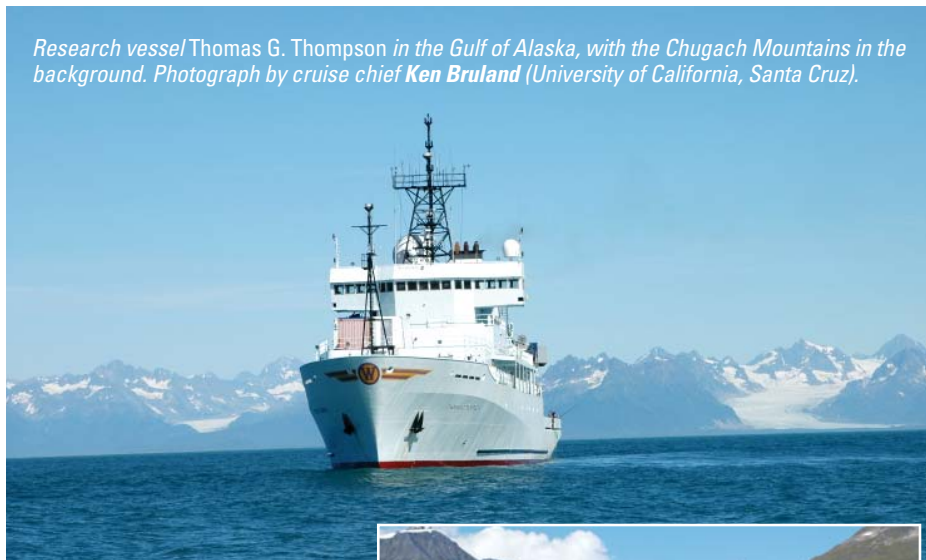


Fieldwork

## USGS Researchers Participate in Research Cruise Studying Iron Biogeochemistry in the Gulf of Alaska

By Andrew Schroth and John Crusius

Iron is a nutrient that is believed to limit primary productivity in about 30 to 40 percent of the ocean's surface waters, including much of the northern North Pacific, where iron addition has been shown to stimulate plankton growth. By facilitating phytoplankton blooms, iron supply to surface waters may lead to a transfer of carbon to the deep sea and thus decrease the concentration of atmospheric CO<sub>2</sub>. As a result, private companies have begun to express interest in iron "fertilization" of the ocean because of the value of atmospheric CO<sub>2</sub> reduction in the carbon-offset market. Understandably, this concept is both intriguing and highly controversial (see URL <http://www.whoi.edu/oceanus/viewArticle.do?id=34167&sectionid=1000>). Iron supply could also impact the fish yield of ecosystems controlled by nutrient supply. Before connections can be made between iron supply and these broader topics, however, some fundamental questions must be addressed, including (1) how does naturally occurring iron move from the continent to the open ocean? and (2) what fraction of that iron is



Research vessel *Thomas G. Thompson* in the Gulf of Alaska, with the Chugach Mountains in the background. Photograph by cruise chief **Ken Bruland** (University of California, Santa Cruz).

"bioavailable"—in a form that is accessible by such organisms as phytoplankton?

Continental sources of iron to the marine environment are numerous and include airborne dust, riverine input, continental-shelf sediment resuspension, submarine ground-water discharge, and remobilization during sediment diagenesis (the changes that take place in sediment after burial). However, the supply and bioavailability of iron from these sources is poorly constrained and likely to vary in both time and space. Improving our understanding of the processes governing iron transport and bioavailability in marine waters could prove critical in predicting the response of marine ecosystems to environmental change.

During August and September 2007, U.S. Geological Survey (USGS) scientists **Andrew Schroth** (Mendenhall Postdoc-



**John Crusius** (left) and **Andrew Schroth** aboard the research vessel *Thomas G. Thompson* in Prince William Sound, with a tidal glacier in the background.

toral Research Fellow) and **John Crusius** (research geochemist) of the Coastal and Marine Geology Team in Woods Hole, Massachusetts, participated in a research cruise focused on iron and funded by the National Science Foundation. **Ken Bruland**, professor of ocean sciences at the University of California, Santa Cruz, led the expedition on the research vessel *Thomas G. Thompson*. In addition to **Bru-**

*(Iron Biogeochemistry continued on page 2)*

### Correction for December issue:

Two agencies that operate broadband seismographs in the Caribbean region and contributed data to USGS studies of Caribbean earthquakes were inadvertently omitted from "Earthquake Swarms in the Puerto Rico Trench Monitored by Ocean-Bottom Seismometers" in the mailed edition of the December 2007 *Sound Waves*. The Royal Netherlands Meteorological Institute and the Meteorological Service of the Netherlands Antilles and Aruba collaboratively operate seismic stations on the Islands of St. Maarten, Saba, and St. Eustatius in the Netherlands Antilles. We apologize for the omission.

—Editor

## Sound Waves

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## Submission Guidelines

**Deadline:** The deadline for news items and publication lists for the June issue of *Sound Waves* is Friday, April 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).

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/search/faq.html>

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](mailto:ask@usgs.gov)

## Fieldwork, continued

(Iron Biogeochemistry continued from page 1)

land, Crusius, and Schroth, 25 other scientists associated with various universities participated in the cruise, supported by the 22-member crew of the vessel. Some of the specific research objectives of the cruise were to (1) measure the iron content in waters of the northwestern Gulf of Alaska, an area for which few data existed; (2) examine how mixing of iron-rich coastal waters with high-nutrient, low-chlorophyll waters leads to enhanced phytoplankton biomass in the northwestern Gulf of Alaska; and (3) assess what fraction of the particulate iron is "reactive" or bioavailable. The 6-week cruise, which began in Seattle, Washington, and ended in Dutch Harbor, Alaska, involved extensive water sampling in both the coastal and offshore marine waters of the Gulf of Alaska. Once in the gulf, the *Thompson* tracked in and out of the sediment-laden Alaska Coastal Current and the offshore waters of the Alaska Gyre, while the scientists collected both surface samples and depth profiles and made various shipboard measurements.

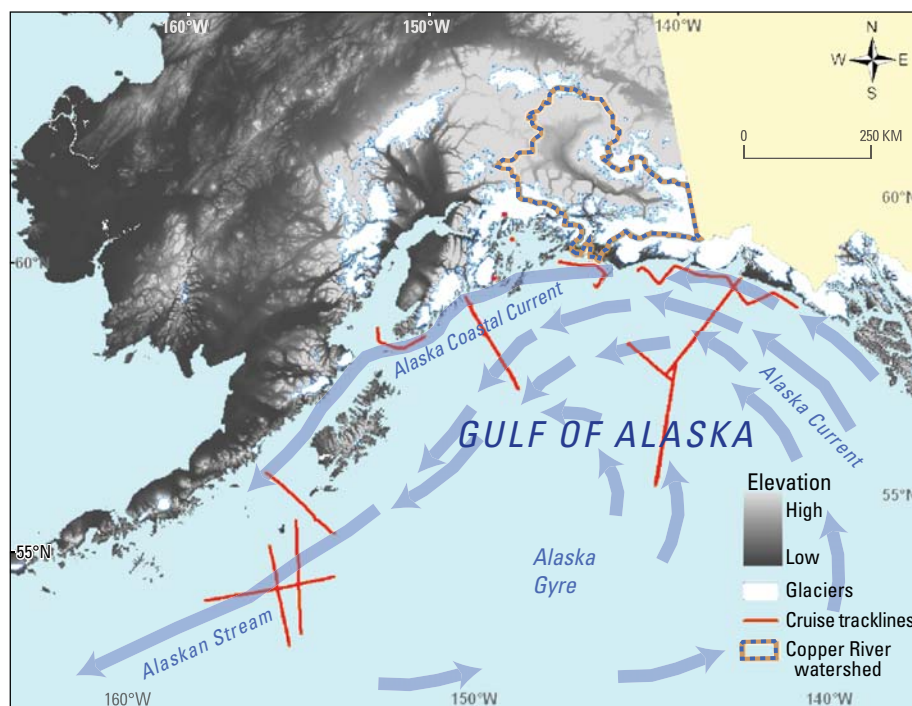
The terrestrial sediment supply to the Gulf of Alaska is large and primarily

glacially derived, a product of extensive mechanical weathering of bedrock by glaciers within the interior mountain ranges of Alaska and by tidal glaciers flowing into the Gulf of Alaska. The USGS scientists observed suspended glacial flour kilometers offshore in the Alaska Coastal Current. This glacial sediment, transported offshore by various processes, could be an important

(Iron Biogeochemistry continued on page 3)



Boundary between coastal waters influenced by glacial weathering (light blue) and offshore waters of the Gulf of Alaska (darker blue). Photograph by Ken Bruland.



Coastal Alaska, showing tracklines (red) along which water samples were collected during Gulf of Alaska research cruise led by Professor Ken Bruland (University of California, Santa Cruz). Also shown are approximate areas of Alaskan glaciers (white), boundary of the Copper River watershed (dashed line), and general movements of regional ocean currents (blue arrows).

(Iron Biogeochemistry continued from page 2)

source of iron to the waters of the Alaska Gyre in this region. Though relying on different methodologies, **Schroth's** and **Crusius's** research projects both seek to answer fundamental questions about the transport and bioavailability of terrestrially derived iron in the marine environment.

**Schroth's** research focuses on determining the speciation and bioavailability of "particulate" iron—distinct particles of iron, as opposed to dissolved iron—in the Gulf of Alaska and on assessing the variations in such parameters as a function of particulate source. "Speciation" refers to the form, or "phase," in which iron exists, including its oxidation state and bonding environment. Along with dissolved iron (present at low concentrations in seawater), particulate iron is believed to be an important source of iron for biota if it is present in a bioavailable form. **Schroth** collected suspended-sediment samples through filtration of both surface waters (collected from **Bruland's** "fish" ultra-clean surface-water-sampling system) and water collected at depth (with an assembly consisting of a Niskin bottle rosette and a conductivity-temperature-depth [CTD] sensor). These samples were collected in various areas—the sediment-laden Alaska Coastal Current, sediment-rich near-bottom (nepheloid) layers near the continental shelf of the Gulf of Alaska, fiords immediately adjacent to tidal glaciers draining areas with multiple bedrock types, and offshore waters of the Alaska Gyre—to encompass an array of water masses that could contain unique iron particulate phases and distributions. **Schroth** will determine the solid-phase speciation of iron in these samples by using synchrotron-based X-ray-absorption spectroscopy at the Stanford Synchrotron Radiation Laboratory (URL <http://www-ssrl.slac.stanford.edu/>) in Stanford, California (the same facility where USGS scientist **Jim Hein** is studying deep-sea iron-manganese crusts; see URL <http://soundwaves.usgs.gov/2007/05/research.html>).

In addition, **Schroth** will determine iron speciation in suspended sediment from tributaries with different catchment (drainage basin) bedrock geology and degree of glaciation in the Copper River drainage

system—a primary source of sediment to the Gulf of Alaska. Exposed glacial sediment was also sampled at the toe of glaciers that differ in catchment geology; **Schroth** will examine the solubility of iron in this sediment when reacted with seawater from the gulf. The terrestrial component of this project will allow USGS scientists to assess how iron speciation in glacial sediment and bedrock influences the reactivity of iron that is transported to the Gulf of Alaska.

Specifically, **Schroth's** research seeks to answer the following questions:

- What is the solid-phase speciation of iron across different water masses and biogeochemical gradients in the Gulf of Alaska, and how does iron speciation relate to iron bioavailability in these marine waters?
- Does the solid-phase speciation of iron vary by terrestrial source, and what role do glaciers and their catchment geology play in iron reactivity in riverine and dust loads delivered to the ocean near glaciated coasts?

**Crusius's** work on the Gulf of Alaska cruise involved examining the dynamics of mixing of nearshore, iron-rich waters with



**Andrew Schroth** (right) and **Pat McGinn** (Princeton University) prepare a Niskin bottle rosette and conductivity-temperature-depth (CTD) sensor for collection of water samples from sediment-rich benthic boundary layers along the continental shelf and slope of the Gulf of Alaska. Photograph by **John Crusius**.



**Ken Bruland's** "fish" surface-water-sampling system collecting surface-water samples from the sediment-laden Alaska Coastal Current in the Gulf of Alaska on the research vessel *Thomas G. Thompson*. Photograph by **Ken Bruland**.

offshore, iron-poor waters, using radium isotopes as tracers. Radium is enriched in nearshore surface waters, both by desorption from sediment surfaces and by discharge of saline ground water. Radium exists as four naturally occurring isotopes with half-lives of 3.6 d, 11.4 d, 5.8 y, and 1,600 y; each of these isotopes is continuously supplied from a long-lived parent isotope. If the radium sources maintain near-constant ratios of these isotopes, the water-column ratios of short-lived to longer lived isotopes will change as nearshore waters are advected or mixed offshore, reflecting the aging of this coastally derived signal (see paper by **Willard S. Moore**, 2000, in *Continental Shelf Research*, URL <http://www.sciencedirect.com/science/journal/02784343>, v. 20, no. 15)

The goal of **Crusius's** work is to understand the rates at which nearshore waters, rich in iron, are transported toward offshore, iron-poor regions of the Gulf of Alaska, using the radium isotopes as tracers. Together, the work of **Schroth** and **Crusius** should help improve our understanding of the processes that transport iron from coastal sources to the open Gulf of Alaska, one of the largest iron-limited regions of the world's oceans. ❁

## Sea-Floor Survey Off Key Largo, Florida, Using Along-Track Reef-Imaging System (ATRIS)

By Emily Klipp and Monica Palaseanu-Lovejoy

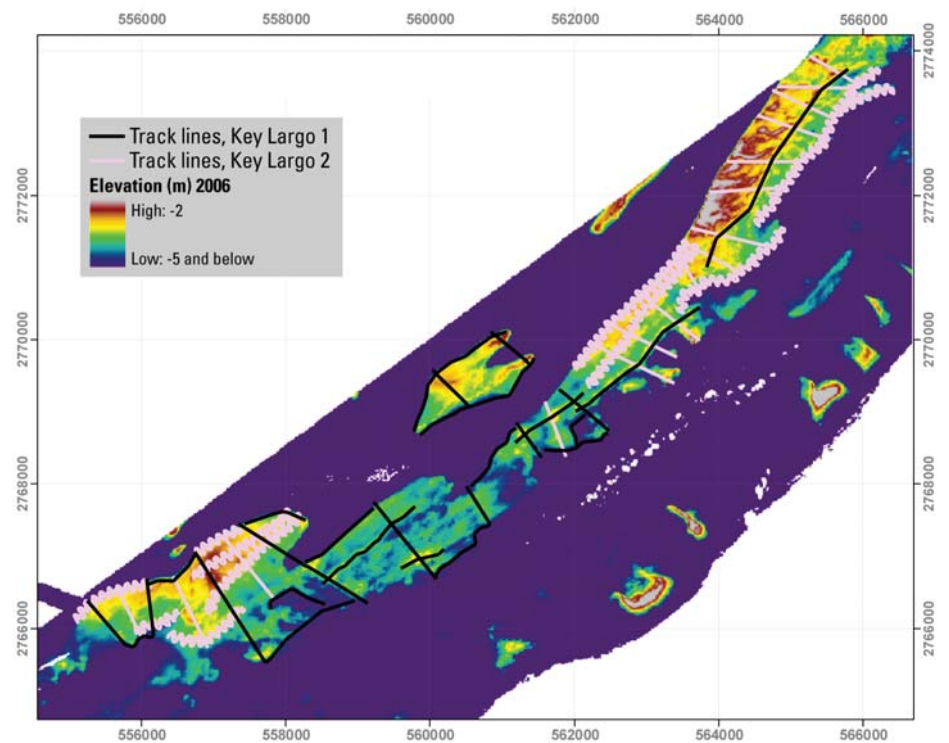
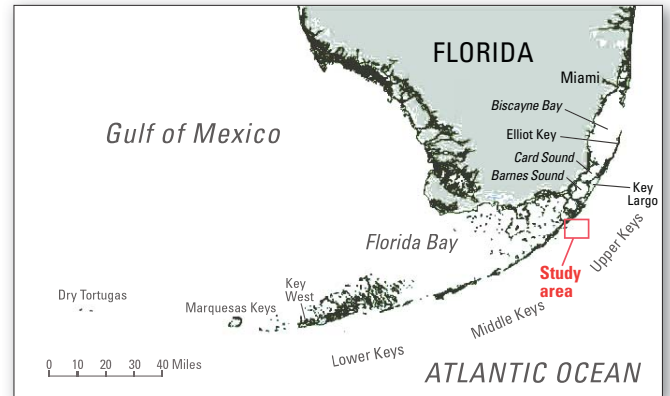
Detailed imagery of the Florida reef tract off Key Largo collected in September 2007 will help scientists better understand local coral reefs and associated habitats. The imagery was collected by the U.S. Geological Survey (USGS)'s Decision Support for Coastal Parks, Sanctuaries, and Preserves project (principal investigators: **Amar Nayegandhi**, **John Brock**), which uses remote-sensing techniques to inventory coastal resources and monitor coastal change.

The Florida reef tract extends along the Atlantic Ocean side of the upper, middle, and lower Florida Keys. The islands of Key Largo and Elliot Key in the upper Keys separate the northernmost part of the reef tract from the shallow inland lagoons of Barnes Sound, Card Sound, and Biscayne Bay. Coral cover in the reefs off the middle and lower Keys has declined over the past several decades, but patch reefs off the upper Keys have been less affected. Recent surveys there have shown comparatively greater richness and diversity of coral and gorgonian species. The patch reefs typically consist of clusters of one or more massive colonies of head corals (so-called for their bulbous shape), an area of head corals scattered among abundant octocorals (which have eightfold symmetry, in contrast to true corals' sixfold symmetry, and include sea plumes, sea whips, and gorgonians), and occasionally a coral-rubble apron.

A 2002 survey of the submerged topography of the coral-reef tract off Elliot Key and Key Largo by the Experimental Advanced Airborne Research Lidar (EAARL) showed that patch-reef clusters are the primary source of benthic topographic complexity. In general, the greater the topographic complexity, the greater the diversity and abundance of plants and animals living in the reef. The lidar (light detection and ranging) survey also showed topographic complexity in the coral-rubble-and-sand zone at the patch-reef margins.

In September 2007, a USGS survey crew collected high-resolution imagery

*Right: Florida Keys, showing location of study area. Below: Digital elevation model (DEM) of study area acquired with Experimental Advanced Airborne Research Lidar (EAARL) and overlain by preplanned track lines used to guide ATRIS survey. Black track lines were plotted in the office; pink track lines were plotted in the field when surveying proceeded more quickly than expected, allowing collection of additional data.*



and bathymetric data off Key Largo to get a more detailed look at sea-floor structure and benthic habitat in that area. The crew consisted of **Phil Thompson**, **Keith Ludwig**, and **Jerry Butcher** of the USGS Florida Integrated Science Center, and **Monica Palaseanu-Lovejoy** and **Emily Klipp**, both working as contractors for the USGS through Jacobs Technology, Inc. The team used a digital elevation

model (DEM) of submerged topography produced from EAARL data to plan track lines, a vessel-mounted echosounder to collect bathymetric data, and an along-track reef-imaging system (ATRIS) to collect high-resolution imagery.

The ATRIS system is a boat-based sensor package for mapping shallow-water (less than 10-m depth) benthic environment. *(ATRIS Survey continued on page 5)*

## Fieldwork, continued

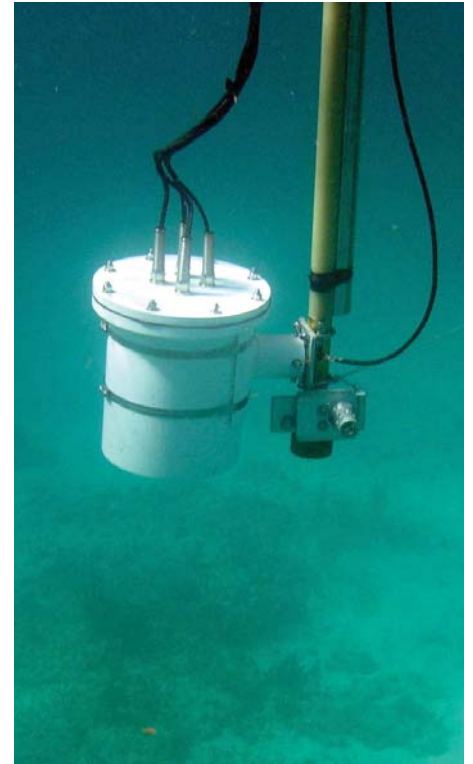
(ATRIS Survey continued from page 4)

ments (see URL <http://coastal.er.usgs.gov/remote-sensing/advancedmethods/attris.html>). The ATRIS captures real-time, high-resolution digital images at a rate of approximately 1,000 images per hour while the vessel is traveling at a speed of about 1 knot. Simultaneously, navigation software guides the vessel along preplanned transect lines and continuously logs the vessel's position. A precision bathymetric sounder records camera-to-sea-floor distances that allow the geometric scaling of each individual image. Acquisition time and geographic coordinates are recorded for every ATRIS image; the "georeferenced" images are later uploaded into a Linux-based program—ATRIS Data Analysis and Processing Tool (ADAPT)—specifically written for the ATRIS. ADAPT allows the user to classify the images into categories, plot the vessel track, and accomplish further qualitative analysis.

Before surveying, the team plotted transects along and across linear topographic features identified on the EAARL DEM of submerged topography. The DEM shows a consistent pattern of smooth areas landward of the reefs and rough, jagged areas seaward of the reefs. A goal of the ATRIS survey was to map submarine topography and determine habitat composition (such as sand, seagrass, or type of coral, some identified to species level). Preliminary interpretation indicates that the survey area consists of three types of habitat: coral reefs to the southwest, seagrass and sand to the northeast, and seagrass and isolated head corals in between. The georeferenced ATRIS images collected off Key Largo will be analyzed for habitat type relative to lidar-sensed topographic complexity. Results will be compared with previous, independently derived habitat maps of the study area. In addition to providing information about benthic habitats, the ATRIS data will expand our understanding of reef development and sea-level changes during the Holocene. ❁

*ATRIS image acquired in the Florida Keys reef tract during September 2007 survey, showing branching gorgonians.*

*ATRIS camera in waterproof housing attached to a motorized pole mounted on the vessel. A global-positioning-system (GPS) antenna is mounted at the top of the camera pole (not shown).*



*Hydrographic survey pole, which supports an acoustic transducer at its lower end and a GPS antenna at its top to collect data for bathymetric mapping.*



## Coral-Reef Builders Vulnerable to Ocean Acidification

By Ann Tihansky, Ilsa Kuffner, and Diane Noserale

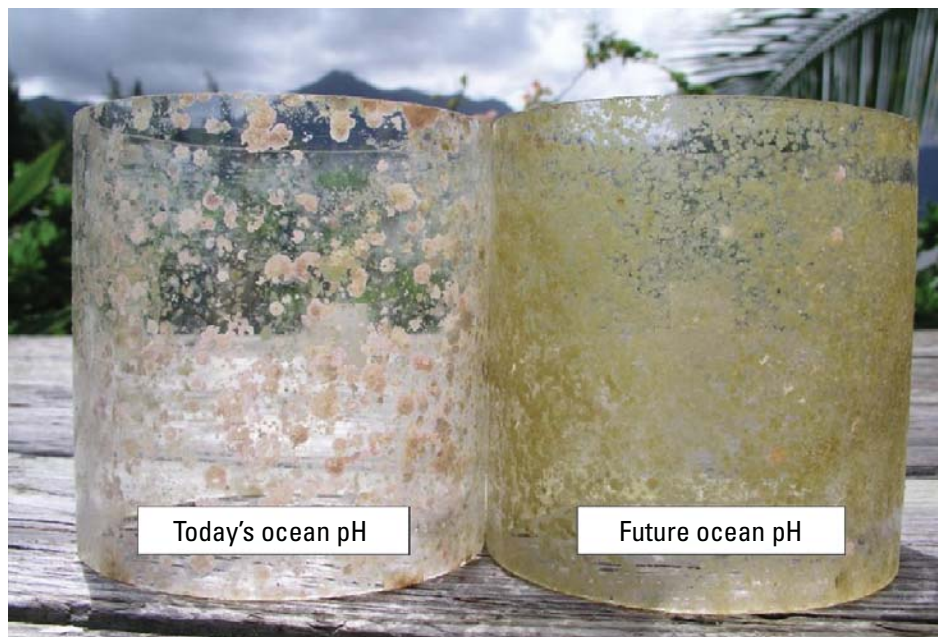
Increasing carbon dioxide (CO<sub>2</sub>) in the Earth's atmosphere has caused a corresponding increase in CO<sub>2</sub> in the world's oceans, leading to lower pH values (increased acidity) of seawater. A new report by the U.S. Geological Survey (USGS) and partners shows that as pH declines in the world's oceans, the effects on coral reefs could be more harmful than previously believed. This pH decline, commonly known as "ocean acidification," could severely limit the growth of coral-reef builders.

To document the potential effects of ocean acidification predicted for the year 2100, scientists from the USGS and cooperating institutions have conducted a unique study looking at the growth of important reef-building plants called crustose coralline algae—a group of calcifying rhodophytes (red algae) that are widespread in the world's oceans.

"Scientists have already shown that coral growth may decrease as the ocean pH declines. This new evidence shows that other essential reef builders, the crustose coralline algae, may be even more sensitive than the corals," said **Ilsa Kuffner**, USGS scientist and lead author of the report published in the February 2008 issue of *Nature Geoscience* (v. 1, no. 2, URL <http://www.nature.com/ngeo/journal/v1/n2/abs/ngeo100.html>).

"The results of our study were visibly obvious and may provide a glimpse into the future. We saw a 92-percent decrease in the area covered by crustose coralline algae in the tanks with lower pH compared with tanks at the pH level of today's ocean. Non-calcifying fleshy algae increased by 52 percent," said **Kuffner**. "These findings suggest that at lower pH, the reef-building algae could be much less competitive on future coral reefs."

**Kuffner** and colleagues at the University of Hawai'i conducted the 9-month study by rearing reef organisms from larvae in an outdoor, semicaptive environment. In the experiments, pH was lowered in half of the test tanks to simulate conditions predicted for the year



*Encrusting algae that developed on surfaces bathed in unaltered seawater from the adjacent reef (left) and those that developed in seawater with pH lowered to the level predicted for the year 2100 (right).*

2100 by the Intergovernmental Panel on Climate Change (URL <http://www.ipcc.ch/>), on the basis of present trends in carbon emissions. Surfaces in control tanks bathed with unaltered seawater from the adjacent reef developed the characteristic pink crust made by the reef-building crustose coralline algae. In tanks where the seawater pH was lowered, recruitment and growth of crustose coralline algae were severely inhibited. Although questions remain regarding the influences of algae-eating animals and nutrient availability, it is possible that ocean acidification could hasten shifts away from dominance by stony corals and other reef builders to fleshy algae, as already observed on many reefs today.

Despite being fairly inconspicuous in nature, the crustose coralline algae are extremely important to coral reefs. They secrete skeletons of calcium carbonate, much like coral, and play key ecological roles that affect the health and sustainability of coral-reef ecosystems. Not only do the crust-forming algae build reef framework, produce sand, and help cement loose coral

fragments into massive reef structures, but they also attract reef-building coral larvae by providing a place to settle. If these ecosystem services are left undone, coral reefs and associated systems and coastlines could be notably altered as the pH of the oceans slowly decreases.

The full reference for the new report is: Kuffner, I.B., Andersson, A.J., Jokiel, P.L., Rodgers, K.S., and Mackenzie, F.T., 2008, Decreased abundance of crustose coralline algae due to ocean acidification: *Nature Geoscience*, v. 1, no. 2, p. 114-117, doi: 10.1038/ngeo100 [URL <http://www.nature.com/ngeo/journal/v1/n2/abs/ngeo100.html>].

Additional information about ocean acidification is available in "Discovering the Effects of CO<sub>2</sub> Levels on Marine Life and Global Climate," *Sound Waves*, January/February 2007, URL <http://soundwaves.usgs.gov/2007/01/>. An article in the *Molokai Times* discusses implications of the new findings for coral reefs off the Hawaiian Island of Moloka'i, at URL <http://www.molokaitimes.com/articles/812119347.asp>. ❁

## National Geographic Program to Include USGS Science in the Everglades

By Ann Tihansky, Gordon Anderson, and Tom Smith

A National Geographic film crew working on a program about the Florida Everglades visited several U.S. Geological Survey (USGS) data-collection platforms in Everglades National Park on January 25, 2008. The crew filmed scientists **Gordon Anderson** (USGS) and **Karen Balentine** (contracted to the USGS through Jacobs Technology, Inc.) as they conducted field measurements and assisted Everglades National Park hydrologist **Vic Engel**, who had invited them to participate. The National Geographic crew, supervised by **Brian Armstrong**, filmed work be-

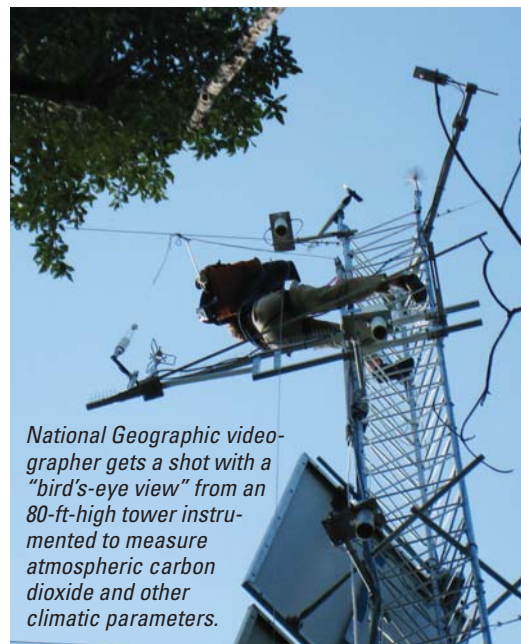
ing done as part of a joint study between the USGS and the National Park Service. During filming, the two USGS scientists assisted **Engel** in taking measurements for his study of atmospheric carbon dioxide. In addition, the National Geographic crew filmed **Balentine** and **Anderson** measuring coastal sediment at a sediment elevation table—a portable, mechanical leveling device for measuring the relative elevation of wetland sediment.

The final film product, a 50-minute TV program slated for National Geographic television, has the working

title “Secret Everglades” and follows two previously released programs called “Secret Yosemite” and “Secret Yellowstone.” All are part of a series about America’s National Parks timed to coincide with the National Parks Centennial Initiative, a presidential initiative to enhance our national parks during the decade leading up to their 100th anniversary in 2016. The Everglades program is expected to air in the fall, and DVD copies should be available for sale at the park’s visitor centers and National Geographic’s online store by the end of 2008. ❁



*USGS scientist **Gordon Anderson** is filmed while he uses a sediment elevation table to measure the relative elevation of wetland sediment.*



*National Geographic videographer gets a shot with a “bird’s-eye view” from an 80-ft-high tower instrumented to measure atmospheric carbon dioxide and other climatic parameters.*

## Lidar for Lunch at St. Petersburg, Florida, Propeller Club

By Ann Tihansky

**Amar Nayegandhi**, an ETI Professionals contractor at the U.S. Geological Survey (USGS) office in St. Petersburg, Florida, was invited to be the luncheon speaker at the monthly meeting of the Propeller Club at the St. Petersburg Yacht Club on January 17, 2008. **Bill Horner**, the current Propeller Club president, requested a high-technology presentation by a speaker who would share some new scientific findings with club members. **Horn-**

**er** wanted “to provide current science and technology information to keep this group of maritime-industry representatives on top of issues affecting our natural coastal resources and the shipping industry.” When he learned of lidar (an acronym for “light detection and ranging”) and its many applications, he knew it would be perfect for his group. **Nayegandhi** discussed the basic principles of airborne lidar technology and presented examples

of how the USGS uses this technology in his talk titled “Applications of Lidar Technology in Coastal and Marine Environments.” **Nayegandhi** highlighted scientific applications that include monitoring coastal-change hazards, characterizing coastal-vegetation communities, and monitoring trends and health of coral-reef habitats (see URL <http://coastal.er.usgs.gov/remote-sensing/>).

*(Propeller Club continued on page 8)*

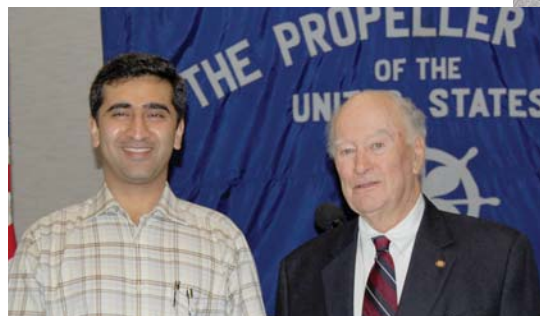
## Outreach, continued

(Propeller Club continued from page 7)

The USGS took the opportunity to share several resources with the group, including a recently published map, “Topobathymetric Data for Tampa Bay, Florida” (URL <http://pubs.usgs.gov/of/2007/1051/>), for which some of the source data were acquired by lidar.

The Propeller Club recognizes that science and technology dominate maritime-related professions in the area, thanks to the C.W. “Bill” Young Marine Science Complex in downtown St. Petersburg (see URL <http://soundwaves.usgs.gov/2005/01/outreach.html>). The group is interested in expanding their membership and hopes to encourage science and technology professionals in the area to join their group. If interested, contact **Bill Horner** at (727) 898-6055. ☼

*Bill Horner (right) introduces luncheon speaker **Amar Nayegandhi** to the St. Petersburg Propeller Club at their monthly meeting.*



*The USGS map “Topobathymetric Data for Tampa Bay, Florida” (URL <http://pubs.usgs.gov/of/2007/1051/>) was a popular take-home item with the Propeller Club members.*

## Meetings

# USGS Hosts Northern Gulf of Mexico Land-Cover Characterization Workshop at the University of New Orleans, Louisiana

By Kathryn Smith and Emily Klipp

The U.S. Geological Survey (USGS) hosted the Northern Gulf of Mexico Land-Cover Characterization Workshop on November 14-16, 2007, in New Orleans, Louisiana. The Pontchartrain Institute for Environmental Sciences (PIES) of the University of New Orleans (UNO) provided space for the workshop. The primary workshop objective was

to educate attendees on regional efforts that involve land-cover characterization, including land-cover mapping, wetland-loss studies, and landscape modeling. The workshop provided an excellent opportunity to learn about current and future efforts in land-cover characterization with a regional perspective, and to enhance collaboration for the Northern Gulf of

Mexico (NGOM) Ecosystem Change and Hazard Susceptibility Project. The workshop was organized by **Kathryn Smith**, USGS Florida Integrated Science Center (FISC), with assistance from the advisory committee: **John Brock**, USGS FISC; **Shea Penland**, UNO-PIES; **Karen Ramsey**, UNO-PIES; **John Barras**, USGS National Wetlands Research Center (NWRC); **Amar Nayegandhi**, ETI Professionals, contracted to FISC; **Emily Klipp**, Jacobs Technology, contracted to FISC; and **Dawn Lavoie**, USGS Gulf of Mexico Science Coordinator.

The first day began with **Lavoie** introducing the importance of land-cover-characterization studies and the role of USGS research in the northern Gulf of Mexico region. The introduction was followed by presentations on capabilities and previous investigations by scientists working in the region. Topics included land-loss mapping, presented by **Penland** and **Barras**; shoreline mapping, presented by **Maryellen** (Land-Cover Workshop continued on page 9)



*Several meeting attendees took a small-plane flight to select potential pilot-study sites for an integrated investigation of Louisiana’s coastal wetlands. Clockwise from top left: **Shea Penland** (UNO-PIES), **John Brock** (USGS), **John Barras** (USGS), **Nate Herold** (NOAA), **Brady Couvillion** (IAP Worldwide Services), **Emily Klipp** (Jacobs Technology), **Amar Nayegandhi** (ETI Professionals), **Mike Miner** (UNO-PIES), and **Luis Martinez** (UNO-PIES). Photograph by **Kathryn Smith**.*



## Meetings, continued

(Land-Cover Workshop continued from page 8)

**Sault**, National Oceanic and Atmospheric Administration (NOAA); land-cover mapping, presented by **Joyce Fry**, USGS Earth Resources Observation and Science (EROS) Data Center, and **Nate Herold**, NOAA; lidar (light detection and ranging) applications to vegetation mapping, presented by **Nayegandhi**; hurricane impacts on coastal vegetation, presented by **John Kupfer**, University of South Carolina; and wetland modeling, presented by **Glenn Guntenspergen**, USGS Patuxent Wildlife Research Center (PWRC).

The second day began with discussions on collaboration and goals for the NGOM project subtasks, with **Brock** introducing the NGOM project and his vision for a coordinated project plan. The meeting was the first time many scientists working on the NGOM study had met in person to discuss subtask goals and products. Four subtasks within the NGOM project include research related to land-cover characterization, from land-cover mapping to wetland-loss studies to wetland modeling. The interrelated research plans will benefit from close coordination and integration. Workshop discussions were intended to inform participants of the activities in the other subtasks, increase collaboration, and

improve communication. In addition, sites for pilot studies in fiscal year 2008 (FY08) were selected to focus research objectives and foster collaboration. The second day ended with a 2-hr small-aircraft flight over the Louisiana marsh, during which some of the meeting attendees viewed potential pilot-study areas.

At the conclusion of the meeting, the scientists—having gained new insight into the research of their colleagues—made preparations for FY08 research and outlined plans for further collaborative efforts. With the identification of study areas, scientists could focus on pilot

studies at sites where individual datasets overlap and permit collaborative analyses. Study sites in the Mississippi River Delta and in southwestern Louisiana's coastal Chenier Plain were selected as pilot sites for land-cover mapping. The process of bringing together USGS scientists and outside experts improves overall communication and facilitates the integration of scientific endeavor. Scientific ventures benefit from the innovative ideas of colleagues and a more comprehensive view of the ecosystem. For more information, see the NGOM project Web site at URL <http://ngom.usgs.gov/>. ☼

*Coastal wetlands of Louisiana have received national attention due to rapid wetland loss over the past century. Under the NGOM project, a team of scientists will work to better understand the causes and consequences of these wetland changes. Photograph by Kathryn Smith.*



## Awards

### Best Publication in *The Condor*

U.S. Geological Survey (USGS) scientist **Josh Ackerman**, a research wildlife biologist stationed at the Davis Field Station of the USGS Western Ecological Research Center, and his coauthors **John Eadie** and **Tom Moore** of the University of California, Davis, are recipients of the Harry R. Painton Award for 2007 from the Cooper Ornithological Society for the best publication over the past 4 years in its journal *The Condor*. **Ackerman** and his collaborators investigated the risk-taking behavior and life-history characteristics of dabbling ducks by measuring their approach behavior during the waterfowl-hunting season. They found that species characterized by a “slow” life-history strategy (for example,

northern pintails and mallards, which are less fecund but longer lived) were more risk averse than species with a “fast” life-history strategy (for example, cinnamon teal and green-winged teal, which are more fecund but shorter lived). Their results indicate that life history influences the risk-taking behavior of dabbling ducks and provides an explanation for the differential vulnerability of waterfowl to harvest. The award announcement appears in *The Condor* (v. 109, p. 991-994).

The citation of the award-winning article is: Ackerman, J.T., Eadie, J.M., and Moore, T.G., 2006, Does life history predict risk-taking behavior of wintering dabbling ducks?: *Condor*, v. 108, p. 530-546. ☼



**John Eadie** (University of California, Davis, left) and **Josh Ackerman** (USGS), coauthors and recipients of the Harry R. Painton Award for 2007 from the Cooper Ornithological Society. (Third coauthor, **Tom Moore** of UC Davis, is not pictured.)

## USGS Scientist Nicole Athearn Receives a National Wildlife Refuge System Centennial Scholarship

U.S. Geological Survey (USGS) scientist **Nicole Athearn** has received a scholarship from the 2007 National Wildlife Refuge System Centennial Scholarship Program in recognition of her research in modeling bird habitat in south San Francisco Bay salt ponds. The Walt Disney Co., the U.S. Fish and Wildlife Service, and the National Fish and Wildlife Foundation are supporting the annual scholarship program, which was launched in 2003 in honor of the 100th anniversary of the National Wildlife Refuge System. The program recognizes students whose research will contribute toward improved management and understanding of the

diverse fish, wildlife, and plant resources in our national wildlife refuges. These merit-based awards take into consideration the value of the research and the student's academic achievements. **Athearn**, a biologist stationed at the San Francisco Bay Estuary Field Station of the USGS Western Ecological Research Center, is



**Nicole Athearn**

pursuing her doctorate at the University of California, Davis. Her research will assist in restoration efforts in Don Edwards San Francisco Bay National Wildlife Refuge (URL <http://www.fws.gov/desfbay/>).

Additional information about the 2007 scholarship winners is posted on the National Fish and Wildlife Foundation Web site at URL [http://www.nfwf.org/AM/Template.cfm?Section=Browse\\_All\\_Programs&Template=/CM/HTMLDisplay.cfm&ContentID=8031](http://www.nfwf.org/AM/Template.cfm?Section=Browse_All_Programs&Template=/CM/HTMLDisplay.cfm&ContentID=8031). (If you don't want to type the long URL, enter the keywords "2007 Centennial Refuge Scholarship Winners" in your favorite search engine.)

### Staff and Center News

## USGS Extreme Storm Team Receives Christmas Week Tour of NOAA Aircraft Facility

By Dennis Krohn

'Twas the week before Christmas, and though Santa may have been busy prepping his sleigh for flight, the staff at National Oceanic and Atmospheric Administration (NOAA)'s Aircraft Operations Center (AOC) in Tampa, Florida, found time to give U.S. Geological Survey (USGS) scientists a tour of their facility. The tour participants—members of the Extreme Storm Team at the USGS Florida Integrated Science Center office in St. Petersburg, who routinely process large amounts of data as part of their work—were particularly interested in better understanding the mechanics of acquiring such data with instrumented aircraft.

NOAA houses many of its research aircraft in a hanger at MacDill Air Force Base in Tampa, only a short drive from the USGS office in St. Petersburg. The tour group was lucky in that two of the three major aircraft used for hurricane research were onsite and available for inspection. **Jack Parrish**, chief science officer for the Gulfstream IV-SP (G-IV), the high-altitude reconnaissance jet, took time from his busy schedule to lead the



**Jack Parrish**, NOAA Aircraft Operations scientist, describes the capabilities of the P-3 to visiting USGS scientists. The engine props vary in pitch to change the speed of the aircraft. The black pod on the bottom of the fuselage is downward-looking weather radar that is lowered away from the main aircraft body in flight for better aerodynamics.

in-depth tour. Unfortunately, the G-IV was offsite getting refurbished with new instrumentation, and so we had a virtual tour of that aircraft.

The workhorse of the NOAA hurricane-research fleet is the Lockheed WP-3D Orion (P-3), a large four-engine turboprop (NOAA Tour continued on page 11)

(NOAA Tour continued from page 10)

aircraft that was originally designed for antisubmarine warfare. We received a detailed tour of the P-3, tail number NR43F, also known as Miss Piggy. The plane was undergoing modifications from its hurricane-research configuration to an air-chemistry configuration to be flown over the U.S. west coast in the spring.

Because of the extensive modifications, which are mostly one-of-a-kind applications, changes to the P-3 do not require Federal Aviation Administration (FAA) approval for flying but are approved locally.



NOAA's P-3 research aircraft with "barber-pole" probe protruding from its forward end. In the early days of aircraft research, the probe was used to sample the air in front of the bow wake of the aircraft. More recent instrumentation has shown that it is more practical to sample the air immediately adjacent to the aircraft. The "barber pole" has remained on the aircraft and serves mainly as a lightning rod.



Dust-and-particulate-sampling apparatus hangs below the port wing of the NOAA P-3. Spare engines and props for the P-3 are stored in the background. Sampling African dust over the Atlantic Ocean is one of the standard capabilities of the NOAA research aircraft. Anecdotal evidence from onboard scientists indicates that the dust in 2007 lasted longer but was not as dense as the dust in previous hurricane seasons. The USGS office in St. Petersburg has a longstanding research interest in African dust (see URL [http://coastal.er.usgs.gov/african\\_dust/](http://coastal.er.usgs.gov/african_dust/)).

The G-IV, in contrast, must conform to more standard configurations, and its modifications must receive FAA approval. The P-3 has two barber-pole samplers (named for their red-and-white stripes) protruding from the front of the aircraft, a tail Doppler radar, and several unique-looking instruments hanging from the wing.

One of the standard procedures that NOAA performs on its P-3 missions is sampling dust from the atmosphere. Because most of these missions are in the Caribbean and the Atlantic, African dust makes up a sizable component of the samples. African dust is of particular interest to USGS scientists at St. Petersburg, where a group is studying its relation to coral mortality (see URL [http://coastal.er.usgs.gov/african\\_dust/](http://coastal.er.usgs.gov/african_dust/)). Anecdotal reports from the 2007 missions indicate that the dust in 2007 was less dense but lasted longer than in previous years. Whatever the reasons, everyone was glad that the 2007 hurricane season was not as busy as previous years.

The primary method for gathering data from the aircraft for profiles of the atmosphere is the dropsonde, a weather-reconnaissance device that is dropped from an aircraft and measures atmospheric conditions as it falls to the ground. Typically, a dropsonde carries pressure, temperature, and humidity sensors and a global-positioning-system (GPS) receiver. The measurements are relayed to a computer in the aircraft by radio transmission. AOC has specialized in calibrating its dropsondes both before and during flights. Shrink-wrapping the dropsondes and connecting their electronics in flight are some of the calibration techniques AOC has developed to provide more accurate measurements.

The twin-engine Twin Otter is the aircraft that was used by the USGS Extreme Storm Team to fly some of its early photography and lidar (light detection and



The NOAA DeHaviland Twin Otter aircraft that was used in the early USGS extreme-storm lidar and photographic missions. Still photographs for the USGS photographic missions were taken through a bubble window toward the front, which was designed for marine-mammal surveys.



Janice Subino, who is digitizing the early USGS oblique aerial 35-mm slide photography, observes the inside of the Twin Otter aircraft. For marine-mammal surveys, NOAA commonly configures the Twin Otter with a spare fuel tank to extend its range. The tank, mounted inside the aircraft, is visible to the left.



View of a dropsonde, the main atmospheric-profile sampling device for the hurricane-research flights. The red tag at the bottom is a covering for the temperature sensor; the red tag in the middle is a port to add external power for calibration before the drop. Each dropsonde costs about \$750; about 30 of them are typically used in a mission.

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## Staff and Center News, continued

(NOAA Tour continued from page 11)

ranging) missions. The aircraft is particularly suitable for such missions because it has a slow cruising speed and can take off and land on short runways. NOAA's Twin Otter has a large bubble window just forward of the wing, which is designed for marine-mammal surveys; this bubble window may have added a slight distortion to some of the early USGS still photographs.

The members of the Extreme Storm Team were grateful for the hospitality extended by the NOAA AOC staff for our Christmas tour and extends wishes to everyone for a good and peaceful New Year.

For more information on NOAA's Aircraft Operations Center, visit URL <http://www.aoc.noaa.gov/>. ❁

Tour participants from the USGS office in St. Petersburg included (left to right) **Charlene Sullivan**, **Kara Doran**, **Kristy Guy**, **Janice Subino**, and **Dennis Krohn**.



## Publications

### EDEN—A Paradise for Water Managers?

By Ann Tihansky, Heather Henkel, and Pamela Telis

The Everglades Depth Estimation Network (EDEN), developed by the U.S. Geological Survey (USGS) with collaborators from universities and other agencies, is a powerful tool for water managers, scientists, decision-makers, and engineers working on the South Florida Greater Everglades Ecosystem Restoration. “The greatest challenge in evaluating restoration efforts and the response and effectiveness of changes in managing water flow, such as water depth and hydroperiod [duration of inundation or saturation] in specific areas, is having a network of data that can show us, in one glance, how and where changes affected the hydrology. EDEN is the tool that does that,” said **Barry Rosen**, director of the USGS Florida Integrated Science Center.

The EDEN Web site contains a set of integrated data for 253 gages that describe the water depths throughout Big Cypress National Preserve, Everglades National Park, and the Water Conservation Areas. Data from these areas are combined with USGS data in the USGS National Water

Information System (NWIS) database and then provided in near-real time to water managers, our Department of the Interior partners (such as the U.S. Fish and Wildlife Service and the National Park Service), the U.S. Army Corps of Engineers, the South Florida Water Management District, and the general public. The data also have been used to create daily models of the water surface covering the greater Everglades. These modeled water surfaces are available as geographic-information-system (GIS) layers from January 1, 2000, through the present. The EDEN data, models, and documentation are available on the EDEN Web site at URL <http://sofia.usgs.gov/eden/>.

Among the target users of EDEN are biologists and ecologists examining trophic-level responses to hydrodynamic changes in the Everglades. **Dale Gawlik**, an ecologist and director of the Environmental Sciences Program at Florida Atlantic University, said: “EDEN is one of the most useful tools to come from the Everglades restora-

tion to date. It has removed our hydrologic blindfold and has given wildlife ecologists the power to develop unprecedented models of animal responses to hydrologic changes in the Everglades.”

The EDEN Web site provides additional data and tools that can be used to view the information in various ways. Field measurements of ground elevation and vegetation are available for almost all gages. Users can extract data at specific locations or time periods to look at trends, events, or long-term conditions. Examples of the software tools provided to assist users working with EDEN data are posted at URL <http://sofia.usgs.gov/eden/edenapps/>; here are descriptions of a few of them:

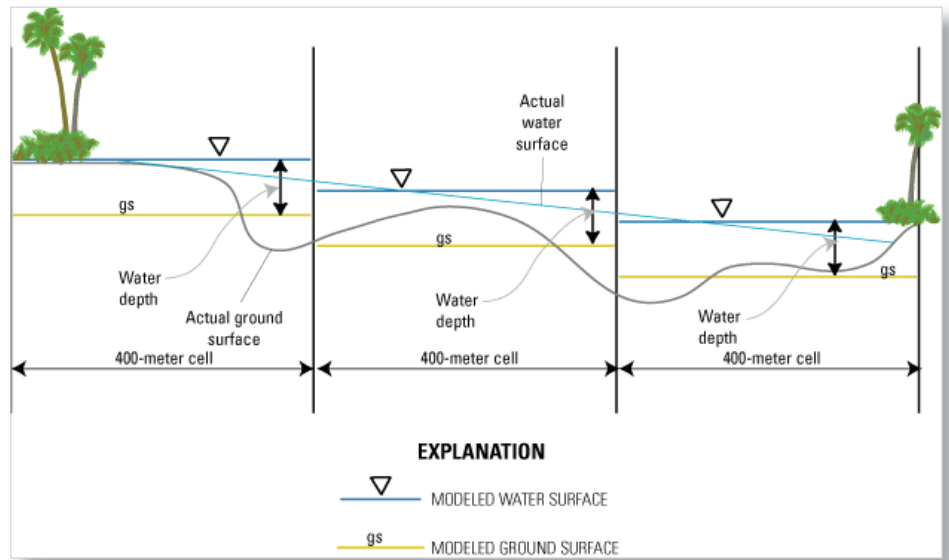
- The Data Viewer tool displays EDEN data layers and allows panning, zooming, and animation of multiple dates of water surface, water depth, and days since dry; queries of data values; and generation of time-series graphs.

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- The EDEN xyLocator is a program for extracting data from spatial hydrology time series, such as water stage, water depth, ground elevation, and days since dry.
- EDEN Transect Plotter is a program for plotting daily water-level surfaces and ground-elevation profiles for user-specified transects across the Everglades. The water surface can be animated over a user-specified time period, and the water-surface slope is calculated and displayed along transects for user-specified distances.

The concept and initial work on designing EDEN started in mid-2004, with collaborators sharing data across multiple platforms and between academic institutions and State and Federal agencies. **Aaron Higer**, retired after a highly successful career with the USGS and currently an assistant scientist with the University of Florida, has been involved in the EDEN concept from its beginning. He notes: “The EDEN system provides water managers and ecosystem scientists with a new assessment tool. They now have daily water-assessment capabilities that were not possible a year ago.” As scientists play more of a role in looking at the effects of managing water resources, the EDEN network has become “a critical tool for interpreting our data on fish and other aquatic animals,” said **Joel Trexler**, an ecologist with Florida International University. “It’s not very surprising that our work has shown huge impacts of marsh drying on aquatic food-web function in the Everglades. Our innovation is to use EDEN to help us pinpoint drying events in places that are not directly monitored by hydrolo-



To estimate water depths, EDEN subtracts the elevation of modeled ground surfaces (based on data that include ground-elevation measurements at more than 50,000 sites throughout the Greater Everglades) from modeled water surfaces (based on hourly water-level data from more than 250 gages) in “cells” measuring 400 by 400 m. The estimated water depths allow users to see at a glance where hydrologic changes are occurring in the Greater Everglades, including places that are not directly monitored. From USGS Fact Sheet 2006-3087 (URL <http://sofia.usgs.gov/publications/fs/2006-3087/>).

gists, so that we can better interpret our data on aquatic animals that wading birds eat. We also use EDEN in developing statistical models to separate the effects of drying events that are unavoidable because of low rainfall from those created by management choices. This is important information to provide clarity about trade-offs that must be weighed in managing scarce water resources.”

The EDEN network benefits all partners involved in managing water resources and ecosystems within the South Florida region, including Big Cypress National Preserve, Everglades National Park, and the Water Conservation Areas. “EDEN and the EDEN-applications (EDENapps) are

examples of the next generation of integrating hydrologic and topographic information into analytical tools for evaluating biological response to water-depth dynamics. The ecological-science community is finding this long-awaited tool to be most useful in analyzing their species/community data,” said **G. Ronnie Best**, coordinator of USGS Greater Everglades Priority Ecosystems Science.

Additional information about EDEN is available in “The Everglades Depth Estimation Network (EDEN) for Support of Ecological and Biological Assessments,” U.S. Geological Survey Fact Sheet 2006-3087 (URL <http://sofia.usgs.gov/publications/fs/2006-3087/>).

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