL—with a balance of skills and disciplines. This approach of using small teams with mixed skills has proven successful as part of the use-case methodology.

The Citizen Science Biodiversity group, led by **Dave Remsen**, manager of the Marine Resources Center at MBL, proposed a goal to "use School of Science students to collect species occurrence data in Eel Pond [Massachusetts] to be published online for education and research." (The Children's School of Science [<**http://childrensschoolofscience.org/**>] offers field-oriented summer courses for children aged 7–16.) The Compliance Checker group, led by **Danie Kinkade** of the Biological and Chemical Oceanography Data Management Office (BCO-DMO) at WHOI, proposed a goal to "streamline process for Program Manager to check on status of award number and project names by providing one view" (a single webpage that provides all the information the program manager needs). The Protein Portal group, led by **Mak Saito**, associate scientist in WHOI's Marine Chemistry Department, proposed a goal to "create a portal that allows users to discover where, when, and which organisms contain a protein/enzyme of interest that occurs in the oceans through a bioinformatics analysis of large mass-spectral libraries created from many oceanic samples."

*Participants in the May 2014 use-case training for the Woods Hole, Massachusetts, research community. **Fran Lightsom**, U.S. Geological Survey (front row, far right), and **Stace Beaulieu**, Woods Hole Oceanographic Institution (front row, far left), convened the workshop. **Peter Fox**, Rensselaer Polytechnic Institute (middle row, with hands clasped), provided guidance in use-case methodology.*

Following the RPI methodology, each team described how "actors" interact with the "system" to achieve their goals, prepared activity diagrams illustrating these interactions and their outcomes, and modeled the concepts that play an important role in the use case. (Read about similar workshops held in late 2011 and early 2012, <**http://soundwaves.usgs.gov/2012/02/meetings.html**>.) This three-pronged approach leads to the orderly development of design requirements for the system—often, but not necessarily, a computer system (use cases are ideal for business processes).

Enthusiasm is growing as more people come to understand use cases. At the conclusion of the 2014 workshop, one participant from WHOI commented, "I think if everyone at WHOI were familiar with or at least exposed to this methodology, we'd be able to communicate better, write better proposals, and work better together across disciplines." Another participant said, "The methodology is so useful: it helps groups narrow down their scope/focus, but also helps reveal new ideas that wouldn't come about without that group interaction."

The workshop was convened by **Fran Lightsom**, USGS (**flightsom@usgs.gov**), and **Stace Beaulieu**, WHOI (**stace@whoi.edu**), and was sponsored by the USGS Woods Hole Coastal and Marine Science Center, WHOI Ocean Informatics Initiative, and Woods Hole Data Mongers. ❁

Spring 2014 Monterey Bay Marine GIS User Group Meeting

By Nadine Golden

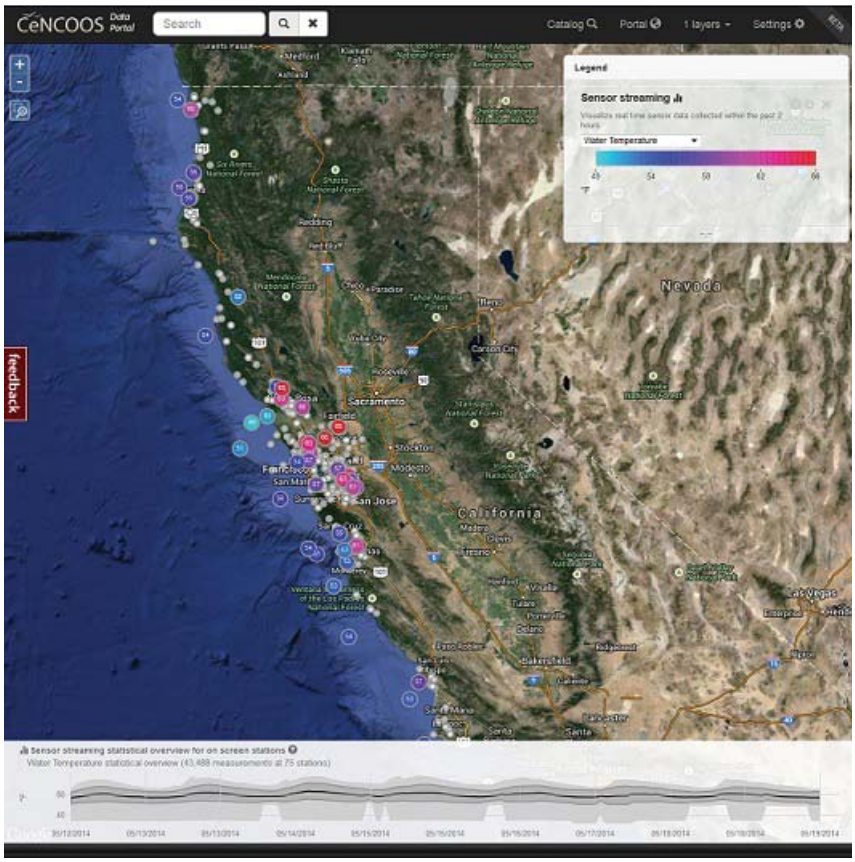
The fourth meeting of the Monterey Bay Marine GIS User Group was held on April 14, 2014, in Monterey, California. A GIS (geographic information system) is a computer-based system for storing, manipulating, analyzing, and managing all types of geographically referenced information. The goals of this user group are to foster collaboration among academic institutions, the private sector, government agencies, and non-governmental organizations (NGOs) in the Monterey Bay marine GIS science community; to facilitate hands-on GIS training; and to increase awareness of marine spatial data sets within the broader GIS science community in the Monterey Bay area.

The April 2014 user group meeting was hosted by the 2014 CalGIS Conference—an annual meeting sponsored by the Urban and Regional Information Systems Association (URISA) to foster a sense of community among California GIS users. The Monterey Bay Marine GIS User Group met on the first day of the larger conference, all of whose participants were welcome.

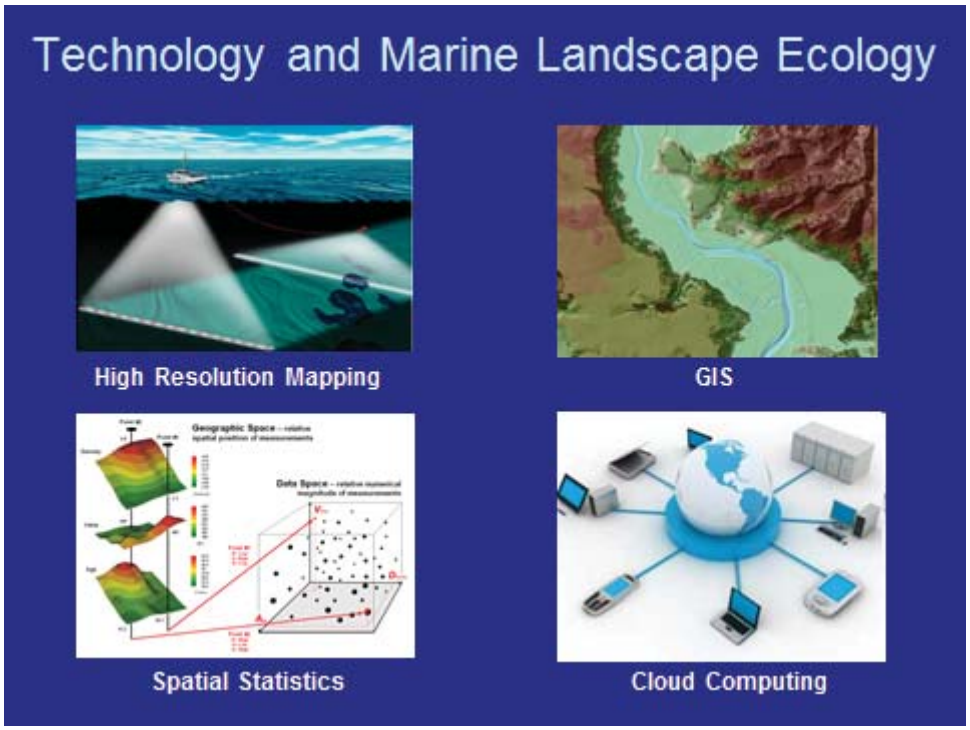
During the user group meeting, approximately 110 members of the Monterey Bay coastal and marine community—including GIS users, marine scientists, and policy makers—gathered for a morning of networking and presentations that focused on marine GIS in scientific research and software tools for more effective GIS use. A workshop in the afternoon taught participants how to use one of those tools, the Environmental Data Connector (EDC, <**http://www.pfeg.noaa.gov/products/EDC/**>), for importing satellite data into ArcGIS. (ArcGIS is a widely used GIS product developed by the company Esri, <**http://www.esri.com/software/arcgis**>.)

To start off the morning, **Rob Bochenek** of Axiom Consulting & Design (<**http://**

(Monterey GIS continued on page 16)



*View of real-time water-temperature data in a demonstration of the beta release of the CeNCOOS Data Portal (<**http://www.cencoos.org/sections/data/portal.php**>) by **Rob Bochenek** of Axiom Consulting & Design (<**http://www.axiomalaska.com/**>).*



*Slide from **Cory Garza**, Division of Science and Environmental Policy at California State University, Monterey Bay (CSUMB), who described work that he and his students have conducted recently at CSUMB's Marine Landscape Ecology Lab (<**http://sep.csumb.edu/mlel/**>).*

(Monterey GIS continued from page 15)

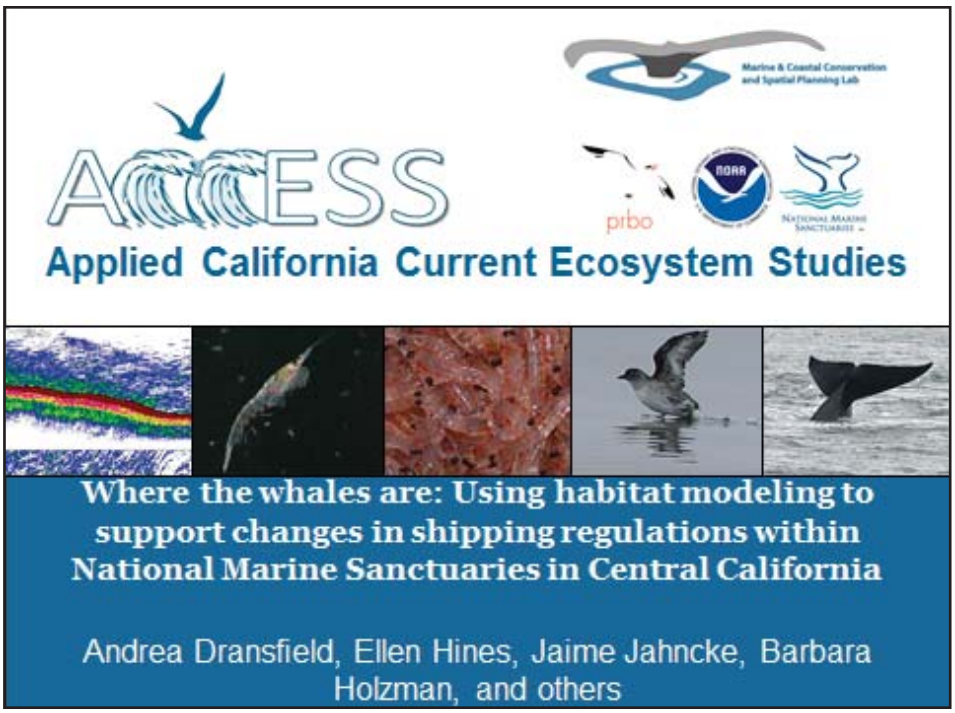
www.axiomalaska.com/>) demonstrated the CeNCOOS (Central and Northern California Ocean Observing System, <**http://www.cencoos.org/**>) Data Portal. (An ocean observing system integrates data from various buoys, satellites, and other measurement stations and makes them available online; examples of the data include water temperature, air temperature, wave height and period, wind speed and direction, and turbidity.) Bochenek presented some of the new functionality in the beta release of the CeNCOOS portal (<**http://www.cencoos.org/sections/data/portal.php**>). He showed examples of new data types, data sources, additional parameters (such as chlorophyll, pH, dissolved oxygen), and new features (such as data-search catalog, filtering, summary statistics).

Next, **Chris Besenty** of the California Ocean Protection Council (OPC, <**http://www.opc.ca.gov/**>) demonstrated the California Coastal Geoportal (<**http://portal.gis.ca.gov/geoportal/catalog/OPC/OPC.page**>), a State of California website for improving access to government-derived geographic data. Besenty led the group through the products, tools, and options of the geoportal. He also shared the lessons he learned in designing this portal, with the goal of making it "easy for users to find and use the best geospatial data that is relevant to their task."

Josh Mode of the company CARIS (<**http://www.caris.com/**>) gave a presentation on managing and sharing bathymetric data with CARIS software.

Next **Corey Garza** of California State University, Monterey Bay (CSUMB) described the work that he and his students have conducted recently at CSUMB's Marine Landscape Ecology Lab (<**http://sep.csumb.edu/mlel/**>), where they use geospatial technologies and spatial statistics to study the relationship between habitat complexity and patterns of species distribution and abundance in intertidal and subtidal marine communities.

Ellen Hines of San Francisco State University (SFSU) presented recent research from SFSU's Marine & Coastal Conservation and Spatial Planning Lab (<**http://gis.sfsu.edu/coastal/**>). The lab's research addresses population and community ecology of threatened and endangered species as related to local conservation efforts and regional-scale coastal and marine management science.



*Slide from **Ellen Hines** of San Francisco State University (SFSU), whose lab emphasizes consistent standards of field methodology and monitoring techniques, and the creation of educational materials that can be applied to community-based conservation planning.*

*Slide from **Adam McClure**, a recent graduate of Hine's lab and the SFSU Department of Geography and Environment, who discussed historical wetland loss.*

Adam McClure, a recent graduate from the lab and from the SFSU Department of Geography and Environment, presented his research "Error Reduction Techniques

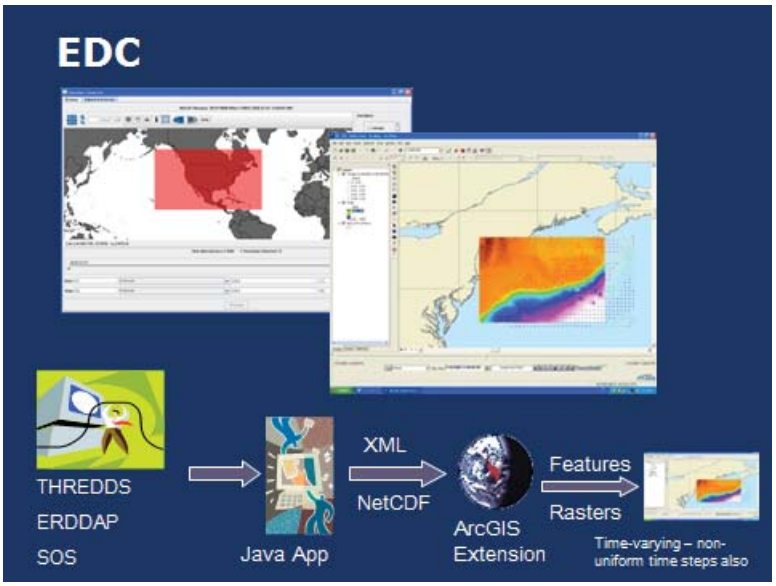
(Monterey GIS continued on page 17)

(Monterey GIS continued from page 16)

on a LiDAR Salt Marsh DEM Using RTK GPS." (LiDAR, for "light detection and ranging," is a laser-based surveying technique. A DEM, or digital elevation model, is an array of ground elevations, usually at regularly spaced intervals, that produce a 3D representation of the ground surface. GPS, or Global Positioning System, is a satellite-based navigation system. RTK, or Real Time Kinematic, satellite navigation is a technique used to enhance the precision of the satellite-based position data.)

Drew Stevens of the Esri Oceans team led the group through the new features of the Esri Ocean Basemap (<**http://www.esri.com/industries/natural-resources/oceans/basemap**>), new maritime products and tools, and future developments of Esri's ArcGIS for Maritime (<**http://www.esri.com/software/arcgis/extensions/maritime**>).

The final speaker of the morning, research oceanographer **Cara Wilson** of the National Oceanic and Atmospheric Administration (NOAA) Southwest Fisheries Science Center (<**https://swfsc.noaa.gov/**>), gave a brief overview of the Environmental Data Connector (EDC, <**http://www.pfeg.noaa.gov/products/EDC/**>), a tool for importing satellite data into ArcGIS. She discussed where and how EDC is being used in current analyses and outlined the goals and tasks for the afternoon workshop on how to use EDC.



*Slide from **Cara Wilson** of the National Oceanic and Atmospheric Administration (NOAA) Southwest Fisheries Science Center, displaying features of the Environmental Data Connector (EDC, <**http://www.asascience.com/software/arcgistools/edc.shtml**>) tool for importing satellite data into ArcGIS.*

After a break for lunch, participants in the EDC workshop gathered again at the meeting site. They saw a demonstration of EDC by Wilson, learned how to configure the EDC tool for gathering information, and then created new EDC projects of their own, with Wilson close by to teach them how to customize EDC features for their own purposes.

The Monterey Bay Marine GIS User Group will meet again in spring 2015; details will be announced on the Monterey Bay Marine GIS User Group website (<**http://walrus.wr.usgs.gov/MontereyBayMarineGIS/**>). For more information about the Monterey Bay Marine GIS User Group or its meetings, please contact **Nadine Golden** at **ngolden@usgs.gov** or **Lisa Wedding** at **lwedding@stanford.edu**.

Recent Publications

Ackerman, J.T., Herzog, M.P., Hartman, C.A., Herring, G., 2014, Forster's tern chick survival in response to a managed relocation of predatory California gulls: Journal of Wildlife Management, v. 78, no. 5, p. 818–829, [**http://dx.doi.org/10.1002/jwmg.728**].

Ahearn, E.A., and Lombard, P.J., 2014, Flood inundation maps and water-surface profiles for tropical storm Irene and selected annual exceedance probability floods for Flint Brook and the Third Branch White River in Roxbury, Vermont: U.S. Geological Survey Scientific Investigations Report 2014–5118, 35 p., [**http://dx.doi.org/10.3133/sir20145118**].

Atazadeh, I., Edlund, M.B., van de Vijver, B., Mills, K., Spaulding, S.A., Gell, P.A., Crawford, S., Barton, A.F., Lee, S.S., Smith, K.E.L., Newall, P., and Potapova, M., 2014, Morphology, ecology and biogeography of *Stauroneis pachycephala* P.T. Cleve (Bacillariophyta) and its transfer to the genus *Envekadea:* Diatom Research, v. 29, no. 4, p. 455–464, [**http://dx.doi.org/10.1080/0269249X.2014.927006**].

Brosnan, D., Wein, A., and Wilson, R., 2014, SAFRR tsunami scenario—Impacts on California ecosystems, species, marine natural resources, and fisheries, chap. G *of* Ross, S.L., and Jones, L.M., eds., The SAFRR (Science Application for Risk Reduction) tsunami scenario: U.S. Geological Survey Open-File Report 2013–1170-G, 60 p., [**http://dx.doi.org/10.3133/ofr20131170G**].

Brown, L.R., Baxter, R., Castillo, G., Conrad, L., Culberson, S., Erickson, G., Feyrer, F., Fong, S., Gehrts, K., Grimaldo, L., Herbold, B., Kirsch, J., Mueller-Solger, A., Slater, S., Souza, K., and Van Nieuwenhuyse, E., 2014, Synthesis of studies in the fall low-salinity zone of the San Francisco Estuary, September–December 2011: U.S. Geological Survey Scientific Investigations Report 2014–

(Recent Publications continued on page 18)

(Recent Publications continued from page 17)

5041, 136 p., [**http://dx.doi.org/10.3133/sir20145041**].

Buscombe, D., Rubin, D.M., Lacy, J.R., Storlazzi, C.D., Hatcher, G., Chezar, H., Wyland, R., and Sherwood, C.R., 2014, Autonomous bed-sediment imaging-systems for revealing temporal variability of grain size: Limnology and Oceanography–Methods, v. 12, p. 390–406, [**http://dx.doi.org/10.4319/lom.2014.12.390**].

Chaytor, J.D., and ten Brink, U.S., 2014, Event sedimentation in low-latitude deep-water carbonate basins, Anegada passage, northeast Caribbean: Basin Research, published online 10 July 2014, [**http://dx.doi.org/10.1111/bre.12076**].

Cochran, S.A., Gibbs, A.E., and White D.J., 2014, Benthic habitat map of the U.S. Coral Reef Task Force Watershed Partnership Initiative Kā'anapali priority study area and the State of Hawai'i Kahekili Herbivore Fisheries Management Area, west-central Maui, Hawai'i: U.S. Geological Survey Open-File Report 2014–1129, 42 p., [**http://dx.doi.org/10.3133/ofr20141129**].

Cross, V.A., Bratton, J.F., Michael, H.A., Kroeger, K.D., Green, A., and Bergeron, E., 2014, Continuous resistivity profiling and seismic-reflection data collected in April 2010 from Indian River Bay, Delaware: U.S. Geological Survey Open-File Report 2011–1039, 23 p., [**http://dx.doi.org/10.3133/ofr20111039**].

Davenport, J., Jones, T.T., Work, T.M., and Balazs, G.H., 2014, Pink spot, white spot—The pineal skylight of the leatherback turtle (*Dermochelys coriacea* Vandelli 1761) skull and its possible role in the phenology of feeding migrations: Journal of Experimental Marine Biology and Ecology, v. 461, p. 1–6, [**http://dx.doi.org/10.1016/j.jembe.2014.07.008**].

Dealy, T.P., East, A.E., and Fairley, H.C., 2014, 2010 weather and aeolian sand-transport data from the Colorado River corridor, Grand Canyon, Arizona: U.S. Geological Survey Open-File Report 2014-1135, 90 p., [**http://dx.doi.org/10.3133/ofr20141135**].

DeWitt, N.T., Pfeiffer, W.R., Miselis, J.L., Bernier, J.C., Reynolds, B.J., Wiese, D.S., and Kelso, K.W., 2014, Coastal bathymetry and backscatter data collected in 2012 from the Chandeleur Islands, Louisiana: U.S. Geological Survey Data Series Report 847, [**http://dx.doi.org/10.3133/ds847**].

Donatuto, J., Grossman, E.E., Konovsky, J., Grossman, S., and Campbell, L.W., 2014, Indigenous community health and climate change—Integrating biophysical and social science indicators: Coastal Management, v. 42, no. 4, p. 355–373, [**http://dx.doi.org/10.1080/08920753.2014.923140**].

Eagles-Smith, C.A., and Ackerman, J.T., 2014, Mercury bioaccumulation in estuarine wetland fishes—Evaluating habitats and risk to coastal wildlife: Environmental Pollution, v. 193, p. 147–155, [**http://dx.doi.org/10.1016/j.envpol.2014.06.015**].

Eagles-Smith, C.A., Ackerman, J.T., Fleck, J.A., Windham-Myers, L., McQuillen, H., and Heim, W., 2014, Wetland management and rice farming strategies to decrease methylmercury bioaccumulation and loads from the Cosumnes River Preserve, California: U.S. Geological Survey Open-File Report 2014-1172, 42 p., [**http://dx.doi.org/10.3133/ofr20141172**].

Ensign, S.H., Hupp, C.R., Noe, G.B., Krauss, K.W., and Stagg, C.L., 2014, Sediment accretion in tidal freshwater forests and oligohaline marshes of the Waccamaw and Savannah Rivers, USA: Estuaries and Coasts, v. 37, no. 5, p. 1107–1119, [**http://dx.doi.org/10.1007/s12237-013-9744-7**].

Enwright, N.M., Hartley, S.B., Brasher, M.G., Visser, J.M., Mitchell, M.K., Ballard, B.M., Parr, M.W., Couvillion, B.R., and Wilson, B.C., 2014, Delineation of marsh types of the Texas coast from Corpus Christi Bay to the Sabine River in 2010: U.S. Geological Survey Scientific Investigations Report 2014–5110, 18 p., 1 pl., scale 1:400,000, [**http://dx.doi.org/10.3133/sir20145110**].

Geist, E.L., 2014, Explanation of temporal clustering of tsunami sources using the epidemic-type aftershock sequence model: Seismological Society of America Bulletin, v. 104, no. 4, p. 2091–2103, [**http://dx.doi.org/10.1785/0120130275**].

Goldstein, J.H., Thogmartin, W.E., Bagstad, K.J., Dubovsky, J.A., Mattsson, B.J., Semmens, D.J., López-Hoffman, L., and Diffendorfer, J.E., 2014, Replacement cost valuation of Northern Pintail (*Anas acuta*) subsistence harvest in Arctic and sub-Arctic North America: Human Dimensions of Wildlife—An International Journal, v. 19, no. 4, p. 347–354, [**http://dx.doi.org/10.1080/10871209.2014.917345**].

Gómez-Gómez, F., Rodríguez-Martínez, J., and Santiago, M., 2014, Hydrogeology of Puerto Rico and the outlying islands of Vieques, Culebra, and Mona: U.S. Geological Survey Scientific Investigations Map 3296, 40 p. plus 2 pls., [**http://dx.doi.org/10.3133/sim3296**].

Hapke, C.J., Adams, P.N., Allan, J., Ashton, A., Griggs, G.B., Hampton, M.A., Kelly, J., and Young, A.P., 2014, The rock coast of the USA, chap. 9 *of* Kennedy, D.M., Stephenson, W.J., and Naylor, L.A., eds., Rock coast geomorphology—A global synthesis: Geological Society, London, Memoirs, v. 40, p. 137–154, [**http://dx.doi.org/10.1144/M40.9**]

Herman-Mercer, N.M., and Schuster, P.F., 2014, Strategic needs of water on the Yukon—An interdisciplinary approach to studying hydrology and climate change in the Lower Yukon River Basin: U.S. Geological Survey Fact Sheet 2014–3060, 4 p., [**http://dx.doi.org/10.3133/fs20143060**].

Howard, R.J., Wells, C.J., Michot, T.C., and Johnson, D.J., 2014, Effects of disturbance associated with seismic exploration for oil and gas reserves in coastal marshes: Environmental Management, v. 54, no. 1, p. 30–50, [**http://dx.doi.org/10.1007/s00267-014-0274-2**].

Huntington, T.G., Culbertson, C.W., Fuller, C., Glibert, P., and Sturtevant, L., 2014, The relative importance of oceanic nutrient inputs for Bass Harbor Marsh Estuary at Acadia National Park, Maine: U.S. Geological Survey Scientific Investigations Report 2014–5123, 19 p., [**http://dx.doi.org/10.3133/sir20145123**].

Jackson, J., Donovan, M., Cramer, K., and Lam, V., eds., 2014, Status and trends

(Recent Publications continued on page 19)

(Recent Publications continued from page 18)

of Caribbean coral reefs—1970–2012: Washington, D.C., Global Coral Reef Monitoring Network, [**http://gcrmn.org/gcrmn-publication/status-and-trends-of-caribbean-coral-reefs-1970-2012/**].

Johnson, S.Y., and Cochran, S.A., eds., 2014, California State Waters Map Series—Offshore of Coal Oil Point, California: U.S. Geological Survey Scientific Investigations Map 3302, pamphlet 57 p., 12 sheets, scale 1:24,000, [**http://dx.doi.org/10.3133/sim3302**].

Keller, J.M., Balazs, G.H., Nilsen, F., Rice, M., Work, T.M., and Jensen, B.A., 2014, Investigating the potential role of persistent organic pollutants in Hawaiian green sea turtle fibropapillomatosis: Environmental Science & Technology, v. 48, no. 14, p. 7807–7816, [**http://dx.doi.org/10.1021/es5014054**].

Kim, J.-W., Lu, Z., Jones, J.W., Shum, C. K., Lee, H., and Jia, Y., 2014, Monitoring Everglades freshwater marsh water level using L-band synthetic aperture radar backscatter: Remote Sensing of Environment, v. 150, p. 66–81, [**http://dx.doi.org/10.1016/j.rse.2014.03.031**].

Kocan, R.M., Hart, L., Lewandowski, N., and Hershberger, P., 2014, Viability and infectivity of *Ichthyophonus* sp. in post-mortem Pacific herring, *Clupea pallasii*: Journal of Parasitology, published online 8 August 2014, [**http://dx.doi.org/10.1645/14-518.1**]

Krebs, J.M., Bell, S.S., and McIvor, C.C., 2014, Assessing the link between coastal urbanization and the quality of nekton habitat in mangrove tidal tributaries: Estuaries and Coasts, v. 37, no. 4, p. 832–846, [**http://dx.doi.org/10.1007/s12237-013-9724-y**].

Krebs, J.M., McIvor, C.C., and Bell, S.S., 2014, Nekton community structure varies in response to coastal urbanization near mangrove tidal tributaries: Estuaries and Coasts, v. 37, no. 4, p. 815–831, [**http://dx.doi.org/10.1007/s12237-013-9726-9**].

Lacy, J.R., Gladding, S., Brand, A., Collignon, A., and Stacey, M., 2014, Lateral baroclinic forcing enhances sediment transport from shallows to channel in an estuary: Estuaries and Coasts, v. 37, no. 5, p. 1058–1077, [**http://dx.doi.org/10.1007/s12237-013-9748-3**].

Lewan, M.D., Warden, A., Dias, R.F., Lowry, Z.K., Hannah, T.L., Lillis, P.G., Kokaly, R.F., Hoefen, T.M., Swayze, G.A., Mills, C.T., Harris, S.H., and Plumlee, G.S., 2014, Asphaltene content and composition as a measure of *Deepwater Horizon* oil spill losses within the first 80 days: Organic Geochemistry, v. 75, p. 54–60, [**http://dx.doi.org/10.1016/j.orggeochem.2014.06.004**].

Long, J., Hu, C., and Robbins, L., 2014, Whiting events in SW Florida coastal waters—A case study using MODIS medium-resolution data: Remote Sensing Letters, v. 5, no. 6, p. 539–547, [**http://dx.doi.org/10.1080/2150704X.2014.933275**].

Madenjian, C.P., Yule, D.L., Chernyak, S.M., Begnoche, L.J., Berglund, E.K., and Isaac, E.J., 2014, Males exceed females in PCB concentrations of cisco (*Coregonus artedi*) from Lake Superior: Science of the Total Environment, v. 493, p. 377–383, [**http://dx.doi.org/10.1016/j.scitotenv.2014.06.007**].

Maier, K.L., Ponti, D.J., Tinsley, J.C., Gatti, E., and Pagenkopp, M., 2014, Geologic logs of geotechnical cores from the subsurface Sacramento-San Joaquin Delta, California: U.S. Geological Survey Open-File Report 2014–1127, 10 p., [**http://dx.doi.org/10.3133/ofr20141127**].

Miselis, J.L., Buster, N.A., and Kindinger, J.L., 2014, Refining the link between the Holocene development of the Mississippi River Delta and the geologic evolution of Cat Island, MS—Implications for delta-associated barrier islands: Marine Geology, v. 355, p. 274–290, [**http://dx.doi.org/10.1016/j.margeo.2014.05.021**].

Moorman, M.C., Kolb, K.R., and Supak, S., 2014, Estuarine monitoring programs in the Albemarle Sound study area, North Carolina: U.S. Geological Survey Open-File Report 2014–1110, 38 p., [**http://dx.doi.org/10.3133/ofr20141110**].

Morgan, K.L.M., and Westphal, K.A., 2014, Baseline coastal oblique aerial photographs collected from Breton Island, Louisiana, to the Alabama-Florida border, July 13, 2013: U.S. Geological Survey Data Series 857, [**http://dx.doi.org/10.3133/ds857**].

Morgan, K.L.M., and Westphal, K.A., 2014, Baseline coastal oblique aerial photographs collected from Dauphin Island, Alabama, to Breton Island, Louisiana, August 8, 2012: U.S. Geological Survey Data Series 860, [**http://dx.doi.org/10.3133/ds860**].

Naftz, D.L., Carling, G.T., Angeroth, C., Freeman, M., Rowland, R., and Pazmiño, E., 2014, Density-stratified flow events in Great Salt Lake, Utah, USA—Implications for mercury and salinity cycling: Aquatic Geochemistry, published online 26 July 2014, [**http://dx.doi.org/10.1007/s10498-014-9237-8**].

Nelson, J., He, R., Warner, J.C., and Bane, J., 2014, Air-sea interactions during strong winter extratropical storms: Ocean Dynamics, v. 64, no. 9, p. 1233–1246, [**http://dx.doi.org/10.1007/s10236-014-0745-2**].

Obelcz, J.B., Brothers, D.S., ten Brink, U.S., Chaytor, J.D., Worley, C.R., and Moore, E.M., 2014, Chirp seismic-reflection data from the Baltimore, Washington, and Norfolk Canyons, U.S. mid-Atlantic margin: U.S. Geological Survey Open-File Report 2014–1118, [**http://dx.doi.org/10.3133/ofr20141118**].

Orlando, J.L., McWayne, M., Sanders, C., and Hladik, M., 2014, Dissolved pesticide concentrations entering the Sacramento–San Joaquin Delta from the Sacramento and San Joaquin Rivers, California, 2012–13: U.S. Geological Survey Data Series 876, 28 p., [**http://dx.doi.org/10.3133/ds876**].

Prinos, S.T., 2014, Using state-of-the-art technology to evaluate saltwater intrusion in the Biscayne aquifer of Miami-Dade County, Florida: U.S. Geological Survey Fact Sheet 2014–3050, 6 p., [**http://dx.doi.org/10.3133/fs20143050**].

Ramsey, E., III, Rangoonwala, A., Chi, Z., Jones, C.E., and Bannister, T., 2014, Marsh dieback, loss, and recovery mapped with satellite optical, airborne polarimetric radar, and field data: Remote Sensing of Environment, v. 152, p. 364–374, [**http://dx.doi.org/10.1016/j.rse.2014.07.002**].

Real, C.R., Johnson, L., Jones, L.M., and Ross, S., 2014, Improving tsunami

(Recent Publications continued on page 20)

(Recent Publications continued from page 19)

resiliency—California's Tsunami Policy Working Group, *in* Kontar, Y.A., Santiago-Fandiño, V., and Takahashi, T., eds., Tsunami events and lessons learned—Environmental and societal significance: Advances in Natural and Technological Hazards Research, v. 35, p. 377–386 [**http://dx.doi.org/10.1007/978-94-007-7269-4_21**].

Rodríguez-Martínez, J., and Soler-López, L., 2014, Hydrogeology and hydrology of the Punta Cabullones wetland area, Ponce, southern Puerto Rico, 2007–08: U.S. Geological Survey Scientific Investigations Report 2014–5102, 58 p., [**http://dx.doi.org/10.3133/sir20145102**].

Romanok, K.M., Reilly, T.J., Lopez, A.R., Trainor, J.J., Hladik, M.L., Stanley, J.K., and Farrar, D., 2014, Characterization of selected bed-sediment-bound organic and inorganic contaminants and toxicity, Barnegat Bay and major tributaries, New Jersey, 2012: U.S. Geological Survey Data Series 867, 51 p., [**http://dx.doi.org/10.3133/ds867**].

Scavia, D., Allan, J.D., Arend, K.K., Bartell, S., Beletsky, D., Bosch, N.S., Brandt, S.B., Briland, R.D., Daloğlu, I., DePinto, J.V., Dolan, D.M., Evans, M.A., Farmer, T.M., Goto, D., Han, H., Höök, T.O., Knight, R., Ludsin, S.A., Mason, D., Michalak, A.M., Richards, R.P., Roberts, J.J., Rucinski, D.K., Rutherford, E., Schwab, D.J., Sesterhenn, T.M., Zhang, H., and Zhou, Y., 2014, Assessing and addressing the re-eutrophication of Lake Erie—Central basin hypoxia: Journal of Great Lakes Research, v. 40, no. 2, p. 226–246, [**http://dx.doi.org/10.1016/j.jglr.2014.02.004**].

Skarke, A., Ruppel, C., Kodis, M., Brothers, D., and Lobecker, E., 2014, Widespread methane leakage from the sea floor on the northern US Atlantic margin: Nature Geoscience, published online 24 August 2014, [**http://dx.doi.org/10.1038/ngeo2232**].

Smith-Vaniz, W.F., and Jelks, H.L., 2014, Marine and inland fishes of St. Croix, U.S. Virgin Islands—An annotated checklist: Zootaxa, v. 3803, no. 1, p. 1–120, [**http://dx.doi.org/10.11646/zootaxa.3803.1.1**].

Stapaniana, M.A., Madenjian, C.P., Cott, P.A., Rediske, R.R., and O'Keefe, J.P., 2014, Polychlorinated biphenyl congener distributions in burbot—Evidence for a latitude effect: Environmental Toxicology and Chemistry, published online 2 August 2014, [**http://dx.doi.org/10.1002/etc.2703**].

Storlazzi, C.D., Cheriton, O.M., Lescinski, J.M.R., and Logan, J.B., 2014, Coastal circulation and water-column properties in the War in the Pacific National Historical Park, Guam—Measurements and modeling of waves, currents, temperature, salinity, and turbidity, April–August 2012: U.S. Geological Survey Open-File Report 2014-1130, 104 p., [**http://dx.doi.org/10.3133/ofr20141130**].

Swarzenski, C.M., and Mize, S.V., 2014, Effects of hydrologic modifications on salinity and formation of hypoxia in the Mississippi River-Gulf Outlet and adjacent waterways, southeastern Louisiana, 2008 to 2012: U.S. Geological Survey Scientific Investigations Report 2014–5077, 21 p, [**http://dx.doi.org/10.3133/sir20145077**].

Tape, K.D., Pearce, J.M., Walworth, D., Meixell, B.W., Fondell, T.F., Gustine, D.D., Flint, P.L., Hupp, J.W., Schmutz, J.A., and Ward, D.H., 2014, Historical and contemporary imagery to assess ecosystem change on the Arctic coastal plain of northern Alaska: U.S. Geological Survey Open-File Report 2014–1140, 22 p., [**http://dx.doi.org/10.3133/ofr20141140**].

Terando, A., Traxler, S., and Collazo, J., 2014, Landscape and climate science and scenarios for Florida: U.S. Geological Survey Open-File Report 2014–1150, 39 p., [**http://dx.doi.org/10.3133/ofr20141150**].

Welch, H.L., Coupe, R.H., and Aulenbach, B.T., 2014, Concentrations and transport of suspended sediment, nutrients, and pesticides in the lower Mississippi-Atchafalaya River subbasin during the 2011 Mississippi River flood, April through July: U.S. Geological Survey Scientific Investigations Report 2014–5100, 44 p., [**http://dx.doi.org/10.3133/sir20145100**].

Wigand, C., Roman, C.T., Davey, E., Stolt, M., Johnson, R., Hanson, A., Watson, E.B., Moran, S.B., Cahoon, D.R., Lynch, J.C., and Rafferty, P., 2014, Below the disappearing marshes of an urban estuary—Historic nitrogen trends and soil structure: Ecological Applications, v. 24, no. 4, p. 633–649, [**http://dx.doi.org/10.1890/13-0594.1**]

Wittmann, M.E., Jerde, C.L., Howeth, J.G., Maher, S.P., Deines, A.M., Jenkins, J.A., Whitledge, G.W., Burbank, S.B., Chadderton, W.L., Mahon, A.R., Tyson, J.T., Gantz, C.A., Keller, R.P., Drake, J.M., and Lodge, D.M., 2014, Grass carp in the Great Lakes region—Establishment potential, expert perceptions, and re-evaluation of experimental evidence of ecological impact: Canadian Journal of Fisheries and Aquatic Sciences, v. 71, no. 7, p. 992–999, [**http://dx.doi.org/10.1139/cjfas-2013-0537**].

Woodward, A., Torregrosa, A., Madej, M.A., Reichmuth, M., and Fong, D., 2014, Users' guide to system dynamics model describing Coho salmon survival in Olema Creek, Point Reyes National Seashore, Marin County, California: U.S. Geological Survey Open-File Report 2014–1131, 58 p., [**http://dx.doi.org/10.3133/ofr20141131**].

Work, T.M., Aeby, G.S., Lasne, G., and Tribollet, A., 2014, Gross and microscopic pathology of hard and soft corals in New Caledonia: Journal of Invertebrate Pathology, v. 120, p. 50–58, [**http://dx.doi.org/10.1016/j.jip.2014.05.007**].

Wright, C.W., Fredericks, X., Troche, R.J., Klipp, E.S., Kranenburg, C.J., and Nagle, D.B., 2014, EAARL-B coastal topography—Eastern New Jersey, Hurricane Sandy, 2012; first surface (version 1.1, August 18, 2014): U.S. Geological Survey Data Series 767, [**http://dx.doi.org/10.3133/ds767**]. ❁